PHYSICAL, PHYSIOLOGICAL AND ANTHROPOMETRIC CHARACTERISTICS OF MALE ATHLETIC GROUPS IN AHMADU BELLO UNIVERSITY, ZARIA.

BY

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A THESIS SUBMITTED TO THE POST GRADUATE SCHOOL, AHMADU BELLO UNIVERSITY, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF SCIENCE (M.Sc) EXERCISE AND SPORTS SCIENCE.

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DECLARATION

I hereby declare that the work in the thesis entitled 'Physical Physiological and Anthropometric Characteristics of Male Athletic groups in Ahmadu Bello University, Zaria has been performed by me in the Department of Physical and Health Education under the supervision of Professor K. Venkarteswarlu, and Dr. C.E Dikki.

The information derived from the literature has been duly acknowledged in the text and a list of references provided. No part of this Thesis was previously presented for another degree or diploma at any university.

Richard Ogunleye **June 27, 2006**

_____	_____	_____
Name of Student	Signature	Date

CERTIFICATION

This thesis entitled **"PHYSICAL, PHYSIOLOGICAL AND ANTHROPOMETRIC CHARACTERISTICS OF MALE ATHLETIC GROUPS OF AHMADU BELLO UNIVERSITY, ZARIA"**, by Richard Ogunleye meets the regulations governing the award of the degree of Master of Science (M.Sc) Exercise and Sports Sciences of Ahmadu Bello University, Zaria, and it is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This work is dedicated to my late father Mr. James Ojeagbase Ogunleye who slept in the Lord on the 22/12/1987, my beloved mother, Mrs. Florence Aina Ogunleye, and the entire members of Ojeagbase Ogunleye's family for their patience, love and support during the course of this research work.

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DEFINITION OF TERMS

Physical Measures: Variables such as speed, agility, VO_2 max, standing broad jump were measured using 50 meter sprint, 20 meter shuttle run, lower limb explosive strength and maximal heart rate.

Physiological Measures: Such variables as VO_2max and maximal heart rate.

Anthropometric Measures: Variable such as lower and upper limb length measurements of the body.

Proportionality: The different sizes of the human body in terms of weight, height, body dimensions, etc.

ABBREVIATIONS

AAPHERD:	American Alliance for Health Physical Education Recreation.
Vo_2 MAX:	Maximal Oxygen Uptake.
BF:	Body Fat Percent
BMI:	Body Mass Index
NUGA:	Nigerian University Games Association
FASU:	Federation of African University Sports
HST:	High Speed Training
ECR:	Energy Cost of Running
ANOVA:	Analysis of Variance
IWKG:	International Working Group on Kin anthropometry
LD:	Long Distance
ShD:	Short Distance
Kg:	Kilogram
Ht:	Height
Cm:	Centimeter
mm:	Millimeter

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ABSTRACT

One of the most essential requirements for performance excellence in competitive sports is the selection of the most suitable sport for an individual on the basis of his peculiar characteristics. Available research evidence indicates specific physical and physiological characteristics favourable to certain sport. This research was therefore conducted to determine and compare the physical, physiological and anthropometric characteristics of track and field, basketball, badminton, judo and soccer groups. To achieve the purpose of this study, 15 athletes from each of the selected athletic groups representing Ahmadu Bello University in the following group of sports; track and field, basketball, badminton, judo and soccer were selected at random. The athletes thus selected were tested in 20m shuttles run for agility, 50m dash for speed, 12 minute run test to estimate maximal oxygen up take, chest, abdomen and thigh skin folds to determine percent body fat and lower and upper limb lengths. The data thus collected were statically analyzed. Descriptive statistics of mean, standard deviation and standard error, analysis of variance (ANOVA) were used to see if there was any significant difference among the five male groups of sports. The result revealed that the basketball players were the tallest and heaviest and had longer limbs, soccer players were the most agile and fastest, track athletes and badminton groups had the highest leg explosive strength, whereas, judo had the highest percent body fat. Maximal heart rate showed no difference among the male groups. On the basis of these results, it was recommended that selection to a particular sport should be based on the physical, physiological and anthropometric characteristics.

CHAPTER ONE

INTRODUCTION

1.0 BACKGROUND OF THE STUDY

Application of modern scientific and technological principles to the selection and training of athletes in different sports disciplines has been primarily responsible for the incredible high sporting standards registered in modern competitions. Moreover, frequent changes in officiating rules of different sports discipline necessitated the development of new equipment, which in turn stimulated the development of new training technologies and methodologies (Ruth et al; 2002). With this development came the necessity to identify the most suitable individual for a particular sport. Such identification, has been suggested to be possible by the consideration of 3 categories of measurements (Kippers, 1999, Elliot 2002). These variables include the following:

- Are of fundamental importance to sports performance and which can be modified by training e.g (Skin fold thickness, muscle circumference).
- Require a minimum level above which no increase in performance may be seen (e.g. certain flexibility scores etc).
- Cannot be changed, so that strategies need to be developed to overcome any deficiencies (eg height, limb, length, epicondylar diameter etc).

In addition, changes due to growth and maturation, especially in the upper and lower limbs and the trunk of the body, have special

implications for certain sports. For example, when hands and feet grow relatively larger with respect to the rest of the body, it will be an advantage enjoyed by young swimmers with respect to propulsion and resistance in the water (Hebellick and Ross, 1974). There has been a growing tendency to accord special attention to athletes of various sporting activities, such as track and field, ball games, combat as well as racket games. It has also been well documented that athletes of various sports elicit different physical, physiological and anthropometric characteristics and skills which are useful at their various areas of sports (Malina, 1996 and Bouchard, 1991). As nature would have it, different populations are better suited to excel in anaerobic activities such as sprinting, Jumping, and lifting, than in aerobic activities such as distance running, cycling and swimming (Burfoot, 1992). Coastal West African Countries for example, are particularly advantage in sprint as they have less body fat, narrow hip, thicker thighs, longer legs and lighter calves compared to whites, which confer a biochemical advantage (Burfoot, 1992). Contrary to this, in swimming, no black person has ever qualified for the Olympic finals. Bone density which is a major determinant of body density seems to be a major factor attributed to this picture, even for the same sex, compared to the normal population, teenage female distant runners are small in height, higher in ectomorphy, with a smaller skeletal framework (Burk and Brush, 1979).

In team sports, body shape, size, composition and fitness all play important roles in providing a clear advantage for specific playing position, especially at the highest level of performance where there is a

high degree of specialization (Bale, 1986). In soccer, for example goalkeepers are the tallest and heaviest players, while mid field players are the shortest and lightest. Similarly, in rugby, backs are lighter, smaller and less endomorphic compared to forwards, similar differences in physiological make up of athletes have also been reported. (Elliot et al, 2002), however, according to the knowledge of this investigator, no study has been reported from Nigeria on the physical, physiological and anthropometric differences between these athletic groups of this kind. This study was therefore conducted to determine the differences between the male groups in their physical, physiological and anthropometric characteristics.

1.1 Statement of the Problem

Psycho-biological and physical demands of different sports discipline significantly differ from each other. Performance excellence therefore depends mainly on the selection of the sport to an individual according to his psycho biological and physical characteristics and utilization of specific training protocol suitable to the demands of the sport and the development of appropriate techniques required for that sport (Burfoot, 1992). All those studies on physiological, metabolic and anthropometric characteristics of athletes from specific disciplines like triathlon, cycling, teakwondo, distance running and wrestling,(Khosla, 1983) has been reported, no studies to the knowledge of this investigator, especially from Nigeria, have been reported on the physical, physiological and anthropometric characteristics of different

athletics groups, with a view to findout the differences between such groups in their different characteristics.

This study was therefore conducted to determine and compare the following physical, physiological and anthropometric characteristics of male athletic groups from track and field, soccer, basketball, badminton and Judo.

1. Physical Characteristics
    (a) Age
    (b) Muscular power
    (c) Speed
    (d) Agility
2. Physiological Characteristics
    (a) Vo_2 max (Maximal Oxygen uptake)
    (b) Maximal heart rate
3. Anthropometric Characteristics
    (a) Height
    (b) Weight
    (c) Lower and upper leg lengths
    (d) Lower and upper arm lengths
    (e) Total leg length
    (f) Percent Body Fat

1.2 Research Questions

This study was conducted to answer the following research questions:

(a) What are the height, weight, % body fat, speed, agility, physical, physiological and anthropometric characteristics of male athletes from track and field, soccer, basketball, badminton, and Judo.

(b) Are there differences between track and field, soccer, basketball, badminton and Judo athletics group in their percent body fat, weight, height, agility, speed, muscular power and their physiological characteristics?

(c) Are age, weight, height, percent body fat, speed, agility of male physical, physiological and anthropometric characteristics related to each other?

1.3 Basic Assumptions

On the basis of available research evidence, the following assumptions were made for the purpose of this study.

(a) Physical, physiological and anthropometric characteristics affect athletic performance.

(b) These characteristics differ not only from athlete to athlete within the same athletic group, but also between athletes of different athletic groups or disciplines.

(c) These characteristics can be objectively measured and quantified.

1.4 Hypothesis

Based on the research questions and assumptions on this study, the following hypotheses were formulated.

Major Hypothesis

- There are no significant differences between male athletic groups in their physical, physiological and anthropometric characteristics.

1.5 Sub-Hypothesis

1. There are no significant differences in anthropometric characteristics between track and field, basketball, soccer, badminton and Judo athletic groups in their age, height, weight, percent body fat, lower leg length, upper leg length, total leg length, lower arm length, and upper arm length.
2. There are no significant differences in physiological characteristics between soccer, track and field, basketball, badminton, and Judo athletic groups in their Vo_2 max, and maximal heart rate.
3. There are no significant differences in physiological characteristics between soccer, track and field, basketball, badminton, and Judo athletic groups in their physical characteristics, which are 50-meter speed, 20-meter shuttle run and standing broad jump.
4. There are no significant correlations between different anthropometric, physical and physiological characteristics of these groups of athletes.

1.6 Significance of the Study

The study is justified on the basis of the following contributions it can make to knowledge and professional practice.

(a) Although several studies have reported on different physical, physiological and anthropometric characteristics of different athletics group, it is not clear the kind of people with specific physical, physiological and anthropometric characteristics that are more suitable to sports like track and field, basketball, badminton and soccer, the result of this study will reveal the physical, physiological and anthropometric characteristics that are best suited for these sports, so that individual with such characteristics early in life for this sport can be selected.

(b) Sports discipline differ in the energy demand they make in the adaptation they cause physically, physiologically and anthropometrically, the physiological changes they produce in the athlete who participate in these sport, training method and techniques should therefore be based and such specific demands made by different sports discipline, the result for this study will show the differences between track and field, basketball, badminton, Judo and Soccer in their physical, physiological and anthropometric characteristics, which can be used to select appropriate training methods and techniques for each of these sports group.

(c) Research evidence regarding the psycho biological and physical profile of different athletic groups has been very inconsistent, as this study is primarily concern with the physical, physiological and anthropometric characteristics of male athletics groups, it will indicate the anthropometric, physiological and physical profiles specific to each of the male athletic groups.

(d) This study would bring to light the physical, physiological and anthropometric characteristics of different athletics group.

1.7 Delimitation

This study was delimited to male athletics groups namely: Track and field, basketball, badminton, Judo and soccer group. Track and field athletes was selected to represent individual sport, basketball was selected to represent ball games limited in playing areas, Judo was selected to represent combat sports and basketball was selected to represent ball game limited in playing area, soccer was selected to represent speed endurance sport. All the selected athletics groups were highly anchor-related in the playing areas, the use, in the duration of the play, in the instruments used to play, and the surface on which they play and are therefore expected to have different physical, physiological and anthropometric demands. All the athletic groups used in the study were from Ahmadu Bello University, Zaria, Nigeria.

1.8 Limitation

The study had the following limitations which would be considered while interpreting the result, intra and inter tested variability had been reported in the measurement of anthropometric characteristics to minimize these reliability, anthropometric measurements were taken only after all the testers produces evidence of reproducing the same measurements within acceptable limit (0.02 millimeters).

As most of the equipments were not available to carry out the measurements, the variables in this study were measured by standardized field test.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.0 Introduction

The purpose of this study was to determine and compare the physical, physiological and anthropometric characteristics of male athletic groups. To achieve this purpose available related literature has been critically reviewed and discussed under the following sub-titles in this chapter:

1) Physical Characteristics

2.2 Age

2.3 Muscular Power

2.4 Speed

2.5 Agility

2) Physiological Characteristics

2.6 Maximal Oxygen uptake (Vo_2 Max)

2.7 Maximal heart rate

3) Anthropometric Characteristics

2.8 Height

2.9 Weight

2.10 Percent Body fat

2.11 Upper and lower arm length

2.12 Upper and lower leg length

2.13 Total leg length

2.14 Selected Research studies on Physical, Physiological and anthropometric characteristics of athletic groups.

2.15 Summary

2.1 Age

Strength reaches its peak in the early 20s and declines slowly until 60 and above. Thereafter, the rate of decline usually accelerates. Champion weight lifters have achieved personal records in their 40s. Mechanics retain grip strength into their 60s. Training before puberty leads to improvements that are mostly due to changes in the nervous system (neurogenic factors include reduced inhibitions and learning how to exert force). Training after puberty combines nervous system changes with muscle tissue (myogenic changes). Since testosterone levels decline in old age, many physiologists thought that senior citizens would be limited to neurogenic changes. However, a study of very elderly people (72-98 years) has shown that resistance training leads to increase in strength, muscle mass and mobility (Fiatarone, 1994). Training at any age maintains or improves strength, especially when the diet is adequate.

Changing proportions during growth are of interest. For example, during the adolescent growth spurt, hands and feet reach adult size first, followed by calf and forearm, then by hip and chest width, then by the shoulders and lastly by the trunk and chest depth. The sequence of events especially when the hands and feet are relatively large with respect to the rest of the body, especially the shoulders, is a tempting kinanthropometric speculation of biochemical advantages enjoyed by young swimmers with respect to propulsion

and resistance in the water (Hebbelinck, 1974). Conversely, recent study has shown that athletes whose age range falls within 15-19, their physiological characteristics are poorly developed (Verducci, 1980).

Wilmore (1974) reported that muscular power, speed and estimated Vo_2 max were 20-40% poorer than previously reported in subjects whose age range was within 30 and above at professional and semi-professional levels. This is because Vo_2 max increased as the playing level increased. Similarly, age at playing experience level between two groups, matters a lot. The physiological capacities of these two groups of these players differed due to their age difference (Gabbett, 2001).

As inevitable and regular developing process, aging leads to the weakening of an organism's vital functions, a decrease in its adaptation abilities and an increase in the probability of death (Korkushko, 1999). One of the factors supporting this statement is an age-associated decrease in the maximal aerobic capacity of the energy processes, which demonstrates a reduction in the maximal uptake of oxygen (Vo_2 max).

Robinson's, (2001), was the first to show a Vo_2 max age-associated reduction. Robinson in his classical cross-sectional study of the physical work capacity of males from 6 to 75 years old, showed that starting at 25 years of age, $V0_2$ max reduction occurs at a rate of 0.56mμ (Kg min year). The Vo_2 max age-associated reduction was supported by a number of studies. The rate of Vo_2 max associated reduction varies widely from 0.20 to 0.52mμ (kg min year).

As it is known, due to physical exercise the Vo_2 max level can increase 25-50%. In general, the level of physical activity also substantially affects Vo_2 max. Age and sex in short-term performance are apparently more related to variations in body size, especially fat free mass or thigh muscle cross-sectional area (Amstrong, 1999). Several environmental factors may also influence the qualitative determinants of anaerobic power. Some studies have shown that maximal short-term power output is significantly affected by socio-economic and nutritional status (Bloc et al., 1996). Several studies have indicated that activity levels decline with increasing age. During adolescence, this decrease is more marked in females than males (Pete, L. and Hachisuka H. 1994).

2.2 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. It is also known as the ability to exert a maximum contraction in one explosive act. According to Nelson and Jensen (1992) it is the ability to apply force rapidly. Power is typically demonstrated in projecting the body (as in jumping) or an object (as in throwing). The muscles must apply force at a rapid rate in order to give the body to object the momentum necessary to carry it through the desired distance.

Explosive strength is very important to vigorous performance, because it determines how hard a person can hit, how far he can

throw, how long/high he can jump and to some extent how fast he can run. Running is a series of projections; therefore leg power is essential to fast running (Neilson, 1992). It can be increased by increasing strength without sacrificing speed or by increasing speed of movement without sacrificing strength. According to Jensen and Fisher (1979), increased strength affords the greatest potential for improving power, because strength can usually be increased by a significant amount, while speed can be improved by limited amounts.

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

Power is then calculated by the formula;

Power (Kg × meters/sec) = Body weight (Kg) × Vertical distance (meters)

Elapsed time (seconds)

W = 70Kg

D = 1.05 meters

T = 0.01 sec

Power = 70 × 1.05m

0.01 Sec (Mathew, 1981).

McArdle, (1981) explained that power scored in Magaria-Kalamen test is influenced significantly by the person's body weight. This is to say that the heavier person will necessarily have a higher power score if several individuals achieved the same speed. Mathew, (1981) reported some classification guide for male and female subject6s, aged between 20-50 years, based on data from studies conducted by Margaria and Kalamen. These guidelines seem to suggest that age and sex are other variables that are likely to affect power.

Power is important and related component of most sports. It is somewhat related to muscular strength, and this can be improved through a series of weight training exercises. Power is important in a number of sports but is seldom required of non-athletic adults. If you want increase your power for cycling, skiing, basketball or some other sport, the principle of specificity is required, that is, movement must be specific to the sport, such as a shot putter throwing heavier weights as fast as possible which means that the training should stimulate the action as closely as possible (Sharkey, 1979).

2.3 Speed

According to Neilson (1992), speed is the velocity of a body part or an object, that is, the rate of motion. Speed is basically the result of rapid application of force to a mass. This force is caused by muscle contraction. If the force is greater than the resistance, the movement

occurs and as the force becomes proportionately greater, the speed with which the mass moves increases (based on Newton's second law of motion).

The speed of muscle contraction is basic to speed of a moving body or an object. The speed of contraction of different muscles varies considerably among individuals. For example, person “A” may have faster leg action while person “B” has faster arm action. In other words, speed is specific to individual body movements (Nelson, 1992).

Watson, (1983) pointed out that speed of contraction is apparently inherent in muscle tissue, because even when muscle receives constant artificial stimuli, they contract at varying rates. Devries, (1974), stated that the difference in speed of contraction is apparently due to differences in biochemical and physiochemical properties of the contractile materials within the muscles and has no relationship to factors outside the muscle tissue. He further stated that the chemical environment of muscle tissues and its chemical make-up can be altered by limited amount, either by training or by nutrition, and this may result in faster body movement.

Speed, mostly in the form of acceleration, is an important factor in almost all sports and games. It becomes a determinant in scoring, passing and defending or preventing a goal. In other words, speed makes the difference where one is able to gain an advantage over an opponent. According to Wilmore (1974), speed can be estimated simply by measuring the time it takes to cover a distance. This can be accomplished for the arm or leg, by using an elaborate system of

microswitches and an electronic timer. Total body speed can be measured by timing the athletes over a set distance from 50-100meters. Running speed can be evaluated from a 10m, 20m, 40m, 50m to 100m sprint using electronic timing device.

2.4 Agility

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, 1974). Agility typically refers to the ability to move and change positions or directions rapidly without losing balance or sacrificing speed.

According to Jensen and Fisher, (1979), “agility is often expressed as the ability to change direction of the body and its parts rapidly. It is a combination of several sporting basic skills demonstrated in such movements as dodging, running, stopping, starting, and changing body position quickly”. Duhu (1978), described agility as the “ability to react quickly with controlled and precise movements”. He stated further that anyone who can control his body quickly and efficiently will have the opportunity to saving himself or others in a time of emergency.

Agility is important in most of the games and sports. This is exemplified by the shift in half back on a broken field run in football, or the supply gymnast performing a complex, free exercise routine. It has been found out that performance of any physical activity is greatly enhanced by increased agility.

Wilmore (1974), stated that “There are no universally accepted tests for agility, although many test batteries exist which use various shuttle run tests to estimate the agility component”. 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 0.082 for girls were reported.

2.5 Vo_2 max

Cardio-respiratory endurance is the most vital means of determining a person's maximal oxygen uptake (Vo_2 max) (Mathew, 1981). Maximal oxygen uptake, according to Verducci (1980), indicates how well various physiological functions can be adjusted to increasing metabolic demand of work.

Over the years, various tests were developed to measure Vo_2 max, but most of these tests require laboratory settings. Such tests include treadmill running/walking, cycle ergo-meter pedaling and stepping tests. Again, most of these tests cannot be used on large populations at the same time because of cost of equipment, time limitation (Pollock, 1978). 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 ½ mile run tests. Cooper (1968) designed a 12-minute run/walk test, which was considered suitable when compared with laboratory test. Pollock,

(1978) stated that the widely used tests for measuring Vo_2 max are the 12 minute and the 1½ mile run tests.

The contributions of metabolic, physique and mechanical variables to athletic performance are functions of distance and intensity. Maximal oxygen uptake (Vo_2 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 Vo_2 max values, use oxygen more efficiently and have significantly lower lactate accumulation than middle distance runners (runners that compete in 800 meters to 3000 meters) (Berg and Bell, 1992).

Evaluating variables that influenced athletics performance, Ramsbotton et al, (2000), found strong relations between a five kilometer athletic performance and Vo_2 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 Vo_2 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 Vo_2 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).

Because the major source of energy for high intensity running efforts of two minutes or less are anaerobically derived, Vo_2 max does not appear to be one of the limiting variables at 800 meters. However, Vo_2 max does not contribute to longer running events in the middle distance range (Tharp, 1992). Clearly, both aerobic and anaerobic energy sources make important contribution to middle distance athletic performance. An individual endowed with exceptional capabilities of either system can be successful in the middle distance range (Daniel and Oldridge et al., 1985).

At competitive level, football is an endurance sport that incorporates periods of intense exercise interspersed with lower levels of activity over a 90minute period (Reilly, 1996). Therefore, a large amount of aerobic ability may be required and assessed by measuring maximal aerobic power (Vo_2 max). This is the maximum rate at which energy can be released from the oxidative process exclusively (Bouchard, 1994). For this reason, Vo_2 max is an essential measurement in the study of a footballer, since the physiological as well as physical characteristics are important considerations in player's performance (Bell, 1980).

Recent study showed that Vo2 max in basketball players' increased as the playing level increased. The differences between the guards and the forwards were not significantly different for any of the team tested, both senior and junior categories (Gabbet, 2001).

2.6 Maximal Heart Rate

The values of an individual resting and exercise heart rates are indicators of his cardiac functions. Also the values of the systolic and diastolic blood pressures for any person give a good indication of his cardiovascular health and level of physical fitness (Mill, 2000).

The differences in the maximal heart rate among athletic groups are due to differences in their physical and physiological capacities, such as speed, muscular power, agility, endurance level and Vo_2 max. These differences may reflect greater access to specialized coaching and conditioning for different selected groups (Gabbett, 2001). The Maximal heart rate can be defined as the highest average value measured at the end of an incremental test or exercise session. It is also termed respiratory compensation point (Miller, 2000). It has been frequently reported that endurance athletes with a similar elevated Vo_2 max have considerable variations in endurance performance levels and that the energy cost of sub-maximal exercise is more important than Vo_2 max in endurance performance (Bentley, 2002).

Maximal heart rate per minute can be estimated by simply subtracting ones age from 220. Heart rate is measured as described below:

- Determine pulse by pressing the first two fingers of one hand gently on either the artery on the inside of the wrist or on a carotid artery (located under the jaw either on the right or left side of the front of the neck).

- Count the pulse beat for ten seconds, multiply the result by 6. this gives the per-minute total.

2.7 Height

A Weish statistician, Kholsa (1983), argued and produced graphs to illustrate that elite sports favour tall people. He suggested that there be more categories in sports as there are in rowing, boxing and wrestling. There could be basketball and volleyball competition for short people. Team games are sports where height, shape and body composition and fitness play an important role in providing distinct advantage of specific playing positions, particularly at the highest level of performance where there is high degree of player specialization (Bale, 1986).

In the game of soccer, goalkeepers are usually the tallest and heaviest players, while the mid fielders are the shortest and lightest (Reiley, 1996). In Rugby, backs ae lighter, smaller, less endomorphic, and more ectomorphic than their forwards (Bale, 1986). In American football, cater found that some players had endomorphy ratings as high as nine. In basketball, pitchers are taller and heavier, with more fat than fielders. Short were lightest with lower fat levels (Burke1976).

Height plays a vital role in most of the track and field events, such as the high jump, long jump, and triple jump and throws that requires standing position. The influence of long arm length and height play a vital role in shot putting, discuss throw and javelin throw. Height

as a variable is important when selecting athletes to their various events (Berg, 2000).

2.8 Weight

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

According to Mueller (1982), skin fold thickness tends to be less in athletes and is related to the amount of endurance activity, whereas the pattering of fat is ethnically based and does not appear to be changed by training. Studies show that for health reasons, weight should not regularly fall below 10% of desirable weight. The upper limit

consistent with good health is 20% above the desirable weight. Somewhere between these boundaries (minimum 10% to plus 20% of desirable weight), lies a level that is best for athletes (Sharkey, 1979).

2.9 Percent Body Fat

Overweight and obesity are rapidly escalating problems in developing countries. Excess body fat (BF), particularly abdominal fat, is a harbinger of several adverse metabolic consequences, including impaired glucose tolerance (Reaven, 1988). The body mass index (BMI) is a way of working out if you are underweight, or actually obese. It is helpful because weight is a useful index in obesity if it is related to height (McKeinge, 1991).

Overweight and obesity are commonly defined by the measurement of BMI. However, this is an imperfect measure, since both fat and fat-free mass (bone, muscles and body water) are estimated. An important limitation of the BMI as a measure of obesity is that it tends to ignore the distinction between fat and fat-free mass. Cut off levels of the BMI for overweight and obesity are based on the 5^{th} and 95^{th} percentile of body weight and the mortality profile derived from Caucasian population (World Health Organization, 1995, 1998, Deurenberg, 1991).

However, body composition is altered with several physiological perturbations, advancing age, hormonal imbalance, and menopause. Moreover, due to differences in height, weight, architecture and proportion of bones, muscles and fat, ethnic differences exist. Several

studies have shown that blacks have an increased proportion of bone and muscle tissue as compared to whites (Cohn, 1995). Furthermore, differences in percentage BF were observed in the same racial lineage residing in different geographic locations. In three different populations of West African heritage from the USA, Jamaica and Nigeria, the relationship between body mass index and body fat differed significantly ($P<0.001$) (Luke, 1997). Short stature, stunning of growth and malnutrition may alter the appropriateness of assessing the relationship between height, weight and body composition (Shethy, 2000).

2.10 Lower and Upper Arm Length

Lower and upper arm lengths, physique and body composition plays an important role in most sports and games. As recent study showed that 18 members of the under seventeen England basketball squad were measured on twenty different anthropometric sites, from which somatotype and body composition were calculated. Four performance measures were also calculated. These included vertical jump, anaerobic power, right and left grip arm and laterality. The variables of the basketball players, grouped according to playing positions were then compared statistically using ANOVA (Cureton, 1992). Centers had the largest measure of physique and body composition, followed by forwards and then the guards. These differences were significant, particularly between the centers and

guards. The centers were taller, had longer arm length, hip width, and were more muscular.

2.11 Lower and Upper Leg Length

Talent identification programmes have traditionally focused on individual sports with discrete physical and physiological characteristics. The measure of an anthropometric attribute, such as the upper and lower length of a player, has limited value in predicting performance in team sports, and individual sports, such as the track and field and combat sports (Berg and Bell, 2001). The differences in the anthropometric variables accounted for a significant proportion of variance in playing performance.

Stride length is the most mechanical variable at a run velocity. It is the mechanical variable that significantly limits performance in longer and middle distance races (Cureton, 1992). Clearly, stride length measured at race pace contributes strongly to athletic performance. Lower limb segments are other body composition variables significantly associated with athletic performance in a distance race (Ramsbolton, 2001). Lower limb segment and thigh length, other body size and composition variables significantly related to the performance run times are reflections of linearity as they correlated highly with height, and height is an important morphological characteristic of successful runners (Kalaman, 2001). These findings are similar to results reported by Berg and Bell, who found that lower extremity length expressed as

percent of height was a significant predictor of mile runtime/performance (Thorn, 2001).

Dillman O. and Lortie G. (2001) concluded that stride length is the most important mechanical parameter in running velocities. However, stride length showed a significant relationship with the 1500m and 3000m run. This finding suggests that stride length measured at peak velocity can be effectively employed in predicting distance run success (Ramsbolton, 2001). Stated that elite Kenyan runners run so fast because they recruit a greater number of motor units in their lower limb during competitions. This could result from a superior capacity for oxygen utilization or other adaptations that reduce afferent sensory information to a supposed brain controller that regulates motor unit recruitment during exercise.

According to Roger Bannister (2001), though physiology may indicate respiratory and cardiovascular limits to muscular efforts, psychological and other factors beyond the ken of physiology, set the razor's edge of defeat to victory and determine how closely the athlete approaches the absolute limits of performance (Entine, 2001). Sir (Dr) Bannister was the first human to run a mile in less that 4 minutes, who more recently concluded that “It is the brain not the heart or lungs, that is, the critical organ is the brain” (Entine, 2001). Perhaps it is how time to test in those very athletes who have become his modern counterparts, the 50 years old theory first proposed in his youthful vigor by one running legendary icon.

2.12 Total Leg Length

Generally, lifters with heavy weight can lift greater load than can their counterparts with lighter body weight. Individuals of small stature are not only relatively found to be stronger than the tall ones, but are also quicker because of lesser body mass. This superior strength and quickness in relation to body size explains why tumblers, gymnasts and divers are usually short. (FaruK, 2003).

The tall man with the long leg has the advantage in high jumping, which is largely a matter of propelling the centre of gravity of the body upward. The tall man has an advantage since every pound of weight is a burden for the muscles to lift over the bar. This build is an advantage to the jumper since the trunk, which is dead weight in jumping is lighter (Faruk, 2003).

Sheldon (1998) classified physique, or body type as endomorphic, mesomorphic and ectomorphic. This body assumes importance as a facet of measurement and because of its effects on motor performance, certain body builds are advantageous to a certain activities. A heavy build may help a football tackle, but it is a hindrance to a distance runner.

2.13 Selected Research Studies On Physical, Physiological And Anthropometric Characteristics Of Athletic Groups.

Before the age of 13, Junior rugby league players compete under modified rules, with a reduced emphasis on physical collisions and increased emphasis on skill development. After the age of 13, the

physiological demands placed on Junior players are increased, with players required to compete under the same rules and regulations as senior players, with only slight variations in the duration of matches between junior (60 minutes) and senior (80 minutes) rugby players (Baker, 2003). This study found a progressive improvement in agility, speed, muscular power, and Vo_2 max scores with increasing age and playing level. In addition, playing experience and body mass also progressively increased from Junior players through to senior players. It is likely that the improvement in physiological capacities from Junior to senior players reflects a normal adaptation associated with the onset of puberty and moderate increase in age (Pollock, 1978) it is also possible that the progressive improvement in physiological capacities from under 13 players through to first grade players is due to the greater training load and higher playing intensity at the higher playing level. Indeed, the longer matches and training sessions and higher match intensity experienced by senior players may explain, at least in part, their superior physiological capacities. The recent finding of no significant differences in preseason muscular power, agility, speed and Vo_2 max scores between first grade and second grade players, despite considerable (2.7% to 18.4%) differences in these variables during the competitive phase of the season in the study. Lends support to the hypothesis that the duration and intensity of matches have an important effect on the physiological capacities of rugby league players.

According to Ramsbottom, (2001), the physiological characteristic of professional rugby league players are well developed with estimates of maximal aerobic power (Vo_2 max) reported to be in the range 48.6 -62. 6 ml/Kg/min. Mean measurements of 10m and 40m speed of 1.71 seconds and 5.32 seconds respectively have also been reported, conversely Baker, (2003) the physiological characteristics of amateur rugby league players are poorly developed, with a recent study showing that muscular power, speed, and estimated Vo_2 max were 20-42% poorer than previously reported for professional rugby league players. Interestingly, there is a progressive decline in the physiological capacities of professional, semi professional, and amateur rugby league players, with estimated muscular power, speed, and Vo_2 max of semi professional rugby league players were superior to amateur players but inferior to professional rugby league players. These findings suggest a relation between physical fitness and the playing level attained (Gabbett, 2001).

Consistent with previous results from amateur, semi professional and professional rugby league players, this study found higher body mass in forwards than backs. In addition, body mass was a significant predicator in correctly classifying players as either a forward or back (Gabbett, 2001). These findings emphasize the importance of large body size in dominating the ruck and tolerating the heavy tackles and collisions associated with forward positions. Of interest were the lack of consistent significant differences between forward and backs, for the 10m, 20m, and 40m sprint tests. Previous

studies have reported similar 10m sprint times between forwards and backs, with backs having significantly faster 20m and 40m speed than forwards. These findings have been attributed to the rare requirement of forwards to run further than 10m in a single bout of intense activity. However, recent time and motion studies of rugby league matches played under the 10m defensive rule have shown that forwards were required to run 49-50% further than previously required under the 5m defensive rule. These finding may suggest that forwards have adapted to the further running distances required for the modern game, or conditioning. Coaches have modified training program to develop a greater sprinting ability in forwards. This finding of higher estimated Vo_2 max in under 16 backs than forwards is consistent with some, but not all studies of senior rugby league players.

Billat, (2003) 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 28min, 36 seconds ± 18s) and 7 women (32 min, 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 (Vo_2 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 Vo_2 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 Vo_2 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 Vo_2 max, a lower (but not significant) fraction of Vo_2 max (F Vo_2 max) at the lactate threshold, and a higher energy cost of running (ECR). Among men, the weekly training distance at Vo_2 max explained 59% of the variance of Vo_2 max explained 59% of variance of Vo_2 max, and Vo_2 max explained 52% of the variance of 10-km performance time. Kenyan women had a high Vo_2 max and Vo_2 max at VLT that was lower than their male HST counterparts. ECR was not significantly different between genders. The velocity at the Vo_2 max is the main factor predicting the variance of the 10-km performance both in men and women, and high – intensity training contributes to this higher Vo_2 max among men.

Warrington, (2001) conducted a study to determine the aerobic power (Vo^sub^2^max), 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 P<0.0001) 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 thread mill test was 55.8 (1.6) ml/Kg/min for the tug of war

participants compared with 51.1(1.4) ml/Kg/min for the rugby forwards (P<0.03). A composited measure of strength derived from (sum of dominant and non-dominant grip strength and back strength) / lean body mass yielded a strength/mass ratio that, was 32% greater (P<0.0001) for the tug of war group that the rugby group.

Dynamic leg power for the tug of war group than the rugby forwards (4659.8(151.6) V 6198.2 (105) W respectively, P<0.0001). Leg flexibility was 25.4 (2.0) cm forwards 34.2(1.5) cm. Whereas blood chemistry and haematology were normal, packed cell volume, haemoglobin concentration, and erythrocytes volume were lower in the tug of war group than the rugby players (P<0.05). All three haemoblobin measures correlated with muscle mass (packed cell volume, r^Sup2^ = 0.13, P< 0.05, erythrocytes volume, r^Sup2^ = 0.37, P<0.0001, haemoglobin concentration, r^Sup2^ = 0.21, P<0.01).(Green H. J. (2001)).

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

The physiological characteristics of triathletes have been substantially reviewed (Toole and Douglas 1995, Sleivert and Rowlands 1996). As with other endurance athletes it has been reported that triathletes possess a high Vo_2 max and an elevated ventilatory 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 submaximal 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 triathletes differ dramatically, since the training volume has been previously shown to influence the oxygen cost of submaximal exercise (Scrimgeour, 1986), the metabolic adaptations to submaximal or incremental exercise task may differ in triathletes 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) triathletes. Fifteen elite male triathlete participating in the world championships were divided into two groups (ShD) and (LD) and performed a laboratory trial that comprised submaximal ergometry cycling and then an additional submaximal run, best short distance triathlon performances were also analysed for each athlete. Short

distance demonstrated a significantly faster swim time than long distance whereas Vo_2 max (ml kg' min'), cycling economy (wl' min'), peak power output (w peak, w) and ventilatory threshold (% Vo_2 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 ($r = -0.89$, $P< 0.01$) 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 triathlete had a faster swimming time but did not exhibit different maximal or submaximal physiological characteristics measured in cycling and running than long distance triatheletes.

2.14 Summary

In this chapter, extensive review work on related issues concerning the study has been done. It delved into expert opinion, theories, and research findings related to physiological and anthropometric characteristics of some selected male athletic group of sports, i.e. tack and field, basketball, badminton, Judo and soccer group.

It was opened by an introduction followed by some opinions on the physical and anthropometric characteristics of athletes of the various group sports. James, (2001) specifically stated that athletes on various sports elicit different physiological and anthropometric

characteristics and skill. As nature would have, different populations are better suited to excel in anaerobic activities such as sprinting, jumping, and lifting than in aerobic activities such as cycling, swimming, and running. It is believed that in athletic activities and other forms of physical activities involving explosive movements such as jumping, sprinting, throwing, soccer, basketball and boxing require anaerobic power for successful performance. Therefore, a number of tests such as the standing broad jump, 50 meter dash, Margaria Kalamen test, have been developed to assess anaerobic power performance of different populations. The various field test measure of physical, physiological and anthropometric characteristics of these group pf athletes was also discussed. Studies reviewed relating to this indicated, these fields are accepted as valid and reliable test to measure the physiological differences in the group of athletes.

The tall man with long legs has the advantage in high jumping. This could be a setback to a judoker as the centre of gravity of the body is upward. A long arm would aid a javelin and discuss thrower. A footballer needs some amount of weight as a means of balance; this could be a setback to a distance runner who does not need much weight to perform. These differences were discussed in this chapter. Faruk, (2004)

CHAPTER THREE

METHODOLOGY

3.0 Introduction

The purpose of this study was to assess the physical, physiological and anthropometric characteristics of male athletic groups, that is track and field, soccer, basketball, badminton, and Judo sport athletes. To achieve this purpose, the research design, the population and the sample, the procedure, instruments used, controls and statistical analysis used in this study are described in this chapter, under the following sub-titles.

1. Research design
2. Population and description of population
3. Sampling and sampling technique
4. Test items used
5. Testing procedure
6. Instrumentation
7. Study conditions and controls
8. Research Assistants
9. Statistical techniques

3.1 Research Design

The research design adopted in this study was the one-shot research design. In this design, the subjects were tested for their physical, physiological and anthropometric measures, without giving

any treatment. The treatment was their participation in training and competitions before they were tested.

3.2 Population of Subjects

The population of this study consisted of athletes from the following five athletic groups in Ahmadu Bello University, Zaria.

(a) Track and field

(b) Basketball

(c) Badminton

(d) Soccer

(e) Judo

3.3 Sample and Sampling Technique

The sample for this study consists of 75 male athletes who were selected by using stratified random sampling technique. In this technique, the 14 athletic groups that were available in ABU were stratified into the following 5 groups:

(a) Track and individual sport, consisting of track and field and swimming.

(b) Ball games limited in playing area consisting of Basketball, Volleyball, and Handball.

(c) Racket games, consisting of tennis, badminton, Squash and table tennis.

(d) Speed endurance sports, consisting of football and hockey.

(e) Combat sport, consisting of Karate, Judo and Teakwondo.

From each of these 5 groups, one athletic sport was selected from each of the group at random by using pick and dip method. In this method the names of all the athletic groups were written on pieces of papers separately which were well wrapped. Wrapped papers were separated from each group and one out of that group was picked. Thus track and field was selected to represent individual sport, basketball for ball games, badminton for racket games, football for speed endurance sport, and Judo for combat sport. The 5 chosen groups of sport serves as strata for this study. Using the same method, 15 athletes from each chosen athletic group were randomly selected to serve as subjects in this study. Thus the sample for this study consisted of a total of 75 athletes from five (5) athletic groups with 15 male athletes from each athletic group.(Start K.B. and Glencross D.J. 1996) used the cup and dip method in simple random selection, when they investigated power, speed, and strength in the lower limbs of male college athletes. They further explained that this method ensures that the different characteristics that exist within the population are taken care of.

3.4 Test Items Used

Fourteen (14) different test items in all were administered on each subject throughout the duration of the study. All the tests were administered with the help of 20 testers within one week. The tests included:

1. Cooper's twelve minute run test to determine cardio-respiratory endurance.

2. Maximal heart rate to determine one's own maximum heart rate per minute.
3. Standing broad jump to determine lower limb explosive strength (Power).
4. 50 meter sprint to determine speed.
5. Shuttle run test for agility.
6. Skin fold caliper measurement for percent body fat.
7. Height was taken in meters, weight was taken in kilograms using the laboratory weighing scale.
8. The lower leg length was measured from the knee joint to the floor.
9. Upper leg length was measured from the end of the spinal column to the knee joint.
10. The lower arm length was measured from the Olecranon process at the elbow joint to the tip of the third finger.
11. Upper arm length was measured from the acromion process to the tip of the Olecranon process at the elbow joint.
12. Total leg length was measured from the end of the spinal column to the floor or taken from the greater tronchanter to the floor.

All measurements were taken in centimeters, millimeters and kilograms. The length measurements were taken using broad blade anthropometer using Behinke and Wilmore's (1974) procedure. The 12-minute run test as suggested by Cooper (1968) and also as used by Guthehel, (1987), was used as an indicator of cardio-respiratory endurance. Pollock, (1978), reported that the 12 minute run test is one of the best and most widely used field tests to measure cardio-

respiratory fitness. Tukur (1995), Gwani (1986) and Burke, (1976), also reported the reliability of the 12 minute run test as having correlation of 0.91. This therefore indicates that the 12 minute run test is a good measure of cardio-respiratory endurance.

The skin fold measurement is used to determine body composition (percent body fat). The equation of Heyward (1998) (1.1533 – 0.0643 × $log10$ total skinfold) is used and later the Siri fat percentage formula Bf(4.95 /BD - 4.5) × 100 was used to arrive at the body fat percent, the skin fold method is often used because of its accessibility and easy of administration (Chado, 1990). This method gives a good estimate of body fat percent. Skinner and Baldini, (1990) reported correlation coefficient of -0.7 to -0.8 between hydrostatic (under water) weighing and skin fold measures in different populations.

The 50-meter dash test as suggested by AAHPERD (1989) has been used by various researchers as a good indicator of speed. Duhu (1978) emphasized on the 50-meter dash test as the most effective measure of speed. This also confirmed the findings of Ecker (1971) and Arogbonlo (1993) that the 50-meter dash test is a reliable test item for speed. They reported reliability coefficients of 0.86 and 0.94. The American Alliance for Health, Physical Education, Recreation and Dance (AA HPERD), 1989) also recommended the use of this test as a good measure of speed.

The standing broad jump measures the leg power of the subject. Bucher, (1981) recorded reliability co-efficient of 0.93. The standing broad jump is a good measure of leg power.

The shuttle run test measures speed and agility. Machol, (1981), and Barrow, (1979), recorded a reliability coefficient of 0.94 for boys and 0.82 for girls. AAHPERD (1989) recommended the use of this item as a good indicator for agility. The test involves the subject running and swiftly changing direction.

3.5 Testing Procedure

Before the tests were administered, informed-consent forms were given to subjects, which were completed and returned. The subjects were certified to be medically fit to undertake the test by the principal medical officer of the university. It was also made clear to them that an individual was free to quit the test whenever he became uncomfortable. Detailed explanation and demonstration of every test item preceded actual performance of tests. Before the test began, subjects were allowed to inspect the instruments utilized to avoid fright, though all of them were used to these instruments, since they were all active sportsmen of the university who participated in both NUGA and Federation of Africa University Games (FASU).

The test were administered independently on the five groups at the same time and under the same conditions. The five groups were track and field, soccer, basketball, badminton and judo respectively, and each had it's members names drawn alphabetically to avoid confusion and assign numbers for easy identification. The 12 test items included were the 12 minute run test to determine Vo_2 max, percent body fat , maximal heart rate test, muscular power test to determine

lower limb explosive strength, 20 meter shuttle test to determine agility, and 50 meters run to determine speed, and anthropometry measurements, which are the height, weight, lower leg length, upper leg length, lower and upper arm length, and the total leg length. The tests items were completed within a week. During the test, each subject was permitted rest for two minutes relaxation session, after which the test followed. A 10 minute general and specific warm up exercise were taken before engaging in the tests. Each of the 14 test items was administered as follows.

Cooper 12 Minute Run Test

This test is used to estimate cardio-respiratory endurance (aerobic capacity). Subjects were told to run on the University's tartan track from the starting line until they heard the sound of the whistle indicating to start and the final indicating them to stop wherever they were. The subjects ran in groups of 5-10 to avoid confusion. They were told not to run as fast as possible but be sure to pace themselves during the run to prevent premature fatigue when they are getting tired they can slow down to a walking-speed or even stop. The number of times the subject run round the track (lapses) was counted at the end of the 12 minutes. The distance covered at the end of the 12 minutes is determined by multiplying the number of laps covered by 400 meters and recorded against the subject number. The ACSM for the calculation of the Vo_2max from the running is

m/min x 0.2 + 3.5mi/kgm/min.

For instance a subject covered 2400m in 12 minutes run the Vo_2max will be as follow:

$$\frac{2400m}{12} = 200$$

200 x 0.2 = 40

40 + 3.5m/kgm/min

= 43.5m/kgm/min.

The Skin Fold Measurement

This estimates percent body fat. The thickness on the subjects skin fold is measured with a skin fold caliper. The skin fold calculation of body fat is based on the relationship of the subcutaneous (under the skin) fat to total body fat. To perform the skin fold measurement, grasp skin fold between the thumb and fore fingers, apply calipers about half an inch from the fingers. The calipers should go in deep as the fold is wide, If the fold is half inch, go in one and a half-inch with the caliper. Take the measurement, release, repeat the measurement and continue until your measurement is consistent. The regions of measurements are chest, abdomen and thigh skin folds for males. All skin fold thicknesses are measured to the nearest 1mm. The score of 3 readings was recorded at each site, the chest, abdomen and thigh.

Muscular Power

The muscular power test was evaluated by means of standing broad jump test (Butcher, 1981). This test measures power and body co-ordinations. Subjects are asked to stand behind a drawn take off

line with the feet several inches apart and the toe just behind the take off line. In preparation for the jump, the subject bends the knee, both hands are swung backwards and jumps as far forward as possible using the arm to propel the body forward to help him to go further. The testers emphasized taking off feet with the knee extended. Three trails are allowed, measuring each jump from the take off line to the heel or other parts of the body that touches the ground nearest the take off line. The best distance wais recorded as the score.

Speed

Speed was tested by means of 50 meter sprint (AAHPERD, 1989). The test measures the subject's speed ability, that is, the minimum time required for a subject to run 50 meters. The test was administered to two subjects at a time. Both subjects took a crouch position behind the starting line. The starting command was “On your mark, set, go”. When the “Go” command was given, the starter made a down ward sweep of the arm to give a visual signal to timers who stand at the finishing line. On the command “Go” the subjects run the entire 50 meters as fast as possible, passing through the plane of the finishing line. The score is the time elapse between the starter's signal and the time he crossed the finish line. Time is recorded in second to the nearest tenth of a second.

Agility

The test of agility is measured by measuring the subjects in running and changing positions (Machol, 1981). Two parallel lines were marked on the ground 20 meters apart, two blocks of wood, 2 cm × 2 cm × 4 cm were placed behind one of the lines. The subjects start from behind the other line. On signal, the subjects runs as fast as he can to the block, picks up one, runs back to the starting line and places the block behind the line. He then run back and picks up the second block which is carried in hand back to the starting line. Two subjects ran at the same time alternatively, first from behind the other. Two trials were allowed with rest period between trials. Scoring is the record time of the best trial to the nearest tenth of a second.

Maximal Heart Rate

Exercise does not increase the maximal heart rate, it strengthens the heart so that it can pump more blood at this level longer with less strain. To determine one's own maximum heart rate per minute, simply subtract one's age from 220. To determine heart rate do the following: measure the pulse by pressing the first two fingers on one hand gently on either the artery on the inside of the wrist or the carotid artery (located under the jaw, either on the right or left side of the front of the neck). Count pulse beat for 10 seconds, multiply the result by six. This gives the per minute total.

Height and Weight

The standard anthropometric protocol of the International Working Group on Kinanthropometry (IWGK) has described by Ross, (1983) were used to measure height and weight. The height was taken in meters and the weight in kilograms, using the Laboratory weighing scale (Shemond) with subjects dressed in a minimum sports wear and without shoes. The body mass index was determined by dividing the weight by the square of height

$$BMI = \frac{Wt}{Ht^2}$$

Length measurements: This was taken using Broad Blade Anthropometer using Behnke and Wilmore's (1974) procedure.

3.6 Instrumentation

The main purpose of this study was to determine the subjects, physical, physiological and anthropometric characteristics as related to their sports. To achieve this objective, the following instruments were used in conducting the tests:

(a) Electronic stopwatch (World time WR 5 Bar model Japan) for timing. (Pollockl, 1978).

(b) The laboratory weighing scale (Shemond) was used to measure the subjects' weight. (Mueller, 1982)

(c) Whistle to control exercise and test proceedings, especially for starting and stopping. (Matthew, 1981).

(d) A 30-meter measuring tape, used for measuring distance reached in broad jump. (Butcher, 1981).

(e) Skin fold caliper (large model); for skin fold measurement (Skinner, 1990).

(f) The 400 meter tartan track of Ahmadu Bello University, Samaru Campus, Zaria, for the 12 minute run, 50 meter dash, 20 meter shuttle run and the warm up exercise before the test (Cooper, 1968).

(g) An out door jumping pitch for broad jump test.

3.7 Study Conditions and Control

The following study conditions were controlled:

(a) The researcher made sure that the test took place on the same specific course and field. This enabled equal conditions for all the subjects.

(b) The purpose and meaning of the test items were carefully explained to the subjects before the commencement of the test.

(c) The subjects arrived 30 minute before the commencement of the test.

(d) Subjects were to be on their sports outfits including running shoes that they felt were appropriate for the test.

(e) Due to the engagement of the various subjects the test were commenced by 4.30 pm to 6.30 pm each testing day. Also, temperature at this time was favourable to the subjects.

(f) Subjects took their meal at least two hours before the commencement of the exercise.

(g) Proper warm up was conducted to avoid injury.

3.8 Test Assistance

Test team approach was used. A total of 20 test assistance, comprising of lecturers, coaches from various sports and some final year students of the department of physical and Health Education, ABU, Zaria were used for the study. They were taught the procedure, that is, how to keep time of the subjects, in essence this guided them on how to evaluate each subject. The starters kept close watch on the subject from a good position, where they could make a valid and reliable judgment. The team completed the testing in one time block and uniform testing procedures were used.

3.9 Statistical Technique

The data collected for this study were analyzed as follows:

(a) Descriptive statistic of mean, standard deviation, and standard error of mean was used.

(b) One way analysis of variance (ANOVA) to see if there is any significant difference between the five male groups of sports. Where significance difference was found post hoc test was located where the differences lie (Machol, 1981).

(c) Decision to reject or not to reject the Null hypothesis was made at an alpha level of 0.05.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Introduction

The purpose of this study was to determine and compare the physical, physiological and anthropometric characteristics of male athletic groups. To achieve this purpose, the data collected were statistically analyzed, the results of which was presented and discussed in this chapter.

4.1 Results

Information regarding the means and standard deviation of scores of track and field, basketball, badminton, judo and soccer group in age, height, weight, Vo_2 max, shuttle run test, 50 meter sprint dash, standing broad jump, percent body fat, lower leg length, upper leg length, total leg length, upper arm length, lower arm length and maximal heart rate is presented in table 4.1 (a).

TABLE 4.1 (a)

Mean scores of selected athletic groups in different variables.

VARIABLE	ATHLETIC GROUP									
	TRACK & FIELD		BASKETBALL		BADMINTON		JUDO		SOCCER	
	M	SD	M	SD	M	SD	M	SD	M	SD
Age (yrs)	25.2257 ±	3.011	24.6667±	1.1751	22.0667±	1.9445	23.3333±	2.2254	23.7333±	2.1536
Height (m)	1.7053±	0.0775	1.7907±	0.1906	1.7493±	0.0962	1.6413±	0.0564	1.708i7±	0.0962
Weight (kg)	66.6 ±	5.95	77.93 ±	11.03	67.73 ±	3.86	63.95 ±	5.56	67.80 ±	5.83
Vo_2 max (m/s)	47.9333 ±	8.6128	45.8667±	4.91	48.7500±	7.6800	41.7100±	5.5700	45.4253±	5.8000
Shuttle Run (sec)	16.9 ±	.68	16.94 ±	.50	17.07 ±	.62	16.5 ±	.70	16.0 ±	.82
50m Dash (sec)	6.15 ±	.26	6.8±	.47	6.66±	.32	7.03±	.65	7.06±	.42
Standing Broad Jump (cm)	250.5±	22.41	246.07±	14.53	250.22±	13.79	231.73	24..1	228.20±	12.59
% Body Fat (mm)	13.73±	7.32	12.37 ±	2.61	12.20 ±	1.41	18.45 ±	6.34	11.85 ±	1.52
Lower Leg Length (cm)	53.73±	1.95	59.04 ±	3.56	54.40 ±	2.323	51.53 ±	3.50	54.33 ±	3.18
Upper Leg Length (cm)	53.40±	1.99	59.80 ±	3.73	54.33 ±	2.29	51.73 ±	3.71	53.07 ±	3.062
Total Leg Length (cm)	107.27±	3.45	120.27±	6.34	108.73±	3.95	103.80±	5.06	107.93±	5.57
Lower Arm Length (cm)	50.27±	2.196	54.00 ±	3.84	51.13 ±	2.92	47.33 ±	3.22	47.53 ±	2.70
Upper Arm Length (cm)	35.33±	2.41	40.60 ±	3.52	35.93 ±	1.71	34.53 ±	2.39	36.20 ±	2.60
Maximal Heart Rate (b/m)	194.73±	3.01	195.33±	1.18	197.92±	1.94	196.6 ±	2.23	196.27±	2.15

M – Mean SA – Standard deviation

Table 4.1 (a) shows that badminton group was the youngest (22.07 ± 1.94 yrs), whereas, track and field was the oldest (25.23 ± 3.01 years). Basketballers were the tallest and heaviest of all the groups. But the soccer group had the best performance in 12-min run, shuttle run and 50 meter sprint dash test, whereas track and field and badminton groups were better than others in standing broad jump.

Judo group had the highest percent body fat compared to other groups. Basketball group had the longest upper and lower limb compared to other groups. However, the maximal heart rate of all the athletic groups was very similar.

Major Hypothesis

In order to find out whether the differences between the selected athletic groups in their physical, physiological and anthropometric characteristics were significant, it was hypothesized that there is no significant differences between the selected athletic groups in their anthropometric characteristics, in order to test this hypothesis, the following sub-hypothesis were made.

Sub – Hypothesis 1

There is no significant differences between track and field, basketball, badminton, Judo and soccer athletic groups in their anthropometric characteristics which are age, height, weight, percent body fat, lower leg length, upper leg length, total leg length, lower arm length, upper arm length. The null hypothesis of no dignificant difference is therefore rejected. Post hoc results of Scheffe test for difference of mean further shows that the five male athletic groups were different from each other in their anthropometric characteristics.

Sub-hypothesis 1 was tested by analysing the data using one way analysis of variance (ANOVA), the results of which are shown in table 4.2 (b).

TABLE 4.2 (b)

One way (ANOVA) for differences between selected athletic groups in their anthropometric characteristics.

Anthropometric Characteristics

VARIABLE	SOURCE	DF	SS	MS	F/RATIO
Age (yrs)	Between Groups Within Groups Total	4 70 74	91.92 333.47 425.39	22.98 4.76	4.83 **
Height (m)	Between Groups Within Groups Total	4 70 74	0.1857 0.8473 1.0330	0.0464 0.0121	3.8360**
Weight (kg)	Between Groups Within Groups Total	4 70 74	1706.1979 3317.3613 5023.5592	426.5495 47.3909	9.0007**
Body Fat %	Between Groups Within Groups Total	4 70 74	91.9200 333.4667 425.3867	22.9800 4.7638	5.5047**
Lower Leg Length (cm)	Between Groups Within Groups Total	4 70 74	458.0533 639.7333 1097.7867	114.5133 9.1390	12.5910**
Upper Leg Length (cm)	Between Groups Within Groups Total	4 70 74	565.4667 647.2000 1232.6667	146.3667 9.2457	15.8308**
Total Leg Length (cm)	Between Groups Within Groups Total	4 70 74	2345.8667 1734.1333 4080.0000	586.4667 24.7733	23.6733**
Lower Arm Length (cm)	Between Groups Within Groups Total	4 70 74	458.0533 639.7333 1097.7867	114.5133 9.1390	12.5301**
Upper Arm Length (cm)	Between Groups Within Groups Total	4 70 74	336.7200 468.0000 804.7200	84.1800 6.6857	12.5910**

F.(4,70) = 2.50 < .05 ** significant

(P<0.05)

Table 4.2 (b) shows significant differences between the selected athletic groups in all their anthropometric characteristics. Application of Scheffe's post hoc test revealed that significant difference in age was due to significantly younger average age of badminton group compared to that of track and field and basketball groups, in height due to significantly taller height of Basketballers and soccers groups compared to other groups in weight due to heavier weight of basketballer group compared to other group in body fat due to higher percent body fat of Judo group compared to other groups, in lower limbs measurements due to longer limb lengths of basket ball group compared to other groups.

Sub – Hypothesis II

There are no significant differences between track and field, basketball, badminton, Judo and soccer groups in their physiological characteristics which are Vo_2 max, and maximal heart rate. The null hypothesis of no significant difference is therefore rejected. Post hoc result Scheffe test for different of mean further shows that the five male athletic groups were different in their physiological characteristics.

Sub – hypothesis II was tested by analyzing the data using one way analysis of variance (ANOVA), the results of which are shown in table 4.3

TABLE 4.3

One way ANOVA foe differences between selected athletic groups in their physiological characteristics.

VARIABLE	SOURCE	DF	SS	MS	F RATIO
Vo_2 max (m/s)	Between Groups	4	426.6694	106.6673	4.8239**
	Within Groups	70	6133.4560	87.6208	
	Total	74	6560.1253		
Maximal Heart Rate (b/m)	Between Groups	4	91.9200	22.9800	1.2174*
	Within Groups	70	333.4667	74.7638	
	Total	74	425.3867		

F.(4,70) = 2.50 < .05 * not significant

**significant

(P<0.05)

Table 4.3 shows significant difference between the male athletic groups in their Vo_2 max and significant differences in their maximal heart rate.

Application of Scheffe's post hoc test revealed that significant difference in Vo_2 max was due to significantly lower Vo_2 max of Judo group compared to that of other groups. As maximal heart rate of all male athletic groups was very similar, there were no significant differences between the groups.

Sub – Hypothesis III

There are no significant differences between track and field, basketball, badminton, Judo and soccer male groups in their physical characteristics which are 50 meters speed, 20 meters shuttle run and

standing broad jump. The null hypothesis of no significant difference is therefore rejected. Post hoc result Scheffe test for different of mean further shows that the five male athletic groups were different in their physical characteristics.

Sub hypothesis III was tested by analyzing the data using one way analysis of variance (ANOVA), the results of which are shown in table 4.4.

TABLE 4.4

PHYSICAL CHARACTERISTICS

VARIABLE	SOURCE	DF	SS	MS	F RATIO
50m Dash (sec)	Between Groups Within Groups Total	4. 70 74	8.1919 13.8494 22.0393	2.0480 0.1978	10.3528**
Maximal Heart Rate (b/m)	Between Groups Within Groups Total	4 70 74	11.00876 31.4003 42.4879	2.7719 0.4486	6.1794**
Standing Broad Jump (cm)	Between Groups Within Groups Total	4 70 74	6772.3467 23062.9333 29835.2800	1693.0867 329.4705	5.1388**

F(4,70) = 2.50 < .05 **significant

(P<0.05)

Table 4.4 shows significant difference between the male athletic groups in 50 meter dash (speed), 20 meter shuttle run (agility), and standing broad jump (explosive strength) of lower limbs. Scheffe's post hoc test showed that the significant difference in 50-meter dash was because of the highest score of soccer group compared to that of other

groups. Similarly, the better performance of soccer group was responsible for the significant difference in shuttle run when compared to other groups, whereas the significant difference in standing broad jump was due to better performance of track and field and badminton groups.

Sub – Hypothesis IV

There are no significant correlations between different anthropometric, physical and physiological characteristics of these groups of athletes. The null hypothesis of no significant correlation between the male groups of athlete was therefore rejected. Post hoc result Scheffe test for different of mean further shows that the five male athletic groups were different in their physical, physiological and anthropometric characteristics.

Sub – hypothesis IV was tested by computing inter-correlations between anthropometric, physical and physiological characteristics of selected athletic groups. The result of which are shown in table 4.5.

TABLE 4.5

ANOVA Inter correlation between different characteristics of selected athletic groups.

	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14
V1	1.000	.12	.34 *	.11	0.5	.13	.01	.19	.07	.12	.23*	.23*	.08	.09
V2	0.12	1.0000	.06	1.08	.14	.13	.15	.12	.04	.17	.01	.01	.11	.12
V3	0.34*	.01	1.0000	.19	.23*	.16	.34*	.35*	.21	.22	.08	.08	.28*	.28*
V4	.11	.08	.19	.00	.66*	.62*	.58*	.49*	.67*	.64*	.16	.16	.46*	.48*
V5	.04	.14	.23*	.66*	1.00	1.63	.55*	.56*	.50*	.54*	-.08	.08	.21	.47*
V6	.13	.13	.16	.62*	.63*	.68*	.68*	.72*	.75*	.91*	.12	.12	.45*	.24*
V7	-.01	.15	.34*	.58*	.55*	.72*	1.00	.72*	.72*	.86*	.08	.08	.60*	.48*
V8	-.19	.12	.35*	.49*	.56*	.75*	.72*	1.000	.66*	.75*	.02	.02	.47*	.63*
V9	-.07	.04	.21	.61*	.50*	.90*	.72*	.66*	1.00	.79*	.02	.02	.57*	.50*
V10	.12	.17	.23	.64*	.54*	.12	.86*	.75*	.79*	1.000	.01	.01	.57*	.59*
V11	-.23*	.01	.09	.16	0.8	.12	.08	.08	.18	.01	1.00	.98*	.08	.58*
V12	.23*	-.01	-.06	.15	.08	.45*	0.8	.03	.05	.01	.97*	1.00	.08	.06
V13	.08	-.11	.28*	.46*	.21	.45*	.60*	.47*	.57*	.56*	.08	.08	1.00	.99*
V14	-.09	-.11	.27*	.47*	.24*	48*	.63*	.49*	.59*	.58*	.06	.06	.99*	1.00

R (73) = .213 <.05 * Significant at .05 level

V1 = 50m dash (speed), V2 = 20m shuttle run (agility),

V3 = Standing broad jump (explosive strength of leg),

V4 = Weight, V5 = Height, V6 = lower leg length.

V7 = Upper leg length, V8 = lower arm length,

V9 = Upper arm length, V10 = total leg length,

V11 = Age, V12 = maximal heart rate, V13 = body fat %, V14 = Vo_2 max.

Examination of table 4.5 shows that speed is significantly related to total leg length, whereas explosive strength of lower limb (standing broad jump) is significantly related to upper leg length and lower arm length. Similarly, weight is significantly related to height, lower leg length, upper leg length, lower arm length and upper arm length, whereas, height in addition is significantly related to total leg length. The significant finding is negatively related to height and Vo_2 max (Cardiorespiratory fitness).

However, this finding should be considered very consciously because when these correlation are squared, none of them reaches 50% level. In order word, the significant relationship between the variable did not explain even 50% of the variance in the dependent variable e.g the variance in Vo_2 max (cardiorespiratory fitness), is explained only by 9.6% by body fat percent, which means that there are compounding variables responsible for these element of fitness.

Table 4.5 further shows positive relationship of speed with lower leg explosive strength and maximal heart rate and negative relationship with age, positive relationship of explosive strength with speed, high, upper leg length, body fat % and Vo_2 max and positive relationship of weight with height, limb measurement, body fat % and Vo_2 max. Table 4.5 further shows significant positive relationship of height with weight, limb measurement and negative relationship with Vo_2 max, positive relationship of lower leg length with weight, height, upper leg length

and other limb lengths and percent body fat and Vo_2 max. Similar relationship are shown in table 4.5 for all limb measurements. However, age was significantly related with leg explosive strength and negatively with maximal heart rate, whereas percent body fat was positively related with explosive strength, weight, all limb measurements and negatively related with Vo_2 max, whereas, Vo_2 max was significantly related with all limb measurements, height, weight and body fat % negatively.

4.2 Discussion

Anthropometric Characteristics

This study showed that badminton players were the youngest compared to athletes from track and field, basketball, soccer and Judo, previous studies have shown that sports requiring mainly strength can be played for more years than sports that require flexibility and speed that are dependent mainly on nervous system. (Fiatarone, 1984).

Badminton is a sport that require lot of flexibility and speed endurance which can be optimally developed in younger age (Hebellinck, 1974). It's but natural to expect badminton players to be younger than other athletic groups.

Elite sport generally favour tall people (Kolsa 1983). Previous studies have shown that Basketballers, volleyballers and throwers are taller than others (Bale, 1986). This study has come from the fact that Basketballers were the tallest among the athletics groups studied, height provide an advantage in this game as in volleyball and throws,

people who are tall are therefore attracted to this game, it therefore natural to expect elite basketballers to be taller compared to their counterparts from other sports. One limitation in this study was that no analysis was made by specific discipline in athletics, otherwise throwers and jumpers would also have been found to be taller than others. Similarly, weight was closely associated with height in which Basketballers were found to be heavier, perhaps because it is an advantage in that sport as it is in many other sports (Ramsbolton, 2001).

As in the case of height and weight, basketball players had longer limb than other athletic groups, although upper and lower leg length measures was shown to have limited value in predicting performance in team sports (Berg and Bell, 2001). This measure was found to be proportional to the height of the player (Cureton, 1992), much of the work in this area was done in track and field athletic, whereas performance was positively correlated with lower leg length measurement (Kalaman, 2001). On the basis of this study and other similar research work conducted (Dillman, 2001). The longer limb length of basketball players may be explained on the basis that they provide a greater advantage in playing basketball.

4.3 Physiological Characteristics

The physiological variables studied in this research are maximal Oxygen uptake (Vo_2 – max), and maximal heart rate (HRmax). Maximal Oxygen uptake is a reflection of the efficiency of the adjustment of the

physiological function of the body to the increasing metabolism demand of work (Mathew, 1981). Previous studies have clearly shown that distance runners have higher maximal Oxygen uptake values compared to other athletic groups (Berg, 1992).

A few studies have shown that footballers have higher maximal Oxygen uptake levels as this sport involves repetitions of intense exercise interspersed with lower level of activities over a 90 minutes period. (Bouchard, 1994), It has also been shown that as the intensity of the training increases, maximal Oxygen uptake levels increases in sport like basketball (Gabbett, 2001). The judo group in this study recorded the lowest value of Vo_2max. This could be attributed to the fact that judo program does not involve repetitions of high intensity schedule of running which is required to improve speed and endurance.

This study failed to show any significant difference between athletic groups in maximal Oxygen uptake level (Vo_2 max).

4.4 Physical Characteristics

Physical characteristics in this study were 50-meter dash for speed, 20-meter shuttle run for agility and standing broad jump for explosive leg strength. This study showed that soccer players had highest speed and agility compared to other athletic groups, this may be attributed to the fact that soccer players involved in training that consist of repetitions of high intensity sport of running which is required to improve speed, as basically the result of rapid application of force to

a body (Nelson,1992). As the soccer players excel in speed and agility, one would have anticipated a better performance of a group in explosive strength. This study failed to show this, track and field and badminton groups had greater explosive strength than other athletic groups, this may be attributed to the fact that this study involves only leg explosive strength, the training of both badminton and track and field athletes involves only leg strength, the training of both badminton and track and field athletes involves mainly explosive resistance exercises of the lower limb because of which they had greater explosive power which is the fundamental requirement for the sports. This is in agreement with review of (Nelson, 1972). Also skinfold thickness tend to be less in sport person and are related to the amount of endurance activities, whereas the patterning of fat is ethnically based and does not appear to be changed by training (Muller, 1982), it has been proposed that certain sport fattening may favour certain sports or events.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 SUMMARY

Application of scientific method and selection of sports most suitable to individuals have been primarily responsible for recent record breaking performances in different sports discipline. One of the most essential requirements foe the application of new technologies and training methods to improve performance, to identify the suitability of an individual to a particular sport, studies conducted so far have shown that certain biological, psychological and physical characteristics pre dispose one to a particular sport than to other sports. For example, distance runners have been shown to be thinner and shorter, basketballers and jumpers also have been shown to be taller and gymnasts shorter to excel in their respective sports. As very little information was available on the physical, physiological and anthropometric characteristics of Nigerian athletes from different sports disciplines, this investigation was conducted to fine and compare physical, physiological and anthropometric characteristics of track and field, basketball, badminton, soccer and Judo male athletic groups. To achieve the purpose of this study, 15 male athletes from each of track and field, basketball, badminton, soccer and Judo groups were selected at random to serve as subjects for this study. They were all healthy male athletes without any indication to participate in this study. The subjects thus selected were tested in 12 minute run test for cardiorespiratory endurance, standing broad jump for lower limb

explosive strength, 50 meter dash for speed, 20 meter shuttle run for agility, and maximal heart rate. In addition, the thigh, chest and abdominal skinfold measurements were taken to determine the % body fat, lower and upper leg, lower and upper arm, and total leg length were measured. The data thus collected were statistically analyzed to determine the physical, physiological and anthropometric characteristics of the selected atheletics groups and to compare the different athletic groups in its characteristics. The result of this study showed that the badminton group was the youngest and the track and field group the oldest. The basketball group was the tallest and heaviest of all the groups, whereas the soccer group was the fastest and most agile group. Track and field and badminton groups were better than other groups in lower limb explosive strength. The basketball group had longer limbs than other athletic groups. The results of this study further revealed significant differences in selected anthropometric characteristics in speed, and lower limb explosive strength which were the physiological characteristics included in this study. The study also showed that speed was related to lower limb length and weight to height, and height to body fat %. Height was also shown to be negatively related to cardio-respiratory fitness.

5.2 CONCLUSIONS

On the basis of the results and in view of the limitation of this study, the following conclusions are drawn.

(a) The five male athletic groups vary in their physical, physiological and anthropometric characteristics

(b) Basketball players were significantly taller than players from other athletic groups. They had longer limbs than other athletic groups.

(c) Badminton and track and field athletic groups had greater cardio-respiratory endurance than other athletic groups.

(d) Soccer players had greater agility than other athletic groups, whereas, track and field athletes were faster than other athletic groups, track and field and badminton groups had greater lower limb explosive strength than other athletic groups.

(e) Judo group had higher body fat % than other athletic groups.

5.3 RECOMMENDATIONS

On the basis of the findings of this study the following recommendations are made:

(a) People with longer limbs and greater height are more suitable for basketball and other sports that require the use of hands and leg such as volley ball, hand ball, javelin thrown, short put, discus and jumps. Therefore it is recommended that these sports should be preferentially selected for tall people with longer limbs.

(b) People with better sprint endurance, medium height and agility are more suitable for football, hockey and rugby. It is therefore recommended that people with medium height and greater sprint endurance should be selected for these sports.

(c) People with greater explosive strength and speed are more suitable for track and field athletics, especially for short and long sprint and jumps, whereas people with greater maximal Oxygen uptake (Vo_2 max) are more suitable for endurance event such as distance races, cycling and aerobic activities.

(d) People with better explosive strength e.g. speed, agility and medium height are suitable for badminton, tennis, table tennis and squash.

(e) People with greater sprint endurance, leg explosive strength and moderate body fat percent are more suitable for combat sports such as judo, karate and taekwando.

5.4 RECOMMENDATIONS FOR FURTHER RESEARCH

(a) This investigation may be repeated in different age groups in order to find out whether the same characteristics found for different athletic groups are also dominant in different age groups.

(b) Investigation may be conducted to find out the performance indices that can be used to select talents for different sports.

(c) Research is needed to find out whether there are sex differences in the different characteristics peculiar to specific sports.

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APPENDIX I

DEPARTMERNT OF PHYSICAL AND HEALTH EDUCATION AHMADU BELLO UNIVERSITY ZARIA

CONSENT FORM

I …… the undersigned subject voluntarily agree to take part in the study. As part of the said study, I understand and agree that during the participation, complications may arise, if I am not tolerating working well, it usually becomes necessary that exercises can be stopped by my decision or that of the investigator or his representative. Other risk, in addition to dizziness, nausea, vomiting or even fainting may occur during participation but rarely.

Student signature ……

Date ……

Witness name ……..

Signature ……..

Date ……

APPENDIX II

RAW DATA FOR TRACK AND FIELD GROUP

Subjects	(metres) 12 minutes run	Speed (SEC) 50 metres	(sec) 20 m Shuttle run	Muscular Power (cm)stand broad jump	(mm) chest	(mm) body abdomen	(mm) thighs	(kg) weight	9(m) height	(cm) Lower Leg length	(cm) Upper Leg Length	(cm) lower arm length	(cm) upper Arm Length	(cm) total leg length	(yrs) Age	(b/pm) Maximal Heart Rate
	3,300m	6.15sec	16.89sec	228cm	8mm	9mm	12mm	71.6kg	1.76m	54cm	52cm	50cm	35cm	106cm	22yrs	198
	3,335m	6.25sec	17.21cm	247cm	9.5	11	12	64.4kg	1.75m	57cm	53cm	53cm	37cm	110cm	22	198
	2,880m	6.45sec	17.46sec	214cm	11	9	28	51.8kg	1.54m	49cm	48cm	46cm	30cm	97cm	29	191
	1,885m	6.12sec	17.25sec	276cm	14	9	56	75.4kg	1.77m	54cm	55cm	50cm	38cm	109cm	27	193
	1,870m	5.82sec	15.84sec	284cm	26	14	56	68.2kg	1.63m	51cm	53cm	48cm	35cm	104cm	27	193
	3,185m	6.25sec	16.96sec	251cm	14	1	12	69.2kg	1.76m	55cm	55cm	50cm	36cm	110cm	28	192
	3,185m	6.00sec	17.26sec	248cm	9	13	10	63.5kg	1.66m	55cm	52cm	49cm	33cm	107cm	30	190
	2,225m	6.12sec	17.46sec	272cm	14	10	14	62kg	1.68m	53cm	56cm	50cm	37cm	109cm	24	196
	2,500m	5.98sec	16.50sec	24cm	9	9	12	73kg	1.70m	55cm	54cm	50cm	354cm	109cm	27	193
	2,284m	5.94sec	16.50sec	246cm	12	14	12	70kg	1.69m	54cm	52cm	50cm	34cm	108cm	25	195
	2,254m	6.01sec	16.65sec	260cm	12	11.5	14	64kg	170m	53cm	54cm	50cm	37cm	107cm	22	198
	2,885m	6.65sec	17.86sec	208cm	11	9	13	62kg	1.67m	53cm	54cm	49cm	33cm	107cm	22	198
	2,890m	6.64sec	17.84sec	231cm	8.5	10	11.5	63kg	1.68m	53cm	53cm	49cm	34cm	106cm	23	197
	3,110m	5.84sec	15.50sec	272	10	8	9	71.6kg	1.70m	54cm	54cm	50cm	36cm	108cm	29	191
	2,225m	6.12sec	16.86sec	270	14	12	14	70kg	1.87m	56cm	56cm	52cm	40cm	112cm	22	198

APPENDIX III

RAW DATA FOR BADMINTON GROUP

cts	(metres) 12 minutes run	Speed (SEC) 50 metres Speed	(sec) 20 m Account Race	Muscular Power Standing broad Jump (cm)	(mm) Chest	(mm) Body Abdomen	(mm) Thigh	(kg) Weight	9(m) Height	(cm) Lower Leg Length	(cm) Upper Leg Length	(cm) Lower Arm Length	(cm) Upper Arm Length	(cm) Total Leg Length	(yrs) Age	(b/pm) Maximal Heart Rate
	2,745m	7.30sec	17.39sec	241cm	14mm	15mm	18mm	70kg	177m	57cm	54cm	53cm	34cm	111cm	19yrs	201
	3,105m	6.63sec	16.75sec	274cm	10mm	10mm	16mm	69kg	1.78m	55cm	55cm	51cm	36cm	110cm	21yrs	194
	2,220m	6.64sec	17.39sec	247cm	14mm	12mm	16mm	66kg	1.70m	50cm	56cm	51cm	37cm	106cm	22yrs	198
	3,280m	6.43sec	18.22sec	250cm	14	11	14	67kg	1.75m	55cm	56cm	49cm	37cm	111cm	19yrs	201
	3,120m	6.70sec	16.45sec	239cm	12	16	18	65kg	1.74m	54cm	53cm	46cm	35cm	107cm	19yrs	201
	2,525m	7.02sec	17.42sec	260cm	16	14	11	77kg	2.05m	60cm	58cm	56cm	41cm	118cm	21yrs	199
	1,620m	6.64sec	15.99sec	250cm	12	16	14	72kg	1.58m	52cm	48cm	45cm	35cm	100cm	22yrs	197
	2,720m	6.50sec	16.40sec	225cm	12	14	12	68kg	1.72m	55cm	54cm	52cm	34cm	109cm	22yrs	198
	2,450m	6.84sec	1.92sec	254cm	10	12	10	64kg	1.78m	56cm	55cm	54cm	35m	111cm	23yrs	197
	2,680m	7.10sec	17.12sec	240cm	14	11	12	67kg	1.72m	54cm	56cm	54cm	36cm	110cm	23yrs	195
	3,192m	6.55sec	17.10sec	232cm	12	10	12	72kg	1.70m	52cm	54cm	52cm	37cm	106cm	25yrs	195
	2,92m	6.72sec	16.72sec	269cm	14	12	14	68kg	1.74m	54cm	54cm	52cm	36cm	108cm	24yrs	196
	2,850m	6.64sec	16.86sec	264cm	12	10	11	65kg	1.76m	53cm	52cm	49cm	35cm	101cm	24yrs	196
	2,752m	6.12sec	18.24sec	262cm	11	14	12	62kg	1.73m	55cm	56	51cm	36cm	111cm	23yrs	197
	2,990m	6.18sec	17.13sec	247cm	12	10	15	64kg	1.72m	54cm	54cm	52cm	35cm	106cm	22	198

APPENDIX IV

RAW DATA FOR BASKET BALL GROUP

Subjects	(metres) 12 minutes run	Speed (SEC) 50 metres Speed	(sec) 20 m Account Race	Muscular Power Standing broad Jump (cm)	(mm) Chest	(mm) Body Abdomen	(mm) Thighs	(kg) Weight	9(m) Height	(cm) Lower Leg length	(cm) Upper Leg Length	(cm) Lower Arm Length	(cm) Upper Arm Length	(cm) Total Leg Length	(yrs) Age	(b/cm) Maximal Heart Rate
	2.816m	7.9sec	17.09sec	225cm	10mm	8mm	10mm	89kg	1.99m	63cm	61cm	55cm	43cm	124cm	23yrs	197
	2.879m	6.70sec	18.07sec	247cm	12mm	13mm	14mm	68kg	1.72m	59cm	60cm	58cm	44cm	119cm	26yrs	194
	2.895m	6.66sec	16.47sec	268cm	12mm	12mm	15mm	68kg	1.72m	59cm	60cm	58cm	44cm	119cm	26yrs	194
	2.100m	6.7sec	16.84sec	260cm	9	10	9.5	72kg	1.82m	60cm	60cm	55cm	41cm	120cm	25yrs	195
	2.590m	6.68sec	18.03sec	238cm	10.4	11	15	81kg	1.89m	61cm	61cm	52cm	40cm	122cm	24yrs	195
	2.200m	6.83sec	16.64sec	231cm	10.2	11	16	78kg	1.92m	56cm	60cm	58cm	40cm	116cm	26yrs	194
	2.805m	6.81sec	16.47sec	274cm	13	13	17	84kg	1.82m	59cm	66cm	57cm	41cm	125cm	25yrs	195
	2,110m	6.44sec	16.26sec	242cm	12.8	13	15	72kg	1.75m	61cm	62cm	56cm	44cm	123cm	24yrs	195
	2,809m	6.54sec	17.80sec	247cm	13	13	16	72kg	1.75m	62cm	62cm	56cm	44cm	124cm	24yrs	195
	2.650m	6.62sec	16.86sec	223cm	12	10	12	67kg	1.69m	61cm	60cm	55cm	43cm	121cm	24yrs	196
	2.808m	7.9sec	17.07sec	255cm	9.5	9.3	15	65kg	1.65m	58cm	54cm	45cm	33cm	122cm	23yrs	197
	2.400m	6.55sec	16.65sec	237cm	11	11.9	36	68kg	1.75m	56cm	58cm	55cm	39cm	124cm	24yrs	195
	2.105m	6.66sec	16.85sec	245cm	14	12	16	71kg	1.70m	51cm	50cm	46cm	36cm	101cm	24yrs	198
	2.655m	7.03sec	16.45sec	247	13	12	14	99kg	2.03m	64cm	63cm	56cm	44cm	127cm	25yrs	195
	2.225m	6.12sec	16.86sec	270	14	12	14	70kg	1.87m	56cm	56cm	52cm	40cm	112cm	22	196

APPENDIX V

RAW DATA FOR JUDO

Subjects	(metres) 12 minutes run	Speed (SEC) 50 metres Speed	(sec) 20 m Account Race	Muscular Power Standing broad Jump (cm)	(mm) Chest	(mm) Body Abdomen	(mm) Thighs	(kg) Weight	S(m) Height	(cm) Lower Leg Length	(cm) Upper Leg Length	(cm) Lower Arm Length	(cm) Upper Arm + Length	(cm) Total Leg Length	(yrs) Age	(b/pm) Maximal Heart Rate
	2,380m	6.70sec	15.76sec	255cm	10mm	13mm	34mm	69.8kg	1.60m	51cm	54cm	46cm	36cm	104cm	24yrs	196
	2,720m	6.70sec	15.76sec	255cm	13mm	13mm	34mm	69.8kg	1.63m	51cm	53cm	46cm	38cm	109cm	24yrs	196
	3,112m	8.35sec	17.47sec	261cm	13mm	13mm	30mm	65.2kg	1.67m	56cm	56cm	49cm	38cm	112cm	22yrs	198
	2,420m	7.12sec	16.84sec	198cm	11	13	36	63.0kg	1.60m	53cm	46cm	46cm	33cm	99cm	23yrs	197
	2,220m	7.00sec	68.44sec	214cm	11	10	14	56.8kg	1.70m	57cm	50cm	53cm	35cm	107cm	21yrs	199
	2,230m	6.43sec	16.22sec	222cm	12	12	19	55.8kg	1.63m	51cm	51cm	47cm	31cm	102cm	19yrs	201
	2,520m	7.50sec	16.35sec	255cm	14	15	33	69.8kg	1.68m	55cm	52cm	49cm	38cm	107cm	20yrs	200
	2,515m	8.50sec	18.20sec	216cm	15	19	33	61.0kg	1.52m	45cm	51cm	41cm	32cm	96cm	24yrs	196
	1,915m	6.37sec	16.39sec	213cm	13	14	16	56.4kg	1.58m	45cm	51cm	41cm	32cm	96cm	25yrs	195
	2,488m	6.67sec	16.60sec	259cm	14	14	14	61.6kg	1.75m	53cm	59cm	50cm	35cm	112cm	27yrs	193
	2,212m	6.55sec	16.49sec	216cm	135	14	56	75.4kg	1.65m	51cm	54cm	48cm	33cm	105cm	27yrs	193
	1915m	7.30sec	17.05sec	233cm	11	13	35	69.4kg	1.68m	52cm	54cm	49cm	33cm	105cm	24yrs	196
	1,975m	7.20sec	16.93sec	229cm	24	32	38	62.2kg	1.60m	53cm	52cm	44cm	34cm	105cm	24yrs	196
	1,970m	6.96sec	16.84sec	192cm	10	14	14	64.8kg	1.68m	53cm	44cm	43cm	37cm	105cm	24yrs	196
	2,951m	6.24sec	15.47sec	269cm	12	12	14	82kg	1.67m	48cm	49cm	45cm	33cm	97cm	23	197

APPENDIX VI

RAW DATA FOR SOCCER

Subjects	(metres) 12 minutes run	Speed (SEC) 50 metres Speed	(sec) 20 m Account Race	Muscular Power Standing broad Jump (cm)	(mm) Chest	(mm) Body Abdomen	(mm) Thigh	(kg) Weight	9(m) Height	(cm) Lower Leg length	(cm) Upper Leg Length	(cm) Lower Arm Length	(cm) Upper Arm Length	(cm) Total Leg Length	(yrs) Age	(b/pm) Maximal Heart Rate
	2,725 m	6.87sec	15.59ec	228cm	12mm	14mm	12mm	65.8kg	1.72m	55cm	53cm	50cm	35cm	108cm	23yrs	197
	3,920m	6.60sec	15.53sec	229cm	9.5mm	9.5mm	8mm	62.5kg	1.73m	56cm	54cm	50cm	37cm	110cm	23yrs	197
	3.45m	7.29sec	15.75sec	238cm	10mm	10mm	14mm	72.2kg	1.68m	55cm	51cm	48cm	37cm	106cm	25yrs	195
	2,710m	6.72sec	16.31sec	230cm	14	13	17	590kg	1.61m	51cm	50cm	45cm	33cm	101cm	26yrs	194
	2,220m	7.11sec	15.59sec	236cm	12	10	12	65kg	1.68m	51cm	50cm	46cm	35cm	101cm	25yrs	195
	2,827m	7.67sec	16.00sec	237cm	10	9	14	76.58kg	1.95m	63cm	58cm	55cm	37cm	121cm	20yrs	200
	2,820m	7.12sec	16.31sec	255cm	14	15	33	69.8kg	1.68m	55cm	52cm	49cm	38cm	107cm	20yrs	200
	3,100m	7.06sec	17.21sec	243cm	12	10	14	65kg	1.65m	51cm	50cm	45cm	33cm	101cm	23yrs	197
	2,690m	6.19sec	14.63sec	232cm	11	12	12	72.5kg	1.73m	55cm	54cm	47cm	35cm	109cm	20yrs	200
	3,150m	7.12sec	14.72sec	229cm	11	14	17	65kg	1.72m	51cm	58cm	48cm	38cm	109cm	25yrs	195
	2,880m	7.26sec	17.21sec	193cm	11.5	13	14	67kg	1.74m	53cm	56cm	47cm	38cm	109cm	27yrs	193
	2,690m	6.98sec	16.42sec	236cm	11	12	17	69kg	1.68m	57cm	57cm	48cm	39cm	114cm	25yrs	195
	2,720m	7.02sec	15.41sec	210cm	10.8	10.8	14	64kg	1.69m	56cm	54cm	48cm	38cm	110cm	21yrs	199
	2,880m	6.92sec	16.25sec	230cm	12	9.9	12	66kg	1.70m	54cm	50cm	46cm	35cm	104cm	23yrs	197
	2,650m	7.79sec	17.24sec	215cm	12	14	13	82kg	1.71m	55cm	58cm	46cm	35cm	113cm	26yrs	194