A COMPARISON OF CARDIORESPIRATORY PERFORMANCE OF SELECTED ATHLETIC GROUPS IN 9, 12, AND 15 MINUTES RUN TESTS

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A THESIS SUBMITTED TO POSTGRADUATE SCHOOL.
AHMADU BELLO UNIVERSITY, IN PARTIAL
FULFILMENT OF THE REQUIREMENTS FOR THE AWARD
OF THE DEGREE OF MASTER OF EDUCATION IN
PHYSICAL EDUCATION (EXERCISE PHYSIOLOGY)

DEPARTMENT OF PHYSICAL & HEALTH EDUCATION
AHMADU BELLO UNIVERSITY, ZARIA

1989

DECLARATION

I hereby declare that this research report has been written by me, and that it is the record of my own work and that to the best of my knowledge, this work has not been submitted in any previous application for a higher degree.

Amina Kaidal Date:_________________

APPROVAL SHEET

DEPARTMENT OF PHYSICAL & HEALTH EDUCATION

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This thesis report titled: "A Comparison of Cardiorespiratory Performance of Selected Athletic Groups in 9, 12 and 15 minutes Run Tests by Amina Kaidal, meets the regulations governing the award of the degree of Master of Education in Ahmadu Bello University, Zaria and is approved for its contribution to knowledge and literary presentation.

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ACKNOWLEDGEMENT

I am sincerely grateful to all those whose expertise have contributed to the completion of this study.

I am particularly thankful to Dr. M. A. Chado, Department of Physical and Health Education, Ahmadu Bello University, Zaria for his unrelented effort in supervising, reviewing, suggestions and constructive criticisms, that has made it possible for this research to reach this standard.

I sincérely expressed my gratitude to Dr. K. Venkateswarlu and Dr. Emiola whose suggestions have helped me greatly in improving the quality of this work.

I also express my appreciation to Adamau Balami and Aliyu Garafini for sparing their time to assist me in the collection of my data.

I wish to thank the coaches and the entire staff of the Department of Physical and Health Education, Ahmadu Bello University, Zaria, for their co-operation and assistance towards the completion of this work.

Finally, I express my sincere appreciation to David Jogai of the Bindery Division, Ahmadu Bello University, Zaria, for his assistance in the preliminary and final binding of this work.

ABSTRACT

This study was to investigate the cardiorespiratory fitness of seleoted groups of athletes, using timed distance running field tests designed for the durations of 9, 12 and 15 minutes.

The test was administered to 180 athletes, 60 each for Hookey, Basketball and Volleyball with equal number of males and females of Ahmadu Bello University, Zaria, teams. Distances covered in the tests were measured in kilometers and measurements taken to the nearest meter.

The major findings of this research are:

1. There was significant differences in the distanoes covered with the test durations,
2. There was significant difference among the male and the female groups in the average distanoe covered.
3. There was significant difference among the sport groups in the distance covered within the different time durations.
4. Certain independent variable, age, weight, have no significant relationship with performance for both sexes in the running time duration. Height and percent body fat was found to have a significant relationship with performance in the male group. Height was found to have a positive correlation (r = 0.452) percent body fat had a negative

correlation (r -0.523).

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DEDICATION

This research work is dedicated to my

Beloved Mother

Mrs. Hauwa Kaidal

and

Abdulkareem Abdulazeez

Chapter 1

1.1 INTRODUCTION

Physical activities have been one of the major means for human survival for centuries. The primitive man engaged in physical activities to satisfy his basic needs of food, shelter and protection.

As people began to live in small communities, they started to enagage their youth in different aspects of physical training so as to acquire security skills and conduct which they needed to prepare them to obtain food, clothing, shelter and protection against enemies. Van-Dalen at el (1971), stated that youths who were lacking in physical courage, stamina and survival skills were a danger to the community in which they lived.

The need for participation in regular physical activities received different emphasis from different nations, depending on the political ambitions of the leaders.

In 1954, Han Kraus and associates from the Institute of Physical Medicine and Rehabilitation New York University who have been using exercise to treat adult patients who suffered from lower back pain, observed that without organic disease, physical activity was very functional for treating the patients since the pain increased whenever the level of physical activity declined. They designed exercise as test battery and tested the American and European children selected from urban and suburban communities.

They reported their publication six test movement, appraising strength, flexibility of the trunk and leg muscles that 57.9% of the Americans failed while 8.7% among Europeans failed. They concluded that the physical condition of the American children was very poor compared to their European counterparts. Reported by Chado (1986).

This report shocked the American Government and it became more interested in searching for ways to solve the problem.

Since 1954, the concern for physical fitness development programs have not been limited to America only. Other nations have the same belief that an appropriate regular physical activity will contribute to the fitness of their citizens.

In Nigeria, the interest among the citizens to be involved in physical programs have been very high in recent years. In 1985, there was a call by some ndividuals within the field of physical Education, Health and Recreation on the Government to enact a law which would deal with National Policy on Physical fitness. Although this is yet to be achieved, there has been great awareness in the country as to the benefits of regular physical activities.

The benefits of physical fitness to a nation like Nigeria more especially its youth, cannot be overemphasised when one considers the role they have to play in nation building and to portray the image of this great country in international politics. Thus, the need for this nation to employ appropriate measures in developing and maintaining the physical fitness of her citizens. A high level of physical fitness is a prerequisite to good health, greater productivity and participation in competitive sports.

1.2 Background to the Study

Fitness is a term that connotes so many definitions and interpretation by different individuals in different professional fields. Amusa and Udoh (1982) supported the definition of total fitness as stated by the American Association for Health, Physical Education and Recreation (AAHPER) as:

> that state which characterises the degree to which the person is able to live most affectively with his potentials. Ability to function depends upon the physical, mental, emotional, social and spiritual components of fitness, all of which are related to each other and are mutually interdependent. This definition refers to the individual's capacity to survive and live effectively in his environment.

Physical fitness, which is only an aspect of the total fitness, is the concern of exercise physiologists. It is a more specific term, and it is related to the functional capacity of the body's organs.

The definition of physical fitness most accepted by exercise specialists, physical educators and medical personnel is that which defines it, as stated by Onekata (1984) as the individual's ability to endure exertion and stressful physical activity beyond that which is required by his/her normal day to day occupation. Curetorn (1942), appraised fitness in terms of physical and organic efficiency and defined fitness as ... "anatomic and physiological soundness", and added a component "motor fitness".

He explained that "motor fitness" includes endurance, power, speed, agility, flexibility and balance. McCloy and Young (1954), suggested the components of physical fitness as speed of muscular contraction, dynamic energy, ability to change direction, ability to carry dead weights and flexibility.

In the field of sports and exercise, the main components of fitness commonly measured and referred to is "endurance fitness". This attempts to relate fitness to the functional health of the individuals. William and Victor (1981) defined endurance as the ability of a muscle or group of muscles to perform repeated contractions against a load or sustain contraction for an extended period of time. This defition indicates that endurance fitness requires the efficient and effective work of skeletal, involuntary, and cardiacmuscles.

Further definition of physical fitness involved cardiovascular-pulmonary efficiency. John, et al. (1970) stated that endurance fitness is composed of two parts, namely anaerobic and aerobic mechanisms. Anaerobic enduracne is the ability to sustain muscular work while oxygen intake is inadequate. The aerobic endurance refers to ability to sustain muscular work over an extended period for time under conditions in which oxygen consumption has reached a steady state and the oxygen intake equals the oxygen requirement for the task.

An individual's physical fitness can be determined from his metabolic capacity or physical working capacity (PWC) which is directly related to his ability to supply oxygen to the working muscles. The assessment of the total work capacity of an individual therefore involves measurement of such physiologic parameters, as: cardiovascular fitness, respiratory functions, muscular efficiency and local muscular endurance.

Cardiorespiratory tests are used to determine the efficiency of the heart and the blood vessles. A valid information about the physical working capacity of an individual can however, be obtained from knowing the maximal oxygen consumption (Vo_2Max), Rose (1978), stated that Vo_2Max is the most important limiting factor of physical capacity, and therefore the most reliable criterion for evaluating aerobic capacity. Doland et al (1978) similarly stated that Vo_2 Max determined from laboratory continues to be the best indicator of cardiorespiratory fitness. Vo_2 Mx can be measured by the following two methods.

1. Through the direct method

2. The indirect method

The direct method is conducted under laboratory conditions with elaborate equipment the results of which are most accurate, (Herbert 1966), but because of the expenses, time and personnel requirements the direct method is not practicable for testing large group.

Since then other field methods (indirect method) for estimating Vo_2Max from submaximal exercise have been reported to be reasonably accurate.

Cooper (1968) reported studies in which the field and laboratory tests were used with the same subjects to indicate a high correlation of 0.897 ($P. < .05$).

The field tests are often used to predict maximum oxygen consumption through Heat Rate measurement during stationary cycling or Harvard Stepping or timed distance runs.

Several studies available supported the use of Heart Rate as an index of work output or cardiarespiratory endurance. The data presented by Balke (1957), on human subjects shows that there is validity using pulse rate (heart rates) during exercise and recovery periods as a measure of muscular fatigue in performance. A linear correlation was observed between oxygen consumption and pulse rate. Dill (1942), earlier reported a straight line correlation between heart rate and oxygen consumption from his study of young, well motivated subjects.

Field testing have the following advantage over laboratory tests:

1. They use well known physical activity modes such as, walking and running.
2. They cost less.
3. Can be administered within a short time to a large group.
4. Do not require sophisticated equipment and trained personnel.

For these · advantages of the field tests and the inavailability of laboratory equipment every where, the investigator in this study found it convenient to use the timed distance runs in measuring the cardiorespiratory fitness performance of both male and female athletes from selected sports.

1.3 Statement of the Problem

The need for physical fitness has been expressed by many in recent years. Cardiorespiratory fitness received great emphasis in determining the physical fitness level of athletes and non-athletes. It is however, apparent that the response of athletes in different sports to cardiorespiratory fitness test varies according to the demand of their chosen sports. This is based on the fact that different modes of training induce different types of cardiovascular adaptation. This will make it difficult for a single test item, particularly in field tests, to be effective in assessing the cardiorespiratory performance of athletes during and after training. To effectively assess cardiorespiratory fitness, test items must be of sufficient duration. It is the problem of selecting a timed distance run test of sufficient duration for assessing cardiorespiratory fitness of different athletic groups that forms the basis of this study.

Many studies using timed distance running have been conducted (Ezra, 1986, Gwani, 1986, Musa, 1986, Jonathan, 1987) using Nigerian population, but none has inolved athletes from different chosen sports to determine the effectiveness of using 9 minute, 12 minutes or 15 minutes distance runs.

The specific questions to be answered are:

1. What is the mean performance of the selected groups of athletes in a field test of 9, 12 and 15 minutes run?
2. Is there any difference in the distances covered by the groups in the tests of different time durations?
3. Is there any relationships between the performance of the athletes in the different test durations of 9, 12 and 15 minutes?

1.4 Purpose of the Study

With the present understanding of the fact that cardiorespiratory fitness is a good indicator of physiologic adjustement to strenuous activities which helps to show the individual's fitness conditions, the researcher used timed distance running tests of different duration to measure this important physiologic parameter in different athletes of different chosen sports so as to be able to see which test item will be more discriminating among the athletic groups. Specifically the reasearcher investigated the cardiorespiratory performance of Volleyball, Basketball and Hockey players in various distance run tests. The distances they were able to cover within the specified time period were used to assess their fitness level.

1.5 Justification for the Study

In recent times, sports performance has been one of the great political 'weapon' used by different countries to show supremacy.

To be able to achieve international recognition in sport, a good ground work is necessary. The attainment of the highest standard in sports starts with the selection of the right calibre of athletes into the right sports. Astrand and Rodahl (1977) stated that the possession of relevant physical and physiological attributes are very essential for successfull performance in various sports. Many technologically developed countries that Nigeria meet in international competitions, have sophisticated equipment that are used in the laboratory to quantify performance related physiological variables of their athletes. Such equipment are not available to us in Nigeria.

Physiological variables like Vo_2Max, Heart Rate, systolic and diastolic blood pressures, ventilatory capacities have been identified to limit performance.

It is necessary to determine the physical, physiological and performance profiles of each athlete. A good player, apart from possessing the necessary skills for performing the chosen sport, must also attain a certain level of fitness needed for the performance of that sport. It therefore becomes necessary for coaches to use appropriate tests to assess the cardiorespiratory fitness of their athletes at different stages of their training program to gain insight into the ability of each athlete to adjust to the training load. As each sport requires different fitness levels a knowledge of the fitness requirement of each sport and the appropriate test item to be used is of great importance to the coach and any body interested in exercise for fitness. It is in light of this that the researcher decided to carry out this study so as to provide coaches and trainers with a bases for measuring effectively the cardiorespiratory fitness of their athletes based on their chosen sport.

1.6 Significance of the Study

Since the study was aimed at the assessment of the cardio-respiratory fitness of different athletics groups, it is hoped that the results obtained at the end of the study would be beneficial to coaches and all concerned with training of athletes. The study will provide important information to coaches in:

a) The selection of tests items in assessing their athletes fitness at different levels of their training, and the assessment of the effectiveness of the training program and the response of the athletes to the training program.

b) Designing training programes for different sports so as to develop the appropriate fitness levels for the expected performance.

c) Stimulates the desire for further researches in using timed run tests for assessing cardiorespiratory fitness of different athletic groups and develop a standard for each group of athletes.

1.7 Hypotheses

This research was aimed at the measurement of cardiorespiratory fitness of three different groups of athletes and to determine which of the test items used in the study could be used in testing their fitness. Thus the following hypotheses were tested.

1. There is no significant difference among the 9 minutes, 12 minutes and 15 minutes run tests as measures of cardiorespiratpry fitness of athletes in selected athletic sports.

2. There is no significant difference among the performance of male and female athletes of different sports in running test of different durations.

3. Height and weight have no significant correlation with performance in distance running tests.

4. There is no significant relationship between performance in 9, 12 and 15 minutes run tests.

1.8 Assumptions

Based on available previous research data, the following assumptions were made in relation to this study:

1. The physiological response of males and females to physical activity is the same in direction if not in degree.

2. Maximal oxygen consumption is the most valid measure of cardiorespiratory fitness.

3. Maximal oxygen consumption can be determined from distance covered in timed runs.

1.9 Delimitations

This study was deliminated to cordiorespiratory fitness of three different groups of athletes, using timed distance runs. The study was deliminated to the measurement of distances covered in the different time periods. Distance covered were recorded in meters and later converted to kilometers. The recording was done to the nearest meter.

The study was deliminated to three athletic groups: Basketball, Volleyball and Hockey involving both males and females.

1.10 Limitations

The findings of this study might be affected by the degree of involvement of the athletic groups in following their training programmes. Being University athletes their training goes hand in hand with their studies, and it is obvious that their studies take more of their time.

The eating habits of the athletes were also not controlled. Although they were advised not to eat when coming for the test, some might have done so without the researcher's knowledge.

Weather condition might also have been an extraneous variable that might have affeorted the performance of the athletes. As the test was conducted in early February (that is during the harmattan period), the weather condition was not the same for all the test days.

Due to lack of enough population to employ the random sampling method, the study used the whole available population in each athletic group. This may influence the extent of interpretation.

1.11.1 Definition of Terms

Words and phrases carry relative meanings and applications which may differ with the purpose for which they are used. It is therefore important to define certain terms which may appear ambiguous to readers.

Certain terms used in this study are defined in their operational sense.

1.11.2 Training

Subjection of individuals to physical activities that task their metabolic capacity beyond their daily physical engagement.

1.11.3 Athlete

A person trained to participate or compete in a chosen sport.

1.11.4 Cardiorespiratory Fitness

The ability of the circulatory, respiratory and muscular systems to respond adequately and safety to vigorous physical activity. This fitness helps the indiviaual to exercise at a higher intensity or for long periods because the systems can easily transport sufficient oxygen through the blood stream and the oxygen can be utilized by the working muscles. This term was used interchangeably with cardiovascular fitness in the study.

1.11.5 TESTS

A measuring instrument that requires performance by individuals.

Chapter 2

2.0 REVIEW OF RELATED LITERATURE

2.1 Introduction

Cardiovascular tests are used to determine the efficiency of the heart and blood vessels. The administration of these tests usually requires the subjects to perform some specific exercise such as stepping up and down on a bench or running a specified distance or time or cycling on stationary bicycle.

A typical laboratory measurement of cardiovascular performance include the counting of the individual's pulse rate which is done before exercise, immediately following exercise and after exercise. The index for measuring cardiovascular performance is usually the maximal oxygen consumption (Vo_2 Max). The value obatained from a measure of Vo_2Max are directly related to the individuals capacity to sustain physical activity. The measurement when performing exercise also gives the maximal rate of energy output. Astrand and Saltin (1961) stated that Vo_2Max is related to the ability of the cardiovascular system to take up and utilize oxygen. The higher the value, the higher the individual's ability to sustain muscular activity. Strauss (1976) stated that this ability is however, not limited to cardiovascular fitness alone. Equally important is the ability of the muscles to extract the oxygen delivered. Eisenman and Golding (1975) stated that, other physiologic factors to be considered when Vo_2 Max is being measured are age, sex and previous training of the individual.

Maximal oxygen consumption is a aproduct of endurance training, and the higher the value, the higher the individual's level of fitness.

As stated earlier, the laboratory method has been found to be the most reliable method for measuring Vo_2 Max. But the method require sophisticated equipment which are not readily available for use on a large population. It is therefore almost impracticable for most institutions to use this method. These limitations associated with the laboratory method have led to the general acceptance of field tests, some of which have been found reliable. The field methods involve procedure for estimating maximal oxygen consumption during a field run. Such tests include time required to run a certain distance or a total distance run within a specified duration of time. The field tests are therefore considered more practicable for large population, and easier for the researcher, they do not require much technical skills to administer them.

2.2 <u>Effects of Training on Cardiorespiratory System</u>

Available evidence (Bevegard 1963, Kjellberg 1949, Oscai

1968) clearly suggests that cardiorespiratory adjustment to training depends on the specific program employed. The factors for the workouts, type of training, speed, intensity, duration and repetition of the activities.

McArdle et al (1981), stated, that any training program designed towards developing the efficiency of the cardiorespiratory system should be designed in such a way that it provides sufficient overload on the cardiovascular system. They also maintained that this overload should be accompanied by engaging the appropriate muscle groups, circulations and "metabolic machinery". This suggests that training should be similar to task at hand.

Fox and Mathews (1976) observed that, the cardiorespiratory changes induced by training include those that affect mainly the oxygen transport system, and these involve mainly circulatory, respiratory, and tissue level factors. Morganroth et al (1975) and Oscai (1968) reported cardiac hypertrophy in endurance and non-endurance athletes. The hypertrophy for the endurance ethletes was characterised by a large ventricular cavity (VC) and normal thickness of the ventricular walls (VW). While in the non-endurance athletes, the hypertrophy is characteristised by a normal sized ventricular cavity and a thicker ventricular wall McArdle (1981), reported a comparison of left ventricular volume and mass of swimmers, runners and non-athletes. The values were 181ml and 308g for swimmers, 160ml and 302g for runners and 101ml and 211g for non-athletes. It has been reported by Fox and Mathews (1976) that training induces a decrease in heart rate and an increase in stroke volume and that the magnitude of the bradycardia is the same in endurance and non-endurance athletes. Bevegards et al (1963) and Morganroth (1975), reported that the increase in stroke volume is more pronounced in endurance athletes. This may be due to the increased ventricular cavity observed in this class of athletes.

Other changes that are important in the oxygen transport system is blood volume and hemoglobin content. Kjelbert et al (1919) and Oscai (1968) reported an increase in total blood volume and hemoglobin content. Other studies, (Scheuer 1977) reported an increase in mitochondraial mass and cellular concentration of respiratory enzymes in the hearts of animals trained by forced running or swimming.

Similar mitochindrial adaptation was reported (Howald and Clausen 1982) in the skeletal muscles with the greatest increase in the type 11B and 1 fibres. Edward et al (1977) suggested after an experiment with two groups of low and high power training that the increase in Vo_2Max observed in the low power group may be due to changes in mitochondrial density. Hickson (1982) also provide data from rats that showed greater mitochondrial changes during low power compared to high power interval training.

2.3 Timed Run Tests as Measures of Cardioresporatory Fitness

The 12 minutes run test is a field test for estimating Vo_2 Max. This test has been generally accepted as a measure of cardiorespiratory fitness because of its strong correlation with laboratory testing. The distance an individual covers in 12 minutes has been found to correlate positively with his Vo_2Max.

The idea of using the 12 minutes was developed by Balke, (1959), when he tried to develop various run-walk test so as to relate Vo_2Max to distance covered within a specified period of time or time taken to run a given distance. The test was later validated. (Cooper 1968). He used 115 U.S. Airforce male officers and Airmen on 12 minutes test and treadmill for Vo_2 Max. He found a correlation of 0.897 between the field test and the laboratory treadmill test from which he concluded that based on the significance of the relationship, it is possible to estimate Vo Max from the results of the 12 minutes run with considerable accuracy.

The basis for the use of the 12 minutes test is the fact that fitness is assessed on the ability of an individual to continue an activity for a prolonged period of time. The longer the duration (with appropriate work load) the more accurate the estimate of the individual's fitness level. Since Cooper's report in 1968, attempts have been made with interesting results to validate the use of the 12 minutes run test to estimate Vo

Max. Jackson and Coleman (1976) used 50 yards dash, 3 minutes, 6 minutes, 9 minutes and 12 minutes with elementary school children a total of 866 boys and 803 girls) and found that the distance covered in 9 minutes and 12 minutes correlated highly with Vo_2 Max when a sub-group of 22 boys and 25 girls were tested on treadmill. Balke (1976) tried to validate some selected laboratory and field tests of physical working capacity. He compared different laboratory and field tests with Vo_2Max and reported that the 12 minutes test was found to have a high correlation of 0.91 with Vo_2Max.

Using 40 college female between the ages of 18-21, Custer and Chaloupka (1977) used 6 minutes and 12 minutes to determine the relationship between predicated Vo_2Max and performance in the various run tests. The 6 minutes run test was found to have a correlation of 0.45 and the 12 minutes run test 0.49. The difference between the correlations of 6 minutes and 12 minutes was not significant, which therefore suggested that the 6 minutes could be used instead of the 12 minutes which was longer for the same purpose. In trying to explore the validity of using timed distance runs as predictors of cardiorespiratory fitness in grades 1-3 children, Krahenbul et al (1978) used 800, 1,200 and 1,600 meter runs. The result was compared with Vo_2Max obtained via open-circuit method during treadmill running, and concluded that the 1,6000 metres (1.6km) proved to be the best indicator of Vo_2Max in both sexes.

Dorociak and Nelson (1983) tried to find an alternative and a more practical method to evaluate cardiorespiratory fitness. They studied the relationship between the 1 mile (1.6km) and 2 mile (3.2km) runs, and Vo_2Max. They reported that 1 mile and 2 mile run are equally valid measured of cardiorespiratory fitness. Both correlated significantly with Vo_2 Max. (ml/1kg/min) and since there was no significant difference between the two runs the investigators recommended the 1 mile for convenience. The correlation between the two runs was 0.93.

Ezra (1986) reported after a study, which compared Astrand Rhyming test and Cooper's 12 minutes run test, that the 12 minutes run test is a more accurate measure of cardiovascular fitness. He reported a significant correlation of 0.778. His study further revealed that there is a significant performance difference between the sexes. Male subjects performed significantly better than the female subjects. Using diploma and undergraduate students of Physical and Health Education Department of Ahmadu Bello University, Zaria, it was reported by Cahdo (1986) that the males are better on average than the females in performance in the 12 minutes run test. Schwartz (1974) used the 12 minutes run walk test on 107 clinical biochemistry students to determine their fitness level. Most of the students fell into Cooper's "excellent" fitness category and it was concluded that the students were in good physical condition.

Pollock et al (1978) stated that the most widely used field tests to measure cardiorespiratory fitness are the 12 minutes and the 1/2 mile run test. Both tests have high intercorrelation, but because the 1/2 mile is easier to administer and less time consuming, he preferred it to the 12 minutes run test.

Another interesting study was conducted by Norton et al (1980) in which Vo_2Max was used to predict run time. Vo_2Max and the sum of the three skinfold accounted for 80.8% of the variance. Those who performed best in the 3.2km run had high Vo Max values and low percent body fat. This obviously point to the fact that women will be at disadvantage in running tests since they are usually found to have more percent body fat than men.

From the studies reviewed, it can be stated conveniently that the longer the time duration or distance covered during a timed run, the better the measure of cardiorespiratory fitness. The 12 minutes run test was found appropriate in assessing the cardiorespiratory fitness of subjects tested. The 6 minutes and 1 mile run tests were recommended by some researchers for convenience as they both have a high correlation with the 12 minutes run test. Age has been found to have a significant effect on performance in distance running test.

One observation that the researcher has made from all researches available, is the fact that there is no report on the use of these timed runs or measured distance runs for determining cardiorespiratory fitness performance of different athletic groups. This neglected aspect is the major concern of this research, and the resercher was interested in finding out the most effective tests for discriminating the cardiorespiratory fitness level for both males and females in different athletic groups.

2.4 Performance Differences Between Males and Females

The difference in athletic performance between males and females can be attributed to variation in body size, body composition, aerobic power and muscular strength. As Christine and Sharon (1983) rightly stated, the real question in comparing the physiological responses of men and women in exercise and training is not whether differences really exist or the magnitude of the differences, but whether the differences are caused by the biological factor of sex or by cultural expectations and experiences.

The biological factor becomes more crucial when determing the physiological responses of the sexes to physical activity. It becomes more apparent when one appreciates the differences between the sexes as indicated by Behnke's model for the reference man and woman (Behnke 1974). The model clearly indicated that the average man is considerably taller and heavier than the average woman. The height and weight differences have some implication for certain sports. Fox and Mathews (1981) stated that the larger total body size of men typically means that they have larger internal body organs. They went further to state that, the composition of the larger male body is even more critical.

Sparling (1980) reported from ten studies of male and female subjects, 18 years of age and above that the composite means for percent body fat for men was 12.95 and women 24.32. The implication of this in physical activity is that women have less muscle mass with which to exert force in situations that require muscular strength, power, speed and endurance. In an attempt to quantify the effect of sex on Vo_2Max, Sparling (1980), combined the results of 15 comparisons of trained and untrained male and female subjects for Vo_2Max of 15-35 of age and reported that the composite male values were 56% higher than those of the female when expressed in litres per minute (Lt/m'). Statistical analysis showed that almost 60% of the variance in the absolute expression of Vo_2Max was accounted for by just knowing the sex of the individual. The male values were however, only 28% higher when expressed relative to body weight (Ml/Kg /min). 49% was still accounted for by sex.

One of the factors that accounted for sex differences in performance is percent body fat. Cureton and Sparling (1980) measured the metabolic responses of female and male distance runners to sub-maximal and maximal treadmill running and 12 minutes run performance. Both sexes were studied at their natural weight and then exogenous weight was added to the men to equal the percent body fat of a matched woman. They found out that running with the additional weight produced a mean difference of 32% for maximal threadmill run. 30% for 12 minutes run and 68% for Vo_2Max.

Ulyot (1979) theorised that the additional body fat carried by women would be an advantage for them physiologically if endurance event is long enough because fat is highly efficient fuel. Aaken (1981) also stated that women are perfect long distance runners because they are not bogged down by heavy musculature, and they can use fat more efficiently than men. This implies that women should be better in distance running even than men.

Costill and Associate (1979) tested these theories. They used 13 male and 12 female endurance trained runners who were matched for Vo_2Max. Their study indicated that fatty acid metabolism accounted for 39% of the energy during the first ten minutes of the run and roughly 53% by the end. Both sexes obtained approximately 55% of their total energy from carbohydrates and 45% from fat. No differences were found between the groups for free fatty acid or glycerol concentration at the times these measures were taken during the runs. Lipid oxidation obtained from muscle biopsy samples was as much as 20% less in the female muscle than male muscle. It was however suggested by Christine and Sharan (1983) that it occurs because of lower mitochondrial density in women's muscles. This indicated that women have a lower oxidative capacity than men and this puts them at disadvantage in endurance activities since the energy pathway for endurance activities are predominantly aerobic. Even though fat plays a significant role as energy substrate during endurance run, the low oxidative capacity of the female do not place them at advantage.

Fox and Mathews, (1980) and Falls (1979) suggested that other physiological variables important in oxygen transport and fuel utilization that may account for sex differences in Vo_2 Max are heart size, hemoglobin content and blood volume. They further stated that, whether heart size is expressed on absolute volume or relative to body size, the female heart is only 80-90% as large as that of man. Falls (1979) then stated that the smaller female's heart means a smaller stroke volume (S.V.) and to compensate for this, the female's heart rate is higher at rest and at low work loads. Another possible factor that could reduce female's work capacity in continued aerobic activities is iron deficiency. It was reported by Parr at el (1984) that stage 1 iron deficiency (iron depletion) and stage 2 iron deficiency (erithropoiesis) existed in female athletes in the absence of anamia, during prolonged intensive training.

Although several studies comparing fibre composition of males and females found no significant differences in the percentage of slow and fast twitch fibres, Costill (1979), Prince

(1983) and Johnson (980) stated that, despite the similarity in muscle fibre composition, composite, data for several studies support the generalization that the average man is stronger than the average woman by as much as 30-40%. Fox and Wilmore (1977), however, stated that the difference is not consistant for all muscle groups.

Laubaok (1976) also found out that the upper body strength measurement of women average about 55% of those in men, 64% in trunk strength and 72% lower body strength. Wilmore (1974) reported similar findings. He also reported that, these differences are reduced when strength is related to body weight and lean body mass and that training increases women's strength.

The biological and performance differences between males and females have been supported by many studies. In determing the sex differences in the 12 minutes run performance, Phillip and Kirk (1983) reported that men were significantly lower in percent body fat and higher in Vo_2 Max regardless of the expression used and run significantly further (19.9%) in the 12 minutes test than women. No statistical significant sex difference was obtained for running economy.

Although running economy was not significantly related to 12 minutes run performance (0.2%), it had a significant contribution to the prediction of the 12 minutes run when combined with percent body fat and Vo Max (ml min/kg).

Considering the magnitude of differences between men and women in the biological variables and their degree of relationship with the 12 minutes run, the finding that percent body fat explained the sex difference (45%) in the 12 minutes run is understandable. The greater difference in percent body fat between men and women is a determinant of the sex differences in performance, compared to differences that exists within the sexes.

2.5 Male and Female Response to Heat Stress

Recent studies suggested that there are few differences in men's response to heat stress when they are matched for Vo_2 Max. Emily and Haymes (1984) however, suggested that women sweat more than men during exercise. The greater relative dehydration in women reduces blood volume and puts a greater strain on the cardiovascular system than men's. When exercising in a hot, dry environment women were found to have higher rectal and skin temperatures and heart rate. Avellini et al (1980) Wells (1980) observed that women have higher skin temperature than men when exercising at the same percent of Vo_2Max outdoors in a desert environment. This is due to the larger females body surface area to weight ratio which makes them gain more heat from radiation.

Frye and Kaman (1981) found no such differences when exercising in an environmental chamber. The globe tempeature in the Well's study was 4^{o}C above the ambient temperature, which indicated that Solar radiation was an important factor affecting heat balance (bsa/wt surface area to weight ratio).

In a hot humit environment, Avellini et al (1980) found that sweat rate was suppressed more in women than in men at the first hour of exercise. Sweet gland suppression was thought to be related to skin wetness. No significant difference was found between the sexes in threshold for sweating. Studies by Shapiro et al (1980) also indicated no differences in rectal temperature or Heart Rate between the sexes. Acclimatization to hot, humid environment reduces rectal temperature and Heart Rate in both sexes.

2.6 Maximal Oxygen Consumption and Aerobic Work Capacity

High level of cardiorespiratory function indicates a high physical work capacity (PWC), the ability to release relatively large amounts of energy over an extended period of time. Haskell and Balair (1980) Pollock et al (1978) and Cooper (1976) stated that, a high PWC has numerous advantages for leisure and occupational pursuits. There is ample evidence that cardiorespiratory functions respond to training and that they can be validly assessed by field tests, Doraciak et al (1983) and katch et al (1983).

Although Vo_2Max has been described as important factor for predicting performance in middle and long distance running.

Astrand et al (1977), Saltin et al (1967), Sherpherd et al (1968) and Conley and Kranhanbuhl (1980) suggested that success in distance running may rely more on factors determing a good or poor utilization of Vo Max than on Vo max itself. Costill, (1967) and Wyndhan et al (1969) suggested other factors such as running economy (RE) and Ventilatory threshold (VT) as factors contributing to athlete's performance. It is also pointed out that the major performance differences between males and females lie in the extra fat carried by women which over tax their cardiorespiratory capacity more than men. Although some researchers, such as Asken and Ullyot (1980), argued that this can be of advantage to women when the activity is prolonged, other researchers like Fox and Wilmore (1977) and Cureton and Sparling (1981) suggested that the extra weight is a disadvantage to women.

In view of these findings, the present study investigated the cariorespiratory performance of athletes in different sports, using various timed runs. The performance differences of males and females in the same sport was also investigated.

2.7 Summary

It is clearly indicative from the review of previous studies that field tests are valid measures of cardiorespiratory fitness, and that the 12 minutes run is the most widely used fiend test of cardiorespiratory fitness or endurance in both adults and adolescents.

It is also pointed out that the major performance differences between males and females lies in the extra fat carried by women which over taxes their cardiorespiratory capacity more than men. Although some researchers, such as Aaken and Ullyot (1980), argued that this can be of advantage to women when the activity is prolonged, other researchers like Fox and Wilmore (1977) and Cureton and Sparling (1981) indicated that the extra weight is a disadvantage to women.

Chapter 3

3.0 METHODOLOGY

Since the purpose of this study was to evaluate the cardio-respiratory fitness performance of athletes in different sports, various field tests were selected and used to determine which of these tests (9 minutes, 12 minutes and 15 minutes) are better measures of cardiorespiratory performance of selected athletic groups. These tests were chosen because they appear to be valid. Katch et al (1973) reported that continuous running for a period of above five minutes was intensive enough for testing cardiovascular fitness. Dorociak et al (1983) also reported that covering a distance of either 1.6km or 3.2km was alright for cardio-vascular test.

3.1 Research Design

The design used in this study was the one case study design in which each subject performed only once (XO) in the three test times.

3.2 Subjects

The subjects for this study were healthy male and female athletes who have had a minimum of 6 weeks training in their chosen sports. The subjects were drawn from Ahmadu Bello

University teams that represented the University in the Nigerian Universities games (NUGA) in 1988 and those found to be active players. For each game, there were 60 subjects made up of 30 males and 30 females in each sports for a total of 180 subjects. All the subjects consented to serve as subjects in this study after necessary explanation was given before the tests were administered.

3.3 Variables Measured

In this study the variables measured were the distance covered by the subjects in the stipulated time period. Height, weight and percent body fat of each subject was also measured. The test items used were the 9 minutes, 12 minutes and 15 minutes run tests.

3.4 Measurement Procedure

The measurement procedure included asking the subjects to stand behind the starting line on the 400m track and on a command start running for either of the time duration stated. Distances covered were recorded to the nearest 1/10 of a meter. These were later converted to kilometer.

The procedure used for measuring the fat percent involved grasping with the thumb and forefinger a fold of skin and subcutaneous fat away from the underlying muscular tissue. The pincher arms of the caliper are then placed on the skinfold and the measure of its thickness read from the caliper. The measurements were taken on three sites: Chest, Abdominal and thigh for the male group, and the triceps, suprailac and thigh for the females.

3.5 Sequence and Time of Testing

The tests were administered within one week. The subjects were randomly assigned to each test item. The testing started as soon as the subjects chosed randomly, the test times of 9 minutes, 12 minites and 15 minutes time duration which were written on pieces of papers and squeezed so that they won't know which test item they are taking, such as the 15 minutes, followed by 12 minutes and then the 9 minutes or the other way round. The tests were administgred on different days.

3.31 Test Time

The tests were conducted in the evening 4-6 p.m. each day.

3.32 Warm-Up

The subjects were allowed 5 minutes to Warm-Up before the start of the test each day. They were free to engage in any type of exercise they desire. This was based on research findings that it is good for athletes to do some preliminary exercises prior to any strenuous physical activity. This prepares the athletes physiologically and psychologically, to face the task ahead.

3.4 Instrumentation

The instruments used in conducting this research were:

3.4.1 A Standard 400 Metre Track

This becomes important so that the number of Laps each subject covered was easily calculated and any extra distance which was not a complete lap was earsily determined in meters and added to establish the total distance covered.

3.4.2 Measuring Tape

A measuring Tape graduated in meters was used for measuring the distance covered which is not a complete lap, and the result added to the number of laps (which was already known to be 400 meters) and all were covered to kilometers.

3.4.3 A Whistle

This was used to start the races and to stop the subject at the expiration of the time. Each subject was instructed to stand where he/she was when the whistle was blown at the expiration of each time period.

3.4.4 Stop Watch

The Contandor Compteur stop watch was used in this study. This was used for recording the time. The watch was started as the wishtle is blown for the start of each test and stopped at the expiration of the time required.

3.4.5 Skinfold Calipers

The adipometer skinfold caliper was used. This was used to measure the subjects skinfold which was later used to determine the body fat percent of the athletes using Pollack et al (1980) table for estimating percent body fat in male and female from the sum of skinfold measured from three sites. Approximately one half of the body's total fat content is located in the subcutaneous tissue. (For and Mathews (1981). A method for measuring this fat has been developed which utilized an instrument known as a "skin fold caliper" Pollack (1980).

3.4.6 Weighing SCale/Height

The Shermond weighting machine was used. This was used to measure the weight and height of the subjects.

3.5 Test Conditions

The following conditions were followed throughout the test period.

3.5.1 Venue

The venue for the test was Ahmadu Bello University, Zaria main Campus athletic track field.

3.5.2 Attire

The subjects were required to wear proper sports attire for each test. The male subjects wore shorts and shirts, while female subjects had an alternative of using skirt to shorts. All the subjects used canvas shoes during the test.

3.5.3 Attendance

The subjects were required to be on the test venue 10 minutes before the start of the test.

3.6 Statistical Treatment

The data collected for this study were analysed statistically using arithmetic means (X), standard deviations (SD), One-way analysis of variance (ANOVA), Two-way analysis of variance (ANOVA II), Persons Product Moments (PPM) correlation coefficient (ppm) and t-test.

a) One-way analysis of variance was used to determine the significant differences within the sex groups in each sport in the performance in the three tests items.

b) Two-way analysis of variance was also used to determine the significant difference among the sex groups in different sports and males and females in the same sport.

c) Pearson Product Movement correlation coefficient (ppm) was used to test the relationships between certain independent variables, height, weight, age percent body fat and running performances. It was also used in testing the relationships between performance in the items of the athletic groups.

f) t-test was used to determine the significant differences between the male and female groups in certain independent variables and performance means.

A critical value of $P < 0.05$ was used to regret or accept the null hypotheses.

Chapter 4

4.1 RESULTS, ANALYSIS AND DISCUSSIONS

As stated earlier in previous chapters, the purpose of this study was to investigate the cardiorespiratory fitness of athletes in selected athletic groups, using field running tests of 9 minutes, 12 minutes and 15 minutes.

The data collected for this study were analysed using computer system at Institute of Agricultural Research (I.A.R.), Ahmadu Bello University, Zaria. This was carried out to test the significant differences among the scores of the groups. One-way analysis of variance (ANOVAI) was used in situation where there were more than two mean scores and two-way analysis of variance (ANOVA II) was used in situations where male and female mean scores were tested to determine the significance of main effect and probable interaction. The t-test was used to determine the significant differences between the mean scores of male and female groups.

Pearson product movement correlation (ppm) was used for establishing the extent of relationship among some physiological independent variables as age, weight, height and sex with the dependent variables to determine factors which could affect the perforamnce of ths athletes during the tests. The same method of

(PPM) was used to determine the extent of relationship of the performance scores of the different tests items between the groups and within the groups of the selected athletes. A critical value of $P < .05$ was used to evaluate the results.

As earlier stated (Chapter 3), 180 subjects participated in this study. The result showed that the average age of the females was 23.5 years while the males was 25.1 years. The average height of both sexes was 1.7 metres; the males was 1.79m while the females was 1.62m. The average weight of both sexes was 67.75kg. The males' was 70.9kg and the females 64.57kg. As regards present body fat, the groups mean was 15.7%, the females was 21.43% while the male was 10.13%. Their values showed that the male group was significantly order, taller and heavier but with less body fat percentage. Further t-test analysis (Table 4.1) indicated that on the average male subjects performed better than the females in all the 9 minutes, 12 minutes and 15 minutes runt ests ($P < 0.05$). ~~Table 4.1 should come immediately~~ after this.

4.2 Hypothesis One

There is no significant differences among the 9 minutes, 12 minutes and 15 minutes run tests as measures of cardiorespiratory fitness of athletes in selected sports.

Analysis of variance of the data revealed difference among the performance means of the 15, 12 and 9 minutes run test.

Analysis indicated that Basketball female group performed generally better in the 15, 12 and 9 minutes run test than Hockey and Volleyball female groups. However the Volleyball female group performed better than the Hockey female group in the three timed tests. The same observation was made in the male group. The Basketball males performed better on the average than the other groups in all the 15, 12 and 9 minutes run tests. The performance difference between the Hockey and Volleyball male groups in the 12 and 9 minutes tests was very insignificant ($P < 0.05$). They were 2.291km and 2.350km in the 12 minutes test and 1.942km and 1.963km in the 9 minutes test. On the basis of this analysis the Null hypothesis is rejected. ~~Table 4.2 and 4.3~~.

Table 4.1: Physical Characteristics and Performance Scores Between the Male and Female groups in distance running tests: (N = 180)

Variables		Male	Female	Sex	t
Age		25.10 yrs.	23.50 yrs.	0.229	6.99*
Height		1.79m	1.62m	0.006	23.33*
Weight		70.9m	64.57kg	0.561	11.28*
Percent body fat		10.13%	21.43%	0.212	53.30*
Performance:	9min	2.017km	1.562km	0.028	16.25*
	12min	2.505km	1.907km	0.029	20.62*
	15min	3.211km	2.334km	0.036	24.36*

df 178 $P < 0.05$ $t = 1.960$

*Significant at $P < 0.05$.

Table 4.2: ANOVA Table for Each Group in the 15 Minutes,

12 Minutes & 9 Minutes run: (N = 90 for each group)

Source	df	SS	MS	F
Female				
Runs	2	8.993	4.496	29.48*
Error	87	12.268	0.153	
Total	89	22.261		
Male				
Runs	2	21.609	10.805	65.61*
Error	67	14.328	0.165	
Total	89	53.937		

F2/89 $P < 0.05$ $F = 3.09$

*Significant at $P \leq 0.05$

Table 4.3: Mean Distances Covered and Standard Deviations per sex and athletic groups in the 15, 12 and 9 minutes runs: (N = 20 for each group)

Groups	Mean 15 Min.	SD	Mean 12 Min.	SD 9 Min.	Mean	SD
Female						
Basketball	2.502mk	0.436	2.070km	0.319	1.734km	0.277
Hockey	2.176km	0.323	1.773km	0.219	1.417km	0.193
Volleyball	2.326mk	0.506	1.876km	0.590	1.535km	0.382
Male						
Basketball	3.358km	0.537	2.674km	0.473	2.146km	0.325
Hockey	2.917km	0.422	2.291km	0.293	1.942km	0.277
Volleyball	3.157km	0.420	2.350km	0.253	1.963km	0.272

4.3 Hypothesis Two

There is no significant difference among the performance of male and female athletes of different sports in running tests of different time durations.

Using two-way analysis of variance (ANOVA II) to determine the main effect and interaction of sports on the performance results with sex groups showed that specificity exists in the use of the tests. Detailed results from Table 4.4 showed significant variations in timing which caused significant differences in distances cover by all the subject. But comparison within and between groups, using sport groups and sex type as independent variables in 9, 12, and 15 minutes durations, showed significant differences among the sports and time variations in running field tests. The null hypothesis is therefore rejected.

Table 4.4: Main Effect and Interaction of Sports on the Performance Level With Sex Groups:

(N = 90 per each group)

Source	df	SE	Ms	F
Male				
Sports	2	2.106	1.053	7.469*
Runs	2	21.609	10.805	76.631*
Interaction	4	0.771	0.193	1.369
Error	81	11.451	0.141	
Total	89	35.937		
Female				
Sports	2	1.493	0.747	5.15*
Runs	2	8.993	4.496	31.01*
Interaction	4	0.006	0.001	0.01
Error	81	11.769	0.145	.
Total	89	22.261		

F2/89 P < 0.6 P = 3.11

*Significant at P < 0.005.

Further analysis of the result indicated that significant differences were between Basketball, Hockey and Volleyball in the 9 minutes run test. For the male group Hockey and Volleyball showed no significant difference only the Basketball group showed significant difference in the 9 minutes. In the 12 minutes run test differences among the female existed between Basketball and Hockey group only. Hockey and Volleyball groups showed no significant difference and Basketball and Volleyball also showed no significant differences. For the 15 minutes run test, the female group showed no significant difference, while in the male group, significant difference existed between Basketball and Hockey, Basketball and Volleyball and between Hockey and Volleyball. For the female groups 9 minutes seems to be a less discriminating test item for cardiorespiratory fitness for all the groups. The test item that seem to be of sufficient duration to discriminate between the groups is the 15 minutes run test. For the male groups 9 minutes and 12 minutes seemed to be of sufficient duration which can discriminate the fitness level among the athletic groups, but the 15 minutes seem to be a more discriminating test item for the Basketball groups only.

General observation from this result suggested that the Basketball players require a longer time period to assess their cardiorespiratory fitness, while Volleyball and Hockey players require a shorter time. The suggestion is based on the distances covered in the time variation during the tests.

4.4 Hypothesis Three

Height and weight have no significant correlation with performance in distance running test.

Pearson product moment correlation coefficient (ppm) was calculated to determine the extent of relationship between physiological independent variables of age, height, weight and percent body fat on the performance of the athletes in the timed run tests and also the extent of relationship between the performances in the run tests for each athletic group per sex.

The analysis (Table 4.5) showed that the female athletes age has significant negative relationship with height and percent body fat with weight. In the males on the other hand there was significant relationship between weight and height, percent body fat and height. The relationship between age and height for the female, percent body fat and height for the male athletes were however negative. The relationship between height and performance was found to be significant ($P < 0.05$) for the male group, while it was insignificant for the female group. Weight was found to have no significant correlation with performance for the both groups.

Table 5: Inter-correlations matrix among age, height, weight, and percents body fat and performance levels

Groups	Age	Height	Weight	Percent Body Fat	Performance
<u>Female</u>					
Age	1.00				
Height	-0.471	1.00			
Weight	0.256	0.169	1.00		
Percent body fat	0.283	-0.031	0.656*	1.00	
Performance	-0.235	-0.007	-0.233	-0.351	1.00
<u>Males</u>					
Age	1.00				
Height	-0.111	1.00			
Weight	0.011	0.590*	1.00		
Percent body fat	-0.119	-0.640*	-0.137*	1.00	
Performance	-0.059	0.424*	0.234	-0.523*	1.00

df. 178 $P < 0.05$ $r = 0.3889$

*Significant ($P < .05$).

4.5 Hypothesis Four

There is no significant relationship between performance in 9, 12, and 15 minutes run tests.

The results (Table 4.4) showed significant relationships between the three timed run tests. But the relationship between performances in the 9 and 12 minutes run test and 12 minutes and 15 minutes for the Basketball male groups were insignificant. The correlations between 9 and 12 minutes and 9 and 15 minutes for the Volleyball male group was also found to be insignificant ($P < 0.05$). Based on the significance of the relationship between the test items,t henull hypothesis is rejected.

From the results, it is important to recognize that time variation during the distance running tests is sport specific probably with the level of involvement. The more trained the athletes such as the Basketball group the longer the duration of the test, but with the other groups as Volleyball players the same can be assessed within a shorter period. This is in agreement with Katch et al (1973) who reported that continuous running for a period of above five minutes was intensive enough for testing cardiovascular function.

Table 4.6: Correlations of the performance level with test durations (15 minutes, 12 minutes and 9 minutes Per sex and sport groups: (N = 30)

Groups	Time	15 Min.	12 Min.
<u>Female</u>	12 min.	0.939*	0.905*
Basketball	9 min.	0.741*	0.905*
Hockey	12 min.	0.816*	
	9 min.	0.536*	0.772*
Volleyball	12 min.	0.016*	
	9 min.	0.960*	0.887*
<u>Male</u>			
Basketball	12 min.	0.392*	
	9 min.	0.271	0.072
Volleyball	12 min.	0.556*	
	9 min.	0.351	0.184*

df. 28 $P < 0.08$ $r = 0.361$

*Significant at $P < 0.05$

4.6 Discussion

The primary purpose of this study was to measure the cardiorspiratory fitness of some selected athletic groups, using field tests of 9, 12 and 15 minutes, duration. In the cause of the study, attempts were made to measure the relationship of certain independent variables like height, weight, age and percent body fat with the performance of the athletes in the different timed run tests.

From the results of this study, it was observed that simple field tests of different duration of time could be used to measure the cardiorespiratory fitness of athletes from different sports.

Cardioresporatory fitness which is one of the major components of health related physical fitness measured in this study has always been used to estimate maximal oxygen consumption. A correlation as high as .91 was reported (Burks 1976) between 12 minute run test and Vo_2Max.

In measurement of cardiorespiratory fitness, sex, as an independent variable, was found to be an important factor affecting the performance of athletes in 15, 12 and 9 minutes run tests. The male subjects performed better than the female subjects within the same sport in all the different time durations used in this study. The finding in this study agreed with previous studies (Chado 1980), Keong 1981 and Gwani 1986) in the distances covered by the subjects in the 12 minutes run test. The results of this study also indicated that male subjects performed better than their female counterparts in all the test duration. This result agrees with previous studies. The American Association of Health, Physical Education, Recreation and Dance (AAPERD 1980) reported 2.4km for boys as a mean distance and 1.70km for the female groups in the 12 minutes tests.

Chado (1986) reported a mean distance of 2.12km for females and 2.62km for males seeking admission for diploma course in the Department of Physical and Health Education in Ahmadu Bello University, Zaria, and a distance of 1.97km and 2.62km for female and male candidates seeking undergraduate admissions respectively in the 12 minutes run test.

It is also found out from this study that the sport the athletes participates in is an important factor in the running field tests of different duration of time. Basketballers, both males and females performed generally better than their counterparts in Hockey and Volleyball and were found to be more trained.

This may not be too surprising when one looks at what are involved physiologically during the games. As Basketball game is very tough and very challenging, it requires the players to be up and down the court throughout the 20 minutes duration unless he/she is substituted. While Volleyball is nowadays played vigorously, the time lapse between players in playing the ball serves as a relief. Similarly Hookey is played in positions

(1989) who reported a negative correlation between height and distance covered in a modified 6 and 12 minutes run tests. But it must be understood that his samples involved both trained and untrained subjects in which case the untrained subjects might lack the technique in distance running.

This study looked at the extent of relationship betwen the performance levels of the selected athletes in different athletic groups, and the results indicated high correlation between distances covered with the given time variation during the tests. Some correlations were significant ($P \leq 0.05$) while some were not. The implication of these are that the test durations can be used specifically to particular athletic group or groups but not adequate for other sport group. As earlier discussed, for example, there was significant relationship between performances in the 12 and 15 minutes run tests of female Basketball group ($r = 0.939$). From this study, the extent of relationships between the perforamances as regards cardiorespistory fitness in the timed run tests suggests that 12 and 15 minutes run tests can serve as test item for female Basketballers, the three tests can be used for female Volleyballers. Among the male group, Basketballers showed no specificity to any test duration. The 9 minutes and 12 minutes run tests can serve as test items for Hockey and Volleyball groups. The extent of relationship of performance as regards the timed runs reported in the study is supporting the finding of Gwani, (1987) Jonathan, (1988) who used the 6 minutes, 9 minutes, 12 minutes and 15 minutes to assess cardiorespiratory fitness and found them useful. Earlier Custer et al (1977) used the 6 minutes and 12 minutes tun test and reported no significant differences between the two time variations in assessing cardiorespiratory fitness. Other studies which correlated maximal oxygen consumption with 9 minutes and 12 minutes (Jackson and Coleman (1979) reported similarly high correlation. Burke (1976) used some selected laboratory test and the 12 minutes and reported a high correlation coefficient of 0.91 ($P < 0.05$).

5.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

This study measured the cardiorespiratory fitness of athletes in different sports using timed runs of 15 minutes, 12 minutes and 9 minutes. In the process of the investigation, performance in these field tests were related to such independent varibles of height, weight, percent body fat, the type of sport and sex. The distances covered within the three timed periods were also correlated to determine the relationship between the performance of the athletes in the three different types of tests.

The subjects for this study were 180 Basketball, Hockey and Volleyball players, with an equal number of males and females. Before the tests were administered, weight, height, age and percent body fat measurements were taken on each subject. The result indicated significant differences among the test terms and sport groups. Significant differences was also found between males, femalels groups and within the sex groups.

Measurements on appropriate body sites were taken using skinfold calipers.

5.2 Conclusions

From the results of the tested hypotheses, the following conclusions were made:

1. That among the test items used not all can effectively discriminate the cardiorespiratory fitness level of each group of athletes. While the 15 minutes was found to be of sufficient duration to discriminate the cardiorespiratory fitness level of Basketball players, the same time duration may be too long for Volleyball and Hockey players.
2. The performance of the three sport groups indicated that the Basketball groups, both males and females performed better in the three test items, followdd by Volleyball and Hockey groups.
3. That the male subjects performed better than their femal counterparts in all the test duration.
4. That sex and the type of sport one participates in, affects the distance he or she could cover in a specified time period. Therefore in chosing a test item of specified time duration for athletes in the same sport that involves both males females, sex difference must be considered.
5. That high correlations exist between the performance of some group of athletes with the test items used more than others.
6. That height and percent body fat are important factors that affected the distances covered in the timed runs. This was

observed of the male groups who were taller but with less body fat, and covered more distances in the time durations. Height correlated positively with performance $r = 0.424$. Surprising the female groups did not show any significant relationship between performance and these independent variable.

5.3 Recommendations

Based on the results of this study, the following recommendations were made:

1. Coaches should select field tests of different running time variation which are of sufficient duration to effectively measure the cardiorespiratory fitness of their athletes.
2. More studies should be conducted to compare these tests with different sport groups particularly in laboratory setting where maximal oxygen consumption of the athletes can be obtained during exhaustive submaximal exercise.
3. Efforts should be made to develop standard procedures for assessing fitness in Nigerian population. Standards should also be developed for Nigerian population against which test results, can be evaluated. The standard against which we evaluate ourselves were developed for a different population and it most cases they under estimate or over estimate certain values we obtain during a test.
4. Those in the area of physical education should work hand in hand with other health related personnels so as to develop

sound programs of physical fitness development and evaluation for Nigerian Citizens.

5. Government and private individuals should work hand in hand in setting up physical fitness centres in all the state capitals in this country.

6. There is a need for wider publicity on the importance of physical fitness development and maitnenance in Nigeria.

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APPENDIX A: INFORMED CONSENT FORM FOR PARTICIPATION

Informed Consent for Participation in Exercise Testing for Research Purpose

I, ..., have voluntarily consented to participate in the exercise testing for determing my cardiorespiratory fitness performance.

It is my understanding that I will participate in field tests that involve continuous running or walking for a period of 15, 12 and 9 minutes respectively on different dates.

I am also aware that certain changes may occur during the process of the test. These changes may include increased Heart-Rate, blood pressure, and in rare cases "Chest pain" and I am satisfied that expert hands are avilable to observe and immediately stop further participation at the slightest sign of abnormality considered detrimental to my health.

The major purpose of this research is to assess the cariorespiratory fitness performance of the athletes in different sports which will facilitate the reliable selection of test items for each athletes based on their chosen sport.

I understand that I can stop participation at my discretion.

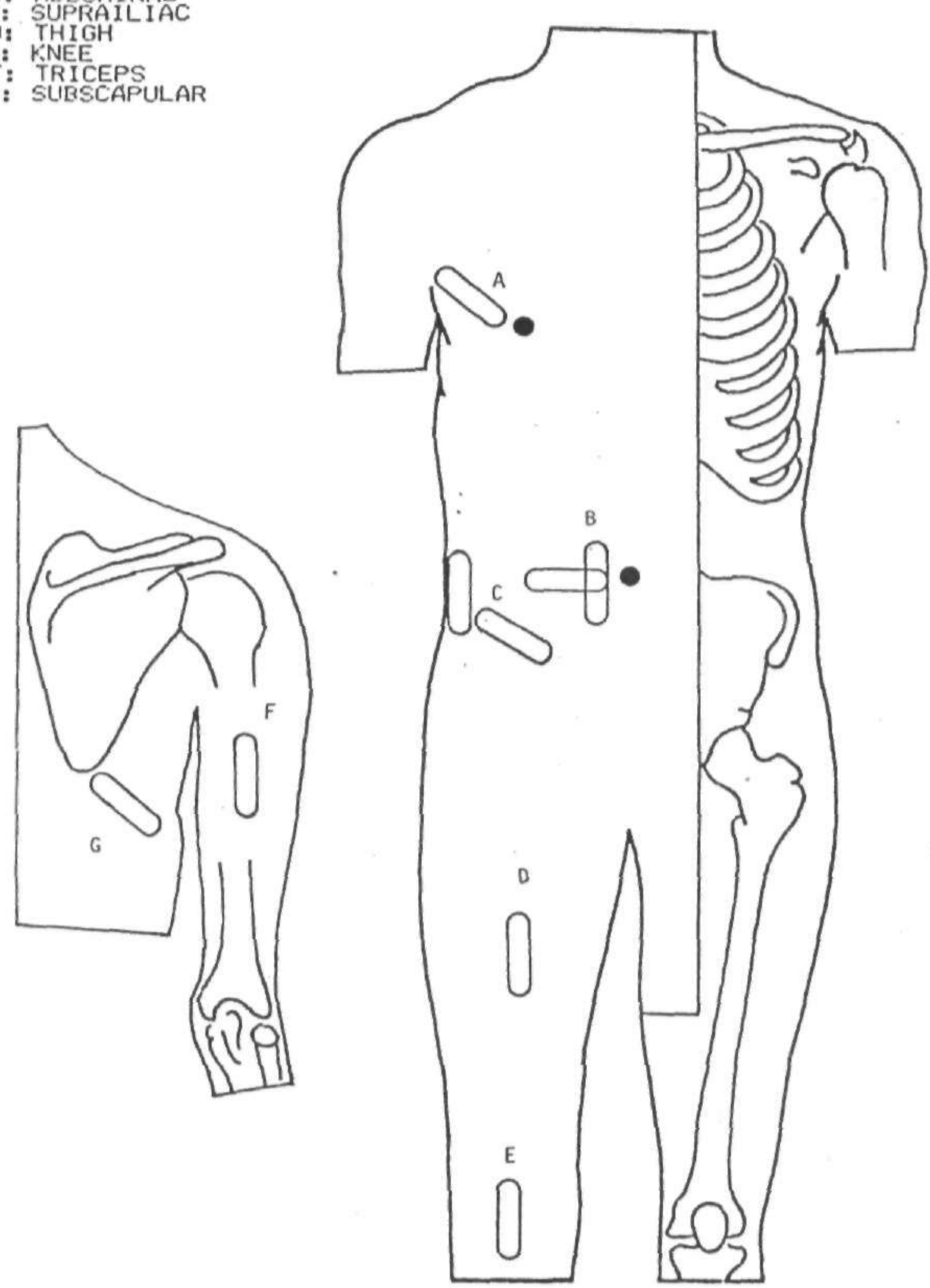
Sign:..................   Witness:..................

Date:..................

APPENDIX B: COMMON SITES FOR MEASURING SKINGOLD THICKNESS

COMMON SITES FOR MEASURING SKINFOLD THICKNESS.

A: PECTORAL (CHEST)
B: ABDOMINAL
C: SUPRAILIAC
D: THIGH
E: KNEE
F: TRICEPS
G: SUBSCAPULAR



APPENDIX C: CONVERSION TABLE OF SUM OF SKINFOLD TO % BODY FAT

2. TABLE FOR ESTIMATING PERCENT BODY FAT IN FEMALES.

POLLACK, M.L., D.H. SCHMIDT, AND A.S. JACKSON. MEASUREMENT OF CARDIORESPIRATORY FITNESS AND BODY COMPOSITION IN THE CLINICAL SETTING. COMPREHENSIVE THERAPY 6(9): 12-27, 1980.

SUM OF TRICEPS, SUPRAILIAC, AND THIGH SKINFOLDS.

♀

	Age to the Last Year								
Sum of Skinfolds (mm)	Under 22	23 to 27	28 to 32	33 to 37	38 to 42	43 to 47	48 to 52	53 to 57	Over 58
23-25	9.7	9.9	10.2	10.4	10.7	10.9	11.2	11.4	11.7
26-28	11.0	11.2	11.5	11.7	12.0	12.3	12.5	12.7	13.0
29-31	12.3	12.5	12.8	13.0	13.3	13.5	13.8	14.0	14.3
32-34	13.6	13.8	14.0	14.3	14.5	14.8	15.0	15.3	15.5
35-37	14.8	15.0	15.3	15.5	15.8	16.0	16.3	16.5	16.8
38-40	16.0	16.3	16.5	16.7	17.0	17.2	17.5	17.7	18.0
41-43	17.2	17.4	17.7	17.9	18.2	18.4	18.7	18.9	19.2
44-46	18.3	18.6	18.8	19.1	19.3	19.6	19.8	20.1	20.3
47-49	19.5	19.7	20.0	20.2	20.5	20.7	21.0	21.2	21.5
50-52	20.6	20.8	21.1	21.3	21.6	21.8	22.1	22.3	22.6
53-55	21.7	21.9	22.1	22.4	22.6	22.9	23.1	23.4	23.6
56-58	22.7	23.0	23.2	23.4	23.7	23.9	24.2	24.4	24.[illegible]
59-61	23.7	24.0	24.2	24.5	24.7	25.0	25.2	25.5	25.7
62-64	24.7	25.0	25.2	25.5	35.7	26.0	26.7	25.4	26.7
65-67	25.7	25.9	26.2	26.4	26.7	26.9	27.2	27.4	27.7
68-70	26.6	26.9	27.1	27.4	27.6	27.9	28.1	28.4	28.6
71-73	27.5	27.8	28.0	28.3	28.5	28.8	28.0	29.3	29.5
74-76	28.4	28.7	28.9	29.2	29.4	29.7	29.9	30.2	30.4
77-79	29.3	29.5	29.8	30.0	30.3	30.5	30.8	31.0	31.3
80-82	30.1	30.4	30.6	30.9	31.1	31.4	31.6	31.9	32.1
83-85	30.9	31.2	31.4	31.7	31.9	32.2	32.4	32.7	32.9
86-88	31.7	32.0	32.2	32.5	32.7	32.9	33.2	33.4	33.7
89-91	32.5	32.7	33.0	33.2	33.5	33.7	33.9	34.2	34.4
92-94	33.2	33.4	33.7	33.9	34.2	34.4	34.7	34.9	35.2
95-97	33.9	34.1	34.4	34.6	34.9	35.1	35.4	35.6	35.9
98-100	34.6	34.8	35.1	35.3	35.5	35.8	36.0	36.3	36.5
101-103	35.3	35.4	35.7	35.9	36.2	36.4	36.7	36.9	37.2
104-106	35.8	36.1	36.3	36.6	36.8	37.1	37.3	37.5	37.8
107-109	36.4	36.7	36.9	37.1	37.4	37.6	37.9	38.1	38.4
110-112	37.0	37.2	37.5	37.7	38.0	38.2	38.5	38.7	38.9
113-115	37.5	37.8	38.0	38.2	38.5	38.7	39.0	39.2	39.5
116-118	38.0	38.3	38.5	38.8	39.0	39.3	39.5	39.7	40.0
119-121	38.5	38.7	39.0	39.2	39.5	39.7	40.0	40.2	40.5
122-124	39.0	39.2	39.4	39.7	39.9	40.2	40.4	40.7	40.9
125-127	39.4	39.6	39.9	40.1	40.4	40.6	40.9	41.1	41.4
128-130	39.8	40.0	40.3	40.5	40.8	41.0	41.3	41.5	41.8

1. TABLE FOR ESTIMATING PERCENT BODY FAT IN MALES.

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SUM OF CHEST, ABDOMINAL, AND THIGH SKINFOLDS. ♂

	Age to the Last Year								
Sum of Skin Folds (mm)	Under 22	23 to 27	28 to 32	33 to 37	38 to 42	43 to 47	48 to 52	53 to 57	Over 58
8-10	1.3	1.8	2.3	2.9	3.4	3.9	4.5	5.0	5.5
11-13	2.2	2.8	3.3	3.9	4.4	4.9	5.5	6.0	6.5
14-16	3.2	3.8	4.3	4.8	5.4	5.9	6.4	7.0	7.5
17-19	4.2	4.7	5.3	5.8	6.3	6.9	7.4	8.0	8.5
20-22	5.1	5.7	6.2	6.8	7.3	7.9	8.4	8.9	9.5
23-25	6.1	6.6	7.2	7.7	8.3	8.8	9.4	9.9	10.5
26-28	7.0	7.6	8.1	8.7	9.2	9.8	10.3	10.9	11.4
29-31	8.0	8.5	9.1	9.6	10.2	10.7	11.3	11.8	12.4
32-34	8.9	9.4	10.0	10.5	11.1	11.6	12.2	12.8	13.3
35-37	9.8	10.4	10.9	11.5	12.0	12.6	13.1	13.7	14.3
38-40	10.7	11.3	11.8	12.4	12.9	13.5	14.1	14.6	15.2
41-43	11.6	12.2	12.7	13.3	13.8	14.4	15.0	15.5	16.1
44-46	12.5	13.1	13.6	14.2	14.7	15.3	15.9	16.4	17.0
47-49	13.4	13.9	14.5	15.1	15.6	16.2	16.8	17.3	17.9
50-52	14.3	14.8	15.4	15.9	16.5	17.1	17.6	18.2	18.8
53-55	15.1	15.7	16.2	16.8	17.4	17.9	18.5	18.1	19.7
56-58	16.0	16.5	17.1	17.7	18.2	18.8	19.4	20.0	20.5
59-61	16.9	17.4	17.9	18.5	19.1	19.7	20.2	20.8	21.4
62-64	17.6	18.2	18.8	19.4	19.9	20.5	21.1	21.7	22.2
65-67	18.5	19.0	19.6	20.2	20.8	21.3	21.9	22.5	23.1
68-70	19.3	19.9	20.4	21.0	21.6	22.2	22.7	23.3	23.9
71-73	20.1	20.7	21.2	21.8	22.4	23.0	23.6	24.1	24.7
74-76	20.9	21.5	22.0	22.6	23.2	23.8	24.4	25.0	25.5
77-79	21.7	22.2	22.8	23.4	24.0	24.6	25.2	25.8	26.3
80-82	22.4	23.0	23.6	24.2	24.8	25.4	25.9	26.5	27.1
83-85	23.2	23.8	24.4	25.0	25.5	26.1	26.7	27.3	27.9
86-88	24.0	24.5	25.1	25.7	26.3	26.9	27.5	28.1	28.7
89-91	24.7	25.3	25.9	25.5	27.1	27.6	28.2	28.8	29.4
92-94	25.4	26.0	26.6	27.2	27.8	28.4	29.0	29.6	30.2
92-97	26.1	16.7	27.3	27.9	28.5	29.1	29.7	30.3	30.9
98-100	26.9	27.4	28.0	28.6	29.2	29.8	30.4	31.0	31.6
101-103	27.5	28.1	28.7	29.3	29.9	30.5	31.1	31.7	32.3
104-106	28.2	28.8	29.4	30.0	30.6	31.2	31.8	32.4	33.0
107-109	28.9	29.5	30.1	30.7	31.3	31.9	32.5	33.1	33.7
110-112	29.6	30.2	30.8	31.4	32.0	32.6	33.2	33.8	34.4
113-115	30.2	30.8	31.4	32.0	32.6	33.2	33.8	34.5	35.1
116-118	30.9	31.5	32.1	32.7	33.3	33.9	34.5	35.1	35.7
119-121	31.5	32.1	32.7	33.3	33.9	34.5	35.1	35.7	36.4
122-124	32.1	32.7	33.3	33.9	34.5	35.1	35.8	36.4	37.0
125-127	32.7	33.3	33.9	34.5	35.1	35.8	36.4	37.0	37.6

APPENDIX D: RECORDING FORM FOR THE PERSONAL DATA AND PERFORMANCE

RECORDING FORM FOR PERSONAL PARTICULARS OF SUBJECTS AND PERFORMANCE IN THE TIMED RUNS

S. No.	AGE	HEIGHT	Wt (Kg)	Sum of Skinfold	Performance in the timed runs		
					15 min.	12 min.	9 min.