EFFECT OF AEROBIC EXERCISE ON CARDIORESPIRATORY FUNCTIONS OF PRIMARY SCHOOL PUPILS IN IBADAN NORTH-EAST LOCAL GOVERNMENT AREA, OYO STATE, NIGERIA

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CERTIFICATION

I hereby certify that this study was carried out by **ADAMU EMMANUEL IYANDA** in the Department of Human Kinetic and Health Education, University of Ibadan, Oyo State, Nigeria.

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DEDICATION

This work is dedicated to God the Father, The Son and God the Holy Spirit

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ABSTRACT

Positive health and wellness across all ages have been associated with regular participation in aerobic activities. Studies have been carried out on aerobic exercise, but not much has been documented on the effect of this exercise on the cardiorespiratory functions of Nigerian children. Hence, this study investigates the effect of aerobic exercise on Forced Vital Capacity (FVC), Forced Expiratory Volume (FEV_1), Peak Expiratory Flow Rate (PEFR), Resting Heart Rate (RHR), Resting Systolic Blood Pressure RSBP), Resting Diastolic Blood Pressure (RDBP) and Maximum oxygen uptake (VO_2Max) among primary school pupils in Ibadan North East Area of Oyo State.

Pretest-posttest control group experimental design was adopted. The purposive sampling technique was used to select 128 pupils from public and private schools in Ibadan. The participants were randomly assigned into experimental and control groups. The experimental group engaged in aerobic exercises such as brisk-walking, running on the spot, cycling in the air, rope-skipping, hopping and bench stepping activities while the control group did only flexibility exercises. The research instruments used were standard stadiometer, (r=0.99), weighing scale (r=0.99), computerised spirometer (r=0.99) and Mini Wright peak flow Meter (r=0.99). Three research questions were answered and six hypotheses tested at 0.05 level of significance. Mean, standard deviation, paired t-test and analysis of covariance were employed for data analysis.

There was a significant difference between experimental and control groups in FVC ($F_{(4,123)}$=3.122; P<0.05) and VO_2max ($F_{(4,123)}$=4.740, P<0.05). There were significant differences between public and private schools with FVC (t=2.09; df=127; P<0.05), FEV_1 (t=10.06, df=127; P<0.05), PEFR (t=12.7; df=127; P<0.05), SBP (t=12.93; df=127; P<0.05), and HR (t=2.60; df=127; P<0.05). Significant sex differences were recorded on FVC (t=2.36; df=63; P<0.05), PEFR (t=4.26; df=63; P<0.05), SBP (t=5.40; df=63; P<0.05), and DBP (t=3.8; df=63; P<0.05). Though, the results imply that children have more tendencies for cardiorespiratory adaptation and improvement, private school pupils have better responses to exercise training than their counterparts in public schools. Furthermore, it is also significant when the participants were exposed along gender basis (P<0.05) with FVC of female (t=2.36; df=63; p<0.05) ($\bar{X}$=1.53) better than the males counterparts ($\bar{X}$=0.93). This implies that the female participants had better respiratory adaptations than their male counterparts during aerobic training
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Aerobic exercise training has positive effects on cardiorespiratory functions. Therefore, professionals and stakeholders should ensure that children are well conditioned during training and also increase their physical activity levels for regular participation in aerobic activities to enhance positive health and wellness that reflects these cardiorespiratory indices (FVC, FEV_1, PEFR, RHR, RSBP, RDBP & VO_2max).

Keywords: Aerobic exercise, Cardiorespiratory function, Health and wellness, Primary school pupils, Ibadan North East Local government.

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CHAPTER ONE

Introduction

Background to the Study

In the past two decades, the world has witnessed a phenomenal growth in interest and participation in various forms of activities. People have come to appreciate the importance of exercise in the promotion of respiratory and cardiovascular functions, physical fitness and general well being of participants. Research scholars have variously submitted that the overall functioning of body organs have been found to be more effective. Similarly, exercise has been proven to help ligaments to maintain power and durability and without exercise they can loosen up. Other studies have also shown that exercise needs sufficient duration and intensity to produce physiological effect. (Ortega, Ruiz, Castillo & Sjstrom 2007, Amao 2007, Harms, wetter croix, Pagelow & Dempsey 2000, Summerfield 2006, Janz et al, 2000, Geiser et al 2001) WHO (2006) also affirms that regular exercise training retains body potency and reduces the loss of muscle mass and strength.

Concern grows that the current dramatic rise of obesity among children and adolescents portrays a future wave of increasing cardiovascular disease as these overweight young children reach the adult years (Olshansky, et al, 2005). Although disputed by Gibbs (2005), the reality of this scenario appears self – evident. Childhood obesity is highly predictive of adult obesity, and among adults, excessive body fats carries manifold risk for morbidity and premature death from coronary artery disease, hypertension, stroke and renal vascular diseases, as well as a host of non –circulatory disorders (type 2 diabetes, asthma, arthritis, certain neoplasms) (Hambody, 2003).

There is evidence that cardiovascular exercise such as walking, biking or swimming improves fitness by increasing endurance, strength, muscle tone, metabolism and flexibility William Katch & Katch (2004). It also improves cholesterol measure, blood pressure reading and mental functioning thereby decreasing resting heart rate and also help control body weight. Individuals who regularly do cardiovascular exercise face a lower risk of developing heart diseases, diabetes, colon and breast cancer.

Scores of aerobic exercise tests have been interpreted as indicators of cardio-respiratory endurance or cardiovascular efficiency, implying that individual differences in response to aerobic exercise predominantly reflects variations in cardio respiratory function. (Di Nallo, Jackson & Mahar, 2000, Amigo, Bustos, Era Bo Quimsille & Silva, 2007). In a study conducted by Amigo et al (2007), it was found that body weight indicates the amount of load the body is ladened with during exercise, even with children a lot of quick and fast movement is definitely hindered by excessive body weight. The only problem that might be envisaged for such children in training is that they tire easily as they burn more energy than average weight participants who carry the same action or skill.

Pulmonary ventilation is the amount of air which is exhaled per minute, and it is regulated so as to provide the gaseous exchange required for aerobic energy metabolism. Koenig (2001) observed that ventilation is usually affected at all stages of exercise. According to him, before exercise commences, it has been noticed that there is a slight increase in ventilation. This increase is referred to as the anticipatory rise, since it is the anticipation of the ensuring exercise. He further pointed out that when exercise begins, there is an immediate large increase in ventilation. After several minutes of sub-maximal exercise, ventilation continues to rise, but at a much slower rate.

Research studies by Wessendorf, Tescheler, Wang, Konietzko and Thilman (2000) substantiated that the amount of inhaled and exhaled air is usually not equal, since the volume of inspired oxygen in most situations is larger than the volume of carbon dioxide expelled. They further said that ventilation increases during exercise and this increase is proportional to the increase in workload. Another study by Koenig (2000) has shown that from a resting value of about 6.0 liters per minute, ventilation during exercise is semi-linear with a relatively greater increase with heavier workloads.

Other researchers have equally reported that respiration is related to oxygen consumption during exercise progressive intensity. Ventilation increases in proportion to the increase in oxygen consumption (VO_2) up to about 60% of maximum oxygen consumption (max VO_2), after which ventilation increases at a relatively higher rate that is affected by increases in depth and frequency of breathing (Carter et al, 2000). Different respiratory parameters in the assessment of children respiratory functions have been used and some of these include forced vital capacity (FVC), forced expiratory volume in 1^{st} second (FEV_1) and peak expiratory flow rate (PEFR) respectively (Kambe et al, 1999).

According to Baumgartner & Jackson (1999); Honig, Connect, Gayeski (1992) and Ross, Freeman & Jansen (2000). A number of workers have demonstrated that aerobic capacity of children is highly predictable from anthropometric measurements and different measuring instruments are used to enhance the procedures for measuring body composition. These are the body displacement method, the underwater weighing technique and the anthropometric measurement.

Blood pressure refers to the force by which the blood exerts against the walls of the vessels in which it is contained (Kelly & Kelly, 2000). It is this pressure that moves the blood through the circulatory system. According to them, blood pressure rises considerably during exercise as a result of cardiac output and nervous influences which affect systolic pressure more than diastolic pressure. Research evidence by Markoff and Schonfield (2004) reveals that the rise in blood pressure with exercise depends on the type and intensity of exercise. Isometric exercise brings about higher rise in blood pressure than dynamic exercise. According to them, high intensity exercise has higher exercise effect than low intensity exercise. Blood pressure is measured in millimeters of mercury (mmHg) with the arterial blood pressure expressed as the systolic value over the diastolic value.

Heart rate is the number of ventricular beats per minute (bpm) and it can be determined easily by auscultation with a stethoscope or by palpation over the heart, both during rest and exercise (ACSM, 2000). Fredson and Miller (2000) observed that heart rate increases during exercise, the increase being proportional to, but not maximal to the intensity of the exercise work load. This view is supported by Hands, Parker and Larkins (2006) when they stated that the slope of this linear relationship varies from children to children depending upon the children's fitness levels.

Tipton and Sander (2004) and Epstein, Paluch, Kalakanis, Godfield Carroy & Roemmich (2001) found that the heart rate is also related to metabolic rate usually measured as oxygen consumptions during exercise. Different respiratory parameters in the assessment of children respiratory functions have been used and some of these include forced vital capacity (FVC), forced expiratory volume in 1 second (FEV_1) and peak expiratory flow rate (PEFR) (Orie, 1999; Lee and Shy 1999, Jaja & Fagbenro 1995; Quadrellie, et al 1999 & Kambe et al 1999). Many studies have been carried out on motor performance in the developed countries, but few were documented on cardio respiratory fitness in children population. There is a paucity of literature on effect of aerobic exercise training on cardiorespiratory fitness in children population. This study therefore intends to examine the effects of aerobic exercise on cardio-respiratory functions of primary school pupils in Ibadan North-East Local Government Area of Oyo State, Nigeria.

Statement of the Problem

Aerobic exercise is any activity which uses large muscle groups that can be maintained continuously and is rhythmic in nature. Subsequently, active performance of aerobic exercise overlaps the heart and lungs and causes them to work harder than at rest. Research studies have also shown strong and convincing evidence that improved levels of physical activity can increase the work load on respiratory muscle of children. Promotion of cardio-respiratory functions and cardiovascular functions, physical fitness and general well being and overall functioning of body organs have been linked to active aerobic performance (Van-sluijs, McMinn & Ariffin 2007, APARCYP 2006).

In developing countries, it is still doubtful that adequate attention has not been given to the need for aerobic exercise among primary pupils especially considering its important preventive role in sedentary lifestyle and various hypokinetic diseases. Many researchers reported that children hardly engage in aerobic exercises but choose sedentary activities over physical activity due to lack of opportunity and self motivation in physical activity (Epstein, Roemmich, Pauluch and Rayon, 2005). This lack of physical activity enhances sedentary behaviour which increases the risk of overweight and obesity in the developing countries. Developing countries in particular (including Nigeria), have been observed to be shifting towards physical inactivity which is detrimental to health among young people thereby promoting sedentary lifestyle.

Physical inactivity has been defined as not obtaining at least 60 minutes of physical activity per day for at least five days per week. Physical inactivity is generally considered to be one of the cornerstones of pediatric obesity treatment (Hirasing, Fredricks, Buren, Vanhorick and Wit, 2001). It is unclear how successful effort have been to increase the activity levels of young people. However, recent researches have established that involvement in aerobic exercise can serve as a way to help children develop the knowledge about required confidence to adapt and maintain physically active lifestyles. Insufficient physical activity is a risk factor for persons being overweight or obese for having many related chronic diseases.

In Nigeria there seems to be a paucity of data about childhood obesity, however, in a study carried out in some selected nations across four WHO regions, two-third of the primary school pupils who were enmeshed in the highest level of inactivity are in Egypt (90.8-94.8%), and the lowest in China (70.9-73.9%). The prevalence of not walking or riding a bicycle to school ranged from (66-22.9%) in Cayman Islands. Over one –third of children spent three or more hours per day on sedentary activities, excluding the hours spent sitting at school and at home doing home work (WHO Global School Health Services, 2005). This finding shows that children and young adults are a vulnerable group and their sedentary lifestyles have to be corrected with immediate action to save our future generation. Thus, efforts should be made to increase levels of physical activities among primary school pupils.

Although decline of physical activity in middle school years has been evident, carefully designed research can assist teachers/physical educators to develop strategies that will reverse this trend and create a culture that values physical activity and realizes its full benefit.

The study therefore examined the effect of aerobic exercise on the selected Cardio respiratory functions before and after training on the population of primary school pupils.

The Objective of the Study

The main objective of the study is to investigate how effective the use of aerobic exercise at different levels will enhance the cardiorespiratory function indices (FVC, FEV, PEFR, HR, SBP, DBP and VO_2max and selected physical characteristics of the primary school pupils in Ibadan.

Specific objective

To examine the effect of aerobic exercise on: (i) Forced Vital Capacity (FVC),

(ii) Forced expiratory volume in 1st second

(iii) Peak expiratory flow-rate

(iv) Systolic and diastolic blood pressure

(v) Heart rate

(vi) aerobic capacity

(vii) Physical characteristics of the primary school pupils

To observe whether the selected six aerobic exercise levels (brisk-walking, rope-skipping, Bench-stepping, running on the spot, Hooping and cycling in the air) can prove to be effective on the designed training programme of 48 mins per session excluding warm up and warm down to enhance adequate improvements on their cardiorespiratory function indices as to recommend it for adoption on the governmental policy of the Nigerian primary school physical education programme.

Research Questions

The following research question were answered

1. Will there be any difference in the pre-test posttest selected cardio-respiratory function indices (FVC, FEV_1, PEFR, RSBP, RDBP, RHR and VO_2 max) of primary school pupils based on gender?
2. Will there be any difference in the pretest-posttest selected cardio-respiratory function indices (FVC, FEV_1, PEFR, RSBP, RDBP, RHR and VO_2 max) of primary school student's athletes based on type of school?
3. Will there be any difference in the pretest-posttest selected cardio-respiratory function indices (FVC, FEV_1, PEFR, RSBP, RDBP, RHR and VO_2 max) of primary school student's athletes based on type of groups.
4. What is the level of respiratory indices (Forced Vital Capacity, forced expiratory volume in 1st second and Peak expiratory flow rate) of participants for the study?
5. What is the level of cardiovascular indices (Resting Systolic Blood Pressure, Resting Diastolic Blood Pressure, Heart-rate and Maximum Oxygen Consumption) of participants for the study.

Hypothesis

The following null hypotheses were tested at 0.05 levels of significance

1. There will be no significant difference in the pretest – posttest forced vital capacity of primary school pupils following aerobic exercise.
2. There will be no significant difference in the pretest – posttest forced expiratory volume at 1st second of primary school pupils following aerobic exercise.
3. There will be no significant difference in the pretest – posttest peak expiratory flow rate of primary school pupils following aerobic exercise

4. There will be no significant difference in the pretest-posttest resting systolic blood pressure of primary pupils athletes following aerobic exercise
5. There will be no significant difference in the pretest-posttest resting diastolic blood pressure of primary pupils athletes following aerobic exercise
6. There will be no significant difference in the pretest-posttest resting heart rate of primary school pupils following aerobic exercise
7. There will be no significant difference in the pretest – posttest maximum oxygen consumption of primary school pupils following aerobic exercise

Delimitation of the Study

The study was delimited to the following

The independent variables of peak expiratory flow rate force expiratory volume in 1st second, (FEV_1), Forced Vital Capacity (FVC), Resting Heart Rate (RHR), Resting Systolic Blood Pressure (RSBP), Resting Diastolic Blood Pressure (RDBP) and Maximum Oxygen Consumption (VO_2max) and the dependent variables of aerobic exercise

1. Randomized pretest – posttest control group experimental design
2. 128 selected male and female athletes in the primary school (primary 3-6) who have been involved in school organized aerobic exercise for at least eight weeks or more
3. (a)Respiratory function indices of peak expiratory flow rate (PEFR), forced expiratory volume in 1st second (FEV_1) and forced vital capacity (FVC)

   (b) Cardiovascular function indices of resting heart rate (RHR) resting systolic blood pressure (RSBP), resting diastolic blood pressure (RDBP) and maximum oxygen consumption (VO_2max)
5. Aerobic exercises like bench-stepping, running on the spot, brisk walking, rope skipping, hopping and cycling in the air will be employed. To facilitate the research effectively, trained research assistants will be used.
6. The following standardized instruments will be used:

a. Bathroom weighing scale

b. Stadiometer

c. Stethoscope

d. Aneroid sphygnomamometer

e. Electronic digital stop watch

f. Interval timer clock
g. Stop watch
h. Dry pocket spirometer
i. Computerized micro spirometer
j. Step benches
k. Metronome

7. Intervention program includes aerobic exercise mode for training
8. Variables measured includes
    a. Physical variables such as height and weight
    b. Respiratory function indices of peak expiratory flow rate (PEFR) forced expiratory volume 1st second (FEV_1) and forced vital capacity (FVC).
    c. Cardiovascular function indices of resting systolic blood pressure (RSBP), resting diastolic blood pressure (RDBP), resting heart rate (RHR) and maximum oxygen consumption (VO_2 max).
9. The descriptive statistics of mean and standard deviation will be used to describe demographic data of participants while inferential statistics of independent t-test and analysis of covariance (ANCOVA) at 0.05 level of significance will be used to test the stated hypotheses.

Limitations of the study

The following limitations were observed during the course of this study:

1. The non-availability of a Nigerian based established norm on reference standard used in carrying out selection of pupils for school sports in the selected primary schools.
2. Mass withdrawal of concerned participants from private and public primary schools due to non-payment of school fees was a major limitation leading to pupils' absenteeism from school.
3. Participant's mortality due to health consideration during the course of the study.

Significance of the Study

The study will serve as an important reference point available for consideration whenever valid decisions are to be taken on the suitability of aerobic exercise training for children.

All the tested cardiorespiratory function indices (forced vital capacity, (FVC), forced expiratory volume in 1st second (FEV_1), peak expiratory flow rate (PEFR), resting systolic blood pressure (RSBP), resting diastolic blood pressure (RDBP) resting heart rate (RHR) and maximum oxygen consumption (VO_2 max) - will contribute data based information to the existing body of knowledge

The results of this study can be used for comparison between the findings of this study with other similar studies from other parts of the world

The findings of this study will also reveal various dynamic means of preventing some hypo-kinetic diseases and enhance the adoption of aerobic exercise training protocol on various versions by local users such as coaches, physical educators and school teachers who will promote the physical, social and emotional well being of children as they develop interest in continuing with exercise/training protocol.

The findings will also add to the pool of knowledge in the area of exercise physiology and serves as impetus for further research studies.

Operational Definition of Terms

Aerobic exercise: any activity that uses large muscle groups and delivers a steady supply of oxygen to the working muscles

Maximum oxygen consumption: Amount of oxygen uptake during maximal aerobic exercise

Stethoscope: Instrument for listening to heart rate

Heart rate: The number of heart beats per minute

Blood pressure: Amount of force the blood exerts against the artery walls

Systolic Blood Pressure: The highest pressure in the during cardiac cycle

Diastolic Blood Pressure: The lowest pressure in the heart during cardiac cycle

Sphygmomanometer: Instrument used to measure blood pressure

Forced Vital Capacity: Volume of air exhaled with maximally forced expiratory effort

Forced Expiratory Volume: Volume of air expired in 1 second

Peak expiratory flow rate: Maximal expiratory flow rate achieved, peak flow volume that a person can exhibit maximal rate during a short maximal expiratory effort after a full inspiration.

Physical Activity: Any bodily movement carried out by the skeletal muscles, requiring energy

Sedentary behavior: An act of spending three or more hours watching television, playin g computer games or talking with friends, excluding the time spent sitting in school and doing home work.

Physical Inactivity: This refers to not obtaining at least 60 minutes of physical activity per day or at least five days per week

Exercise: Activities involving the use of big muscles to participate in fun and enjoyment. It is the repeated use of body organs.

CHAPTER TWO

LITERATURE REVIEW

The related literature was reviewed under the following sub headings

1 Concept of Physical Exercise/Activity

i. Benefits of physical activity to children

ii. Benefits of aerobic and anaerobic training for young athletes/children

2 Exercise and Health

i. Physiological adaptation to exercise training

Acute adaptation

ii. Chronic adaptation

iii. Aerobic energy production system

iv. Energy sources during physical activity

3 Concept of Inactivity and Sedentary Behavior

i. Physical inactivity and sedentary behavior among school children

ii. Physical activity levels and aerobic training among children

iii. Hazards of physical inactivity

4. Effect of exercise on respiratory and pulmonary function

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i. Exercise and heart rate in children

ii. Cardiac output during exercise

iii. Systolic and diastolic blood pressures

iv. Exercise and blood pressure in children

v. Effect of aerobic training on blood pressure

vi. Management of Blood Pressure

9. Anatomy of the respiratory system

i. The respiratory system

10. Anatomy and Physiology of Respiratory System

i. Lymphatic

ii. Function of the Respiratory System

iii. Gas Exchange

iv. Speech

11. Physiological Basis of Respiration

i. Inspiration

ii. Expiration

12. Exercise training program for improving cardio-respiratory function

i. Respiratory function indices

ii. Forced Vital Capacity (FVC)

iii. Forced Expiratory Volume in 1^{st} second (FEV_1)

iv. Peak Expiratory Flow Rate (PEFR)

v. Blood Pressure (B. P)

vi. Systolic Blood Pressure (SBP)

vii. Resting Heart Rate (RHR)

viii. Maximum oxygen consumption ($MaxVo_2$)

13. Appraisal of related reviewed Literature

Concept of Physical Exercise/Activity

Benefits of physical activity to children

Regular participation in physical activity has been observed to help children to build and maintain healthy bones, muscles and joints, help control bodyweight, reduce fat and develop efficient function of the heart and lungs. Physical activity contributes to the development of movement and coordination and helps prevent and control feelings of anxiety and depression. (WHO, 2006). It is stated that even among younger children, the more often they participate in physical activity, the less likely they are to use tobacco. It has also been found that children who are more physically active perform more better academically (WHO, 2006; Fahey et al, 2003). Team games and play promote positive social integration and facilitate the development of social skills among young children.

Participation in plays, games and other physical activities, gives the young ones opportunities for self expression, builds self confidence, gives them a sense of achievement and helps in social interaction and integration. These positive effects help to counteract the risks and harm caused by the demanding, competitive, stressful and sedentary way of life that is so common in young people's lives today. Participating in properly guided physical activity can also foster the adoption of other healthy behaviours which include the avoidance of tobacco, alcohol, drug use and violent behavior. Healthy diet, adequate rest and better safety practices can also be fostered through physical activity (WHO, 2006).

Benefits of aerobic and anaerobic training for young athletes

Aerobic exercises are those exercise that require oxygen to produce the necessary energy (ATP) to carry out the activities while anaerobic exercises are those that do not require oxygen to produce the necessary energy (ATP) to carry out the activities.

Igbanugo, Fabunmi & Odunaiya (2008) and Okely & Patterson (2001) disclosed that cardio respiratory function develops throughout childhood, lung volume and peak flow rates steadily increases until full growth. For example, maximum ventilation increases from 40l/min at five years showing that children have higher respiratory rates than adults; 60 breaths/min compared to 40 breaths/min for the equivalent level of exercise.

It has also been observed that cardiovascular function is also different in children. They have a similar heart chamber but lower volume than adults. This results in a lower stroke volume both at rest and during exercise. Chamber size and blood volume gradually increase to adult values with growth. Children compensate for the smaller stroke volume by having higher maximal heart rate which could be more than 215bpm compared to 20 year old whose maximum heart rate could be between 195-200bpm (Tipton & Sander, 2004).

However, the heart rate volume and cardiac output, measured in L/min is lower than that of adults. Children can compensate a little again, as their arterial oxygen difference is greater. This suggests that a higher percentage of the cardiac output goes to the working muscles in children than the adults. Because of the fact that lung and heart capacity increase with age, one would expect aerobic capacity to increase accordingly. This is true in absolute terms; VO_2 max measured in L/min, increases from 6 - 18 years in boys and from 6-14 years in girls. However, when VO_2max is normalized by body weight, little change is observed in age with boys and in girls, there is a slight decline after puberty. Therefore, relative to body weight, children have a cardio-respiratory system for effective aerobic exercise. This is demonstrated in the fact that children can run quite well compared to adults. Indeed, 10 year-olds have completed marathons in very recent times.

A number of propositions have been put forward by various researchers, but these scattered thoughts have not been unified into a body of coherent theory. For example, for the youth athlete, an inferior VO_2 max, expressed in L/kg/min does not limit running endurance performance. In fact, studies have shown that young pre-pubescent girls have an advantage before their relative body fat increases. It has been observed by various researchers that children have shorter limbs and smaller muscle mass, resulting in a lower mechanical power. They have disproportionately long legs, which means that they are biomechanically out of balance and potentially less coordinated. In addition, they have a greater surface area to mass ratio. All these factors reduce biomechanical efficiency. Physiologically, children have inferior cooling mechanisms, due to low blood volume and high skin temperature. They also expend more energy per kilogram of body weight. Children have a higher VE/VO_2 ratio due to their inferior lung function and they rely more on fat metabolism because of lack of muscle glycogen and glycolytic enzymes.

Exercise and Health

Physiological adaptation to exercise training

Adaptation essentially means changes which accompany various types of physical movement that can be both acute and chronic (Body Building, 2008).

Acute adaptation

These are sudden temporary changes in body functions caused by physical exertion. These adaptations disappear soon after the cessation of the exercise session.

Chronic Adaptation

As the body progresses through days, week and months of training, its structure and functions change to accommodate the consistent work load. These persistent changes are the chronic adaptations that enable the body to respond more favorably to subsequent training sessions (Body Building, 2008). The main physiological adaptations to exercise occur in the heart, lungs and muscles.

The Aerobic Energy Production System

The body uses the aerobic energy system during any physical activity that last longer than two minutes. The oxidative system requires oxygen to generate ATP and the energy generated can be used for a long period of time. In the aerobic energy system, ATP production takes place in the mitochondria. The mitochondria can use carbohydrates (glycose or glycogen) or fats to produce ATP. The actual fuel used depends on the intensity and duration of the exercise and the fitness status of the individual. Increased carbohydrates catabolism during intense exercise provides for a significantly faster aerobic energy transfer rather than fat breakdown and liberates about 6% more energy than fat per quantity of oxygen consumed (Mc Ardle, 2000). Maximum oxygen uptake (VO_2 max) determines how intensely a person can perform endurance exercise and for how long; it is considered the best overall measure of cardio respiratory fitness (Mc Ardle, 2000)

Concept of inactivity and sedentary behaviour

Physical inactivity and sedentary behaviour among school children

The relationship between sedentary behaviour and physical inactivity among school children is currently not entirely clear as results from other research studies have been inconsistent, (Epstein, Roemmich, Paluch and Rayon, 2005) and have found negative relationships (Marshall, Beddle, Gorely, Cameron and Murdy, 2004). As both sedentary behaviour and lack of physical activity have been shown to have negative health effects (Ray – Lopez, Vicente-Rodriguez, Biosca and Moreno, 2008), there is a dire need for interventions that would target a decrease of sedentary behaviour as well as an increase of physical activity.

Lack of physical activity among young people has become a major public health problem in most countries around the globe and needs to be assessed urgently:

1. Physical inactivity and sedentary behaviour are known to be important risk factors for chronic diseases
2. Physical inactivity has been defined as not obtaining at least 60 minutes of physical activity per day for at least five days per week while a child is

considered "sedentary" if he/she spends three or more hours per day in these sitting positions, (e.g. sitting and watching television, playing computers games or talking with friends, excluding the time spent sitting in school and at home doing home work)

3. Regular physical activity is associated with immediate and long term health benefits (e.g. weight control, lower blood pressure, improved cardio respiratory function and enhanced psychological well being). Also, active children are more likely to become active adults, but as many children are into adolescence, their physical activity level declines.

Lack of physical activity may result in low fitness levels and decline of the organic function which often causes certain health problems like obesity, hypertension, heart disease and diabetes mellitus. Extremely poor fitness levels may lead to some pathological cases, arteriosclerosis i.e. chronic high blood lipids that results from accumulated over eating and may eventually develop cholesterol deposits on the wall of the blood vessels. Narrow blood vessel with clogging in the cardio respiratory system may hamper oxygen consumption, thus resulting in extremely low aerobic capacity (VO_2 max value). It could also lead to risk of coronary heart disease and/or stroke at the brain vessels.

Review of research evidence shows that the prevalence of physical inactivity, overweight and sedentary lifestyle are both increasing concomitantly, suggesting that these factors may be causally related. ACSM (1998) physical inactivity and overweight are both important current public health problems; however, the specific mechanisms responsible for these observations are not obvious. On the other hand, a large body of evidence suggests that there is a gradual age related decline in the pulmonary function beginning at about age fourty. It is generally accepted that forced expiratory volume in 1 second (FEV_1), forced vital capacity are strong indicators of lung function, which decline due to overweight, obesity and sedentary lifestyle (Inselma, et. al. 1993; Jakes, et. al., 2002). Also, some authors noted that impaired respiratory function such as forced expiratory volume in 1 second (FEV_1) is strongly related with cardiovascular risk factors, atherosclerosis, arterial stiffness, cardiovascular disease and mortality, although the mechanisms underlying this response area matter of some debate. Review of research evidence shows that aging or obesity combined with sedentary lifestyles has a direct effect on the function of respiratory system by altering hug volume, airway caliber and respiratory muscle strength inselma, et. al. (1993). On the other hand, physical activity has been known to improve physical fitness and to reduce morbidity and mortality from numerous chronic conditions. (U.S. Department, (2002)). Nowadays, most studies on the effect of physical activity on respiratory function are cross sectional ones on special populations such as athletes or diseases, such as asthma or chronic obstructive pulmonary diseases (COPD).

Physical activity levels and aerobic training among children

1. To promote a healthy, more active lifestyle among children and young adults
2. A national initiative to encourage children to engage in and maintain high levels of regular physical activity and
3. To provide a baseline assessment of physical activity levels among children.

As children are naturally more aerobic, it would be useful to know if aerobic capacity is trainable in them. Unfortunately, few studies have shown that aerobic capacity in children improves with aerobic training. However, they argued that no study has been done that included at least 12 weeks training, three times a week training, heart rate of at least 1650 bpm for at least 20 minutes, and a large group plus matched controls. This would be the equivalent of all adult aerobic training programme in a well-controlled study. Guerra, S., Riberro, J.C., Costil, R., Duart, J., and Mota J. (2002), Ekelund, Poortviet, Nilson, Yngve, Holmberg, Sjotrom (2001) found out in his study on children that when adult-type training in terms of intensity was performed, VO_2 max improved between 7 and 26%. This suggests that children can improve their aerobic fitness from a training programme of adult-like intensity. The argument for doing this is probably valid because of lower lactate production. The anaerobic threshold for children is normally at pulse rates around 165 to 170 bpm, similar to that of trained endurance adults. With sedentary adults, the anaerobic threshold will vary from 120 to 150 bpm. Thus, the optimal heart rate training stimulus may be relatively higher for sedentary children than for sedentary adults. Other evidence supporting the high – intensity stimulus theory is the fact that activity levels in children are not related to VO_2 max (Freedson and Miller, 2000). This shows that general activity does not provide a training stimulus but that children have natural fitness. Thus, to improve on their natural fitness, a reasonably tough training programme is required.

Children's physical activity levels today are lower than they have been before. National data for health and fitness have shown that many children are not leading healthy, physically active lifestyles National Center, (2003). Children are choosing sedentary activities over physical activity, due to a lack of opportunity, success and self-motivation in physical activity Tipton and Sander, (2004). According to them, physical education class should be a primary target for intervention. More specifically, physical education need to devise effective educational strategies to increase the physical activity among children both inside and outside of class.

Hazards of physical inactivity in children

Physical inactivity is responsible for low levels of cardio respiratory endurance (the ability of the heart, lungs, and blood vessels to deliver enough oxygen to the cells to meet the demands of prolonged physical activity). The level of cardio respiratory endurance (or fitness) is measured by the maximal amount of oxygen (in millimeters) that every kilogram (2.2 pounds) of body weight is able to utilize per minute of physical activity (ml/kg/min). As maximal oxygen uptake increases the efficiency of the cardio respiratory system also increases. (Jason Menoutis, 2008).

Although physical inactivity has not been assigned the most risk points, but improving cardio respiratory endurance through daily physical activity and aerobic exercise programme helps to control most of the major risk factors that lead to heart disease.

The significance of physical inactivity in contributing to cardiovascular risk was clearly shown in 1992 when the American Heart Association added physical inactivity to the poor cholesterol profile, high blood pressure, diabetes, and obesity. Based on the overwhelming amount of scientific data in this area, evidence of the benefits of aerobic exercise in reducing heart disease is far too impressive to be ignored. (ACSM, 2000, Biddle, Gorely and Stensel, 2004).

The rapid transition of people to an urban lifestyle entailed changes in both diet and level of physical activity. This phenomenon has been found among traditionally indigenous people in developed countries whose lifestyles have been affected by the dominant western oriented majority cultures.

It has been substantiated that inactivity promotes human deterioration. Lack of activity and a sedentary lifestyle have been observed as a related cause of respiratory and cardiovascular disease, type 2 diabetes and obesity (WHO, 2006). Inactivity has also been linked with low level of flexibility, low back pain and susceptibility to strains. Sprains, dislocations and habitual inactivity results in grasping for breath and tiredness at the slightest physical exertion. Any child in this situation has no energy reserve and therefore cannot cope with emergency situations.

There is evidence that a strong association exists between the increase in physical inactivity and the emergence of modern chronic diseases in 20th century industrialized societies (Frank, Booth, Scott, Gordon Christian, Carlson, Mare and Hamilton, 2000). They further stated that epidemiological data have established that physical inactivity increases the incidence of at least 17 unhealthy conditions almost all of which are considered risk factors of chronic diseases. Studies conducted by Amigo et al (2007) and Ray Lopez et al (2008) found inactivity to be a more important guage of death than any other significant hypokinetic disease, most especially the respiratory and cardiovascular risk factors in children whose inactive lifestyle rank high.

Exercise and Respiratory Functions

Ventilator response of the lungs during exercise

AHA/AACPR (2000) assert that the primary purpose of the respiratory system is to provide a means of gas exchange between the external environment and the body. Thus, the respiratory system provides the individual with a means of replacing O_2 and removing CO_2 from the blood. The exchange of O_2 and CO_2 between the lung and blood occurs as a result of ventilation and diffusion. They further observed that since O_2 tension in the lung is greater than in the blood, O_2 moves from the lungs into the blood. Similarly, the tension of CO_2 in the blood is greater than the tension of CO_2 in the lungs; thus CO_2 moves from the blood into the lung and expires. Diffusion in the respiratory system occurs rapidly because there is a large space area within the lungs and a very short diffusion distance between blood and gas in the lungs. They further assert that the O_2 and CO_2 tension in the blood leaving the lung is almost at an incomplete equilibrium and the O_2 and CO_2 tension found within the lung is testimony to the high efficiency of normal lung function. In addition, the respiratory system also plays an important role in the regulation of the acid-base balance during heavy exercise.

Koenig (2001) opined that movement of air from the environment to the lungs is called pulmonary ventilation and occurs via a process known as bulk flow which refers to the movement of molecules along a passageway due to a pressure difference between the two ends of a passage way. Sonnetti, Wetter, Pegelow and Dempsey (2001) thus stated that inspiration occurs as a result of reduction of the pressure below atmospheric pressure. Conversely, expiration occurs when the pressure within the lungs exceeds atmospheric pressure.

Respiratory muscles functions during exercise

Many more studies have been conducted on respiratory muscles and exercise using children population but in recent times, more children are enthusiastic about keeping fit and improving on their fitness especially because of their respiratory muscles that are functionally similar to locomotor muscles. The primary task of the respiratory muscles is to act upon the chest wall to move gas in and out of the lungs in order to maintain arterial blood gas and pH homeostasis. The importance of normal respiratory muscle function can be appreciated by considering that respiratory muscle failure due to disease or spinal cord injury would result in the inability to ventilate the lungs and maintain blood gas and pH levels within an acceptable range.

Research evidence by Sonnetti et al (2001) shows that muscular exercise results in pulmonary ventilation; therefore an increased work load is placed on respiratory muscle. Over decades, the belief had been that respiratory muscles do not fatigue during exercise. However, growing evidence indicates that both prolonged exercise (e.g. 120 minutes) and high intensity exercise (90% to 100% VO_2 max) can promote respiratory muscle fatigue. Regular endurance exercise training increases respiratory muscles oxidative capacity and improves respiratory muscle endurance. (Vincent, Powers, Stewart, Demirel, Shanely and Hisashi, Naito, 2000)

Sonetti et al (2001) substantiate their claims that the large increase in the work of breathing could cause respiratory muscle fatigue during maximal exercise. However, results indicate that for endurance-trained individuals, the ability to rapidly ventilate the lungs is not compromised to VO_2 max during exercise. Interestingly, even highly trained children athletes can show improved lung function during exercise after 5 weeks of training for muscles of ventilation using inspiration resistance.

Pulmonary function response during exercise

The start of exercise is characterized by immediate increase in ventilation. The factors that regulate this increase are numerous and complex involving neural and blood (haemoral) factors. Thole, Sallis, Rubin and Smith (2001) stated that nerves from the central as well as peripheral nervous system respond to stimuli to cause increases in the frequency and depth of breathing, thus increasing ventilation. Additional changes in blood, such as partial pressures of carbon dioxide, increased temperature, increased acidosis, and even decreases in partial pressures of oxygen provide the stimuli to nerves or neural tissues involved in increasing ventilation.

Ventilation involves the movement of air into and from the lungs through the process of bulk flow. During inspiration and expiration, the lung compartment are opened to the external environment and therefore, to the pressure, temperature and humidity of atmospheric air. A differential pressure between the air within the lung and the atmospheric air is generated by the muscles of ventilation. The rapid and refined nature of ventilator control results in characteristics response of ventilation to different types and intensities of exercise.

Research studies on pulmonary adaptations to acute and chronic exercise (training), revealed that the VE (Pulmonary ventilation) for O_2 under exercise conditions decreases as a result of training. However, this improved efficiency in breathing is not the result of improvement in the lung tissue per se but rather of a result reduced metabolic acidosis and thus a lower drive to increase ventilation (Sonnetti et al, 2001)

Robergs and Roberts (2000) pointed out that endurance training in children and young adults does appear to bring about important changes in the lung volumes and capacities. They found significant decrease in functional residual capacity, residual volume, and the ratio of residual volume/total lung capacity in swimmers after four months of training. Control and similar groups of wrestlers showed no significant changes. The swimmers also showed significantly increased vital capacity, which was the result of an increased inspiratory capacity. All of these changes would result in better alveolar ventilation and consequently should weigh in favour of improved aerobic performance.

Research evidence now reveals that respiratory muscle fatigue can lead to exercise limitations even in normal young subjects but there is evidence that the diaphragm and other respiratory muscles are trainable like other skeletal muscles (Sonetti, Wetter, Pegelow and Dempsey, 2001). Aerobic training directed at the diaphragm itself improves contractility and endurance; apparently as a result of increasing the percentage of FT fatigue – resistant fibers and decreasing the percentage of FT fatiguable fibers (Franco, 2005). All fibers displayed increased mitochondrial density and oxidative capacity.

Research evidence by USDHHS (2000) revealed that athletes improve the work of the lungs by increasing their ability to expand more fully, take in more air, and utilize a greater proportion of the oxygen in the inspired air. They also stated that during moderate and heavy exercise there is an increase in body temperature. The increase in central temperature is an added stimulus to the breathing mechanism. Furthermore, they observed that increase in ventilation is ordinarily achieved by increased activity of the inspiratory muscles. This leads to increased distention of the lungs and chest wall as well as greater elastic recoil during expiration. The rate of breathing which is about 14 breaths per minute when a person is at rest, may be doubled with regular exercise. As a result of the increase indepth and rate of breathing, the air intake may increase from 50 to 100 liters per minute in constrast to a resting intake of 5 to 8 litres. AHA/ACPR (2000), Harms et al (2000) in their research studies indicated that the respiratory system was an exercise limiting factor during an endurance test in normal sedentary subjects.

During the elementary school years, boys are superior to girls in terms of efficient participation in aerobic activities such as running, jumping and throwing. With regards to the respiratory system, active aerobic activities bring about adaptation in the functioning of the respiratory system. At rest, there is increase in the depth of respiration and the respiratory rate is reduced. The vital capacity is significantly higher in healthy physically active children, when compared to their sedentary counterparts. This improvement is as a by-product of increased development of respiratory musculature incidental to regular usage.

If one is physically active, there is the tendency to experience increased maximal oxygen intake and increased oxygen extraction capacity, thereby leading to increased anteriovenous oxygen difference. The adaptive changes lead to functional efficiency in that the max VO_2 is a strong indicator of a better cardio respiratory endurance and of the best indicators of an individual's fitness level.

Training effects on pulmonary function

Research evidence by Roberg (2001) revealed that the VE for oxygen under exercise conditions decrease is the result of training. However, this improved efficiency in breathing is not the result of improvement in the living tissue parse but rather of reduced metabolic acidosis and thus a lower drive to increase ventilation.

It is now evidently clear that respiratory muscle fatigue can lead to exercise limitations even in normal young children as applicable to the study of Sonetti et al (2007) but there is also evidence that the diaphragm and other respiratory muscles are trainable like other skeletal muscles (Sonetti, wetter, Pegelow and Dempsey, 2001) Aerobic training or training directed to the diaphragm itself improves contractility and endurance. Apparently, the result of increasing percentage of FT Fatigue-resistant fibers and decreasing the percentage of FT fatigable fibers displayed increase mitochondrial density and oxidative capacity.

Studies on aerobic exercise and pulmonary function in general population Twisk, et al. (1998) Most studies on the effect of physical activity are cross sectional ones, on special population such as athletes or patients with chronic obstructive pulmonary disease (Doherty, et. Al. 1997, Malkia and Impivaara, 1998 and Tiep 1998). Physical activity rehabilitation is widely used in patients with pulmonary diseases. Exploration of the relation between aerobic exercise and respiratory function will aid in understanding how aerobics improves patient's quality of life and in finding a better way to evaluate the effects of rehabilitation.

Follow-up studies described an association between the level of physicl activity and respiratory function Pelkonen, et. Al. (2003). Forced Vital Capacity, (FVC), forced expiratory volume in 1^{st} second, and peak expiratory flow rate are strong indicators of lung function, which declines due to physical in activity and sedentary lifestyle. Jakes, et. Al., (2002).

Research indicates that men who remained in the active lifestyle during the follow-up (19 months) showed 50ml improvement in their FEV_1 and 70 ml in their FVC, whereas participants who remained in sedentary lifestyle had 30 and 20 ml reduction in their FEV_1 and FVC, respectively.

These observations suggest that young Overweight and inactive participants (children) with sedentary life-style are at higher risk for deterioration of their respiratory indices and may be at risk for developing chronic obstructive pulmonary disease in adulthood. Hence appropriate interventions, such as prescribed physical activity programs, may prevent lung function deterioration in these young (children) subjects.

Previous studies provide conclusive evidence that supervised physical activity like Yoga and Tai chi chuan exercise can improve lung function in asthmatic children Chang, et. Al. 2008; Radovanovic, et. Al. (2009) reported FVC an FEV_1 enhancement after programmed physical activity in preadolescents Courteix, et. Al. (1997) found that intensive swimming prepuberty enhances static and dynamic lung volumes. Khalili, et. Al. (2009) showed that an 8-week programme of aerobic exercise can improve lung function in children with intellectual disability.

On the other hand, it is unclear, whether aerobic exercise can improve lung function in Overweight subjects with normal respiratory measures, but FVC and FEV_1 significantly lower than the predicted values.

Several studies were done to investigate the effects of physical activities and sport exercises on pulmonary function in children. These studies had different results which can be explained due to their variety in the kind of tests, measurement tools, exercise schedule and program; disease severity, pulmonary rehabilitation and environmental conditions.

A regular short duration sport activity (less than a few minutes) has fewer problems than long duration sport activity. When courses of exercise within short intervals are embarked, narrowness of bronchus increase gradually. On the contrary, doing light sport exercises before strenuous sport activities can reduce stricture of respiratory airways to minimum.

Aerobic exercise and cardiovascular system

Concept of cardiovascular system

The cardiovascular system, the most important system in the human body, refers to the heart and the blood vessels that make up the life stream of the human body.

Williams (2005) opined that cardiovascular system refers to the blood circulation through heart and blood vessels. Cardiovascular system consists of the heart, which is a muscular pumping device and the closed system of blood vessels, arteries, veins, and capillaries (Gaya and Bwak, 2001). In accord, Gaya and bwak (2001) asserted that the normal movement (circulation) of blood through this system is essential in maintaining homeostasis and unfavourable cellular environment. This very important function cannot be guaranteed if the system is not working well owing to the development of progressive degenerative diseases that affects its function.

Jimoh (2000) recorded that aerobic dynamic exercise which involves steady constant motion of the muscles increases the body's demand for oxygen. It works the heart muscles making them bigger and stronger.

Immune system

Although there have been hundreds of studies that were carried out on exercise and the immune system, there is little or direct evidence on its connection to illness. Epidemiological evidence suggests that moderate exercise has a beneficial effect on the human immune system while extreme exercise impairs it.

Moderate exercise has been associated with a 29% decreased incidence of upper respiratory tract infections (URTI), but studies of marathon runners found that their prolonged high intensity exercise was associated with an increased risk of an infection, although another study did not find the effect. Immune cell functions are impaired following acute sessions of prolonged, high intensity exercise, and some studies have found that children are at a higher risk of getting infected. The immune system of active and fit children and unfit children are generally similar. Children may have slightly elevated natural killer cell count and cytolytical actions, but these are unlikely to be clinically significant vitamin C supplementation has been found necessary for marathon runners with lower URT (Glesson, 2007).

Biomarkers of inflammation such as creative protein, which are associated with chronic diseases, are reduced in active individuals relative to sedentary individuals. The positive effects of exercise may be due to its anti inflammatory effects and the depression in the immune system following acute bouts of exercise may be one of the mechanisms for this anti-inflammatory effect.

Brain function

A review of cognitive enrichment therapies (strategies to slow or reverse cognitive decline) concluded that "physical activity and aerobic exercise in particular, enhances older adults' cognitive function". (Hertzog, Kramer, Wilson, and Lindenberger, 2008). In addition, physical activity has been shown to be neuroprotective in many neurodegenerative and neuro muscular diseases. Clement Grondard et al, biondi, O; Amand; Lecolle, Delta gaspera. Pariset, pariset, Li, Gallien, et al (2005). For instance, it reduces the risk of developing dementia. Furthermore, anecdotal evidence suggests that frequent exercise may reverse alcohol – induced brain damage.

There are several possible reasons why exercise is good for the brain:

- Increasing the blood and oxygen flow to the brain
- Increasing growth factors that help create new nerve cells and promote synaptic plasticity. (Hunsberger, Newton, Bennett, Duman, Russell, Salton and Duman, 2007)
- Increasing chemical in the brain that help cognition, such as dopamine, glutamate, norrepeniphrine and serotonin. Parker – Pope (2001).

Physical activity is thought to have other beneficial effects related to cognition as it increases levels of nerve growth factors, which support the survival and growth of a number of neuronal cells (Edwards, Authur, Kramer, and Stanley, Colcombe, 2004).

Depression

A number of factors may contribute to depression including overweight, low self esteem, stress and anxiety (Keith and Johnsgard, 2004). Endorphins act as natural pain reliever and antidepressants in the body. Endorphins have long been regarded as responsible for what is known as "runner's high", an euphoric feeling a person receives from intense physical exertion, which is an influence of physical activity on mental well being. However, recent research by Sparling et al (2003) and Burfoot and Amby (2004) indicates that anandamide may possibly play a greater role than endorphins in runner's high. When a person exercises, levels of both circulating serotin and endorphins are increased. They maintained that these levels are known to stay elevated even several days after exercise is discontinued, possibly contributing to improvement in mood, increased self esteem, and weight management. This is also the influence of physical activity on mental well being. Exercise alone is a potential prevention method and/or treatment for mild forms of depression. Exercise also enhances a person's sleep. When the body is physically exhausted, it will slip into rapid eye movement (REM); leading to easier and longer sleep. This as well is the influence of physical activity on mental well being.

Cardiovascular Fitness Standard (cardiac functional reserve) for children

There is a direct relationship between physical inactivity and cardiovascular mortality; hence physical inactivity is an independent risk factor for the development of coronary disease. There is a close response relationship between the amount of exercise performed from approximately 700-2000 of energy+ expenditure per week and cardiovascular disease mortality in middle aged and elderly populations. The greatest potential for reduced mortality is in the sedentary who become moderately active. Most beneficial effects of physical activity on the body against cardiovascular disease can be attained through moderate intensity activity (40% to 60% of maximal oxygen uptake, depending on age). Persons who modify their behaviour after myocardial infarction to include regular exercise have improved rates of survival while persons who remain sedentary have the highest risk for all cause and cardiovascular disease mortality. (Stampfer, Hu, Manson, Rimm and Wilet, 2000).

Research studies revealed that any improvement of cardiovascular health involves strengthening the heart and blood vessels and increasing endurances, because the heart like any other muscles in the body, can be made stronger by exercise and conditioning. Gulf Hurricane Relief (2006).

Research scholars have shown that the extent that obesity affects "cardiovascular fitness" depends on the definition being considered. If fitness is considered functionally as performance on an endurance exercise event, obesity is clearly detrimental. For example, Drinkard et al (2004) found a correlation of r = -0.82 between BMI and distance on a 12-minute walk/run test. In a general population of 12 year old boys, research report by Faigenbaum (2002) said that body fat content accounted for 32% of the variance on finish times on a one-mile run. According to him, this negative influence of the obese state on field-measured cardiovascular fitness has generally been considered due to the excess "baggage" of adiposity that must be transported.

When cardiovascular fitness is considered physiologically by the traditional maker of VO_2 max per kg body mass, an adverse influence of obesity is observed. Negative correlation between maximal aerobic power expressed relative to body mass and body fat measures are typically high (r = -0.50 to – 0.80) (Goran, et al, 2000; Loftin, et al, 2001). A research study by Heyward (2002) indicate that the best way to evaluate cardiovascular fitness in children has been a concern to educators and scientists for a greater part of this century.

According to him, the most recent controversy has revolved around the question of what kind of standard to use in making judgements about a child's level of fitness. Normative standards such as percentile scores have traditionally been used to describe where a child stands relative to his or her peers (e.g. 75^{th} percentile). The current thinking, especially for health related fitness tests (one mile walk/run test and the skinfold test) is that criterion reference standards might be more appropriate.

Cardiovascular anatomic and physiologic variables for children

Recent studies have reported that cardiovascular anatomic and physiological variables are clearly related to body size and composition (Faigenbum, 2002). In assessing cardiac effects of elementary children, it is of prime importance to adjust measurements for these influences. Only then can one make appropriate comparisons between individual children, most especially when examining relationships of cardiac features severity of obese children. Although this is critical to reaching appropriate conclusions, the best means of accomplishing such variable adjustments in these children is problematic particularly as it may be affected by variables such gender, age, athleticism and the same is not easily resolved.

Research evidence indicated that for “normalizing” cardiac mass to body size, it has been considered most appropriate to make adjustment for inter-individual differences in body stature or skeletal dimensions (which will make no allowance for adiposity). The cardiac mass of a 12-year old boy is considerably more than that of a 6-year old who has the same body composition. Other factors such as body masculation, athleticism, gender, habitual activity, would also have to be considered.

Pulmonary ventilation is the amount of air which is exhaled per minute, and it is regulated so as to provide the gaseous exchange required for aerobic energy metabolism. Koeing (2001) observed that ventilation is usually affected at all stages of exercise. According to him, before exercise commences, it has been noticed that there is a slight increase in ventilation. This increase is referred to as the anticipatory rise. Since it is the anticipation of the ensuring exercise, he further pointed out that when exercise begins, there is an immediate large increase in ventilation. After several minutes of sub-maximal exercise, ventilation continues to rise, but at a much slower rate.

Research studies by Harms Wetter, Croix, Pegelow and Dempsey (2000) substantiated that the amount of inhaled and exhaled air are usually not equal, since the volume of inspired oxygen in most situations is larger than the volume of carbon dioxide expelled. They further said that ventilation increases during exercise and this increase is proportional to the increase in work load. Another study by Koeing (2000) has shown that from a resting value of about 6.0 liters per minute, ventilation during exercise is semi-linear with a relatively greater increases with heavier work load. Other researchers have equally reported that respiration is related to oxygen consumption, during exercise of progressive intensity. Ventilation increases in proportion to the increase in oxygen consumption (VO_2) up to about 60% of maximum oxygen consumption (max VO_2) after which ventilation increases at a relatively higher rate that is affected by increases in depth and frequency of breathing (Brustaret, Tom, Esterban & Parra, 2006).

Cardiorespiratory Function

The ability of the body to transport and utilize 0_2 (i.e. aerobic power, max Vo_2) represents the best overall measure of cardiorespiratory function. Cardiac output

(HR x SV) represents O_2 transport and a-VO_2 difference represents O_2 utilization. Obviously, other factors such as pulmonary ventilation and hemoglobin concentration can also influence $VO_{2;}$ but given normal pulmonary function and a normal hemoglobin level, these factors are rarely limiting factors. Walton's (2004) research report shows maximal exercise for untrained and endurance trained male subjects.

Beneficial Effect of Aerobics Exercise

Relationship between Aerobics and Circulo-respiratory Function

Circulo – respiratory endurance is one of the most (if not the most) important components of physical fitness especially in the healthy related fitness area. In strenuous activities involving the use of large muscles of the body such as swimming, running, jogging, sawing the wood, and in those other activities that are performed for long period of time (30 minutes upwards), the role of cardiorespiratory system is important. In these activities, the limiting factor in providing the much needed energy is AEROBIC POWER – the ability to take in, transport, and utilize oxygen (Hoeger and Hoeger (2000). Since the circulo-respiratory (CR) system plays an important role in these tasks, these tasks can be considered as measures of circulo-respiratory endurance (McArdle, Katch & Katch, 2000).

During any strenuous work, the oxygen delivered to the working muscle dictates the transformation of energy that takes place in the muscles. It should be remembered that an efficient heart working in conjunction with a highly functioning circulatory system will enhance proper delivery of oxygen and more blood to the working muscles. These combined functions (heart and circulatory system) will also enhance the removal of waste products of metabolism such as Lactate (LA), Cardondioxide (Co_2) and so on as soon as they are built in the body.

One of the facets of the cardiorespiratory function is its influence on physical working capacity (PWC). Briefly defined, physical working capacity (PWC) is the ability of an individual to perform work of various intensities and durations effectively and efficiently. For example, a long distance runner covering some miles has to use a lot of energy. Also, the ability to finish the race depends on efficient circulation, removal of waste products of metabolism, dependable supply of oxygen to the working muscles and ability to fractionally utilize the oxygen and energy supply. From the relationship of these physiological parameters it is clear that whatever is done to improve circulorespiratory system will also improve an individual's physical working capacity. In the same manner, whatever hinders the normal functioning of the circulorespiratoy system will adversely affect the level of an individual's physical working capacity (ACSM ,2000; Plowman and Smith, 2003).

Exercise physiologists, physicians and people concerned with exercise prescription agree that the best indication of a person's fitness is the level of his oxygen consumption (Max Vo_2). The higher this level, the better fit the individuals. It is also this parameter (Max Vo_2) that indicates who is best suited for a particular event or exercise (Gulf Hurricane Relief, 2006).

Circulorespiratory function is also related to the incidence of coronary or circulatory diseases. Health professionals, physiologists and cardiologists are convinced that a developed circulorespiratory system is a potent factor for either preventing or reducing diseases associated with the circulatory system. It has been ascertained that over 55% of all deaths in some of the industrialized countries of the world are attributed to cardio-vascular diseases (Reaven, Strom and Fox, 2000). This information reminds us all that we should regardless of the forms of occupation, sex and religious beliefs give sufficient attention to the development of a good cardiovascular system in order to eliminate this problem.

It is clear from the above fact that a functional circulorespireatory system is essential to both general fitness and athletic fitness. However, good circulorespiratory fitness is dependent upon several factors such as healthy lungs (respiratory) sound heart and blood vessels (cardiovascular), quality and quantity of blood (red blood cell count, blood volume etc) and specific cellular components that help the body in utilizing oxygen during exercises. ACSM (2000).

Health effect of activity/exercise to children

The health benefits of a physically active lifestyle are well known. They include a lower risk of obesity, coronary heart disease and stroke, type 2 diabetes as well as colon and breast cancer. Globally, over 1.9 million deaths per year could be prevented if everybody was sufficiently physically active. Overall, health benefits from physical activity at a young age are likely to be similar to those from adulthood physical activity. Furthermore, individual's that were active during childhood have a greater likelihood of being active as adults and are thus more likely to continue receiving the health benefits of physical activity throughout their adult years (Telama, Yang, Yiikari, Valimaki, Wanne and Raitakari, 2005).

Physical exercise is widely used for various purposes. These include evaluating maximal or peak aerobic power (VO_2 peak), raising the breathing rate, body temperature, promoting cardiovascular fitness and endurance, increasing blood flow to the heart and ensuring the availability of more oxygen to produce energy in children and youths (Satcher, 2000, Yngve, 2000 and Bangkok Post, 2007). Furthermore, Hoeger and Hoeger (2000), IFA (2000) and State of Victoria (2007) asserted that for an aerobic exercise to be capable of achieving its purpose, it must be done at the right intensity, and to an intensive level when one cannot talk but gasp while doing the exercise.

Laboratory studies, clinical findings and epidemiological investigation have provided convincing evidence that improved levels of physical activity have a lot of beneficial health effects. Spanling, Owen, Lambert and Haskell (2000) and Pelzer, Phaswana, and Promtussananon (2002) observed that aerobic exercise has a significant effect on body composition and health related fitness of children and youths. Many work-outs like brisk walking that use large muscles for an extended period of over several months may modestly lower blood pressure. Makoff and Schoenfield (2004) reported that a two-week regular exercise programme revealed benefit in children with high blood pressure. Thus, exercise in black individuals resulted in significantly greater reduction in systolic (top chamber) blood pressure. while Asian individuals had a greater reduction in diastolic (bottom chamber) blood pressure as compared to white children. However, many of these studies indicated that aerobic exercise is a suitable treatment and can even play a role in the prevention of hypertension.

Psychological benefits of physical exercise on children are widely recognized among children. People can claim psychological benefits such as "mood elevation", tension and anxiety reduction, increment in self worth, heightened sense of belonging and promotion of feeling of happiness with reduction of stress and anxiety. Other psychological variables are psychopathological in nature. Many people simply have subjective distress, a broader description of unpleasant emotion, but with well programmed exercises and adherence, therapeutic values in reducing feeling of anxiety and depression will be achieved.

Physiological effects of activity/exercise to children

Physical exercise is important for maintaining physical fitness and can contribute positively to maintaining health weight, building and maintaining a healthy bone density, muscle strength and joint mobility, promoting physiological well being, reducing surgical risks and strengthening the immune system. Exercises also reduce levels of cortisol. Cortisol is a stress hormone that builds fat in the abdominal region, making weight loss difficult (Sparling, 2003).

Frequent and regular aerobic exercise has been known to help prevent or treat serious and life threatening chronic conditions such as high blood pressure, obesity, heart disease, type 2 diabetes, insomnia and depression. Endurance exercise before meals lower blood glucose more than the same exercise after meals (Borer, Wuorineen, Lukos, Denver, Porges and Burrant, 2009).

There is more evidence that vigorous exercise (90-95% of VO_2 max) is more beneficial than moderate exercise (40 to 70% of VO_2 max). Some studies have shown that vigorous exercise executed by healthy individuals can increase opioid peptile (a.k.a. endorphins, naturally occurring opioids that in conjuction with other neurotransmitters are responsible for exercise-induced euphoria and have been shown to be addictive), increase testosterone and growth hormone - effects that are not as fully realized with moderate exercise.

Mechanism of Developing Aerobic Capacity

The attainment of a dependable aerobic capacity depends on important factors such as intensity of training duration and frequency of workout, mode of training and initial level of children fitness (Heyward, 2012).

Frequency of Training

The question of frequency of training is related with how often an individual has to train in a week. Is it once, twice, three, four or five times a week? Research studies conducted to ascertain the frequency of training per week points to the fact that 3 to 4 days per week is optimal but some authorities claim that training for 2 to 3 days per week is considered average for the general population as this period showed a significant improvement in aerobic capacity (Hands, Parker & Lakins, 2006).

Regularity of training is closely linked with the frequency of training. When an individual fails to continue training he loses the improvement gained or maintained fast. The result is that there is a fast decrease in aerobic capacity and related cardiovascular parameters. On the other hand, if this individual who has refrained from exercising decides to re-enter training he has to be very cautious. He should start at a slow tone, gradually increase the training until he reaches the level of fitness he was prior to the training.

Intensity of work

This factor is concerned with how hard one has to push himself before getting any training effect from exercise bouts. Van-sluijs, McMInn & Griffin (2007) and Sparling, Owen, Lamber & Gasket (2000) through several studies, have indicated that a substantial training effect can be accomplished by training at between 60 to 80% of the individual aerobic capacity. Various studies have also indicated that training below 60% of one's aerobic capacity results in little improvement in aerobic capacity and other related cardio-respiratory factors. In other words, a low-intensity program may show little or no improvement, while a high-intensity program may show substantial improvement.

A high intensity aerobic program of interval training or continuous jogging will undoubtedly lead to significant improvement in aerobic capacity and loss of body fat and weight. However, the point of emphasis regarding how hard one should train is safer (DiNallo, Jackson and Mahar, 2000)

An individual can ascertain how hard he is training by applying the concept of training heart rate (THR). The individual's THR is established by determining his exercise capacity on a maximal exercise stress test. He is then assigned a heart rate that is commensurate with that of exercise capacity (Tipton and Sanders, 2004). For example , a THR of 75% of an individual's maximal heart rate (HR max) may represent a value of over 60% of his maximum oxygen consumption (Theoretical HR max= 220-Age).

Duration of Training

The question of duration of training describes how long exercise has to be continued for physiological effects to be derived. There is need for an appropriate combination of exercise intensity and duration so that the individual adequately stresses the cardio-respiratory system without over exertion. The intensity and duration of exercise are inversely related (the lower the exercise intensity, the longer the duration of exercise). The ACSM (2000) recommends 20 to 60 minutes of continuous, aerobic activity. Apparently healthy individuals usually can sustain exercise intensities of 60% to 85% VO_2 R for 20 to 30 minutes. During improvement stage, duration can be increased every two to three weeks until participants can exercise continuously for 30 minutes at a moderate to vigorous intensity.

An alternative way of estimating the duration of exercise is to use the caloric cost of the exercise to achieve health benefits. ACSM (2000) recommends target caloric thresholds of 150 to 400 kcal per exercise session, and a minimal weekly caloric threshold of 1000 kcal from exercise.

Jogging is one of the aerobic activities often used to develop aerobic capacity and cardio-respiratory fitness. For individuals who want to sustain this activity (jogging) for several minutes, an understanding of the concept of slow long distance (SLD) or slower pace and longer duration is important. This plan enables an individual to cover a longer distance while spending longer period of time performing. Apart from using this plan to develop cardio-respiratory endurance and aerobic capacity, this plan has other advantages. First, such plan (slower intensity and long duration) affords one the opportunity to enjoy training.

Aerobic exercise performance and maximum oxygen consumption in children

The more oxygen the body is able to process and use, the more work it should be able to perform before becoming fatigued. The maximal rate at which oxygen can be used by the body is therefore important and is considered by most experts to be the best indicator of cardiovascular (or aerobic) fitness. The rate of oxygen consumption is measured in liters per minute, but because those who weigh more will have a higher total score due to their larger size, comparisons can be made between children of different body weights. With regular participation in exercise programmes, a person can increase his/her maximal oxygen consumption by as much as 30% within 12 week period, depending on his or her initial level of fitness. Wilmore et al, (2001) and Brustaet et al (2008) reported the following changes in the body:

a) An increase in the amount of hemoglobin in the blood, which results in increases in the amount of oxygen that can be transported in the blood.
b) An increase in the maximal cardiac output as the heart becomes stronger and more efficient. This means that the body can circulate more blood to the working muscles.
c) An increase in the amount and/size of the capillaries, allowing for a more efficient exchange of gases which in turn allows the muscles to use more of the oxygen circulated.

Marrow et al (2000) continued that VO_2 max is achieved when the work rate is increased, but the oxygen consumption (VO_2) does not increase or reach a plateau. Furthermore, it is a difficult measure to determine because it requires expensive metabolic equipment, exhaustive exercise performances and a lot of time. Despite this, Marrow et al (2000) maintained that researchers in exercise science have developed techniques for estimating or predicting VO_2 max reliably and validly. They said that VO_2 max can justifiably be estimated by measuring heart rate at different levels of sub maximal work and extrapolating to get the VO_2 max. Since a linear relationship exists between heart rate, work load and VO_2 max. In their assertion, by testing a large number of people, investigators have established relationships that can be used to estimate the maximal VO_2 max consumption from single ergometer ride. This was what led to the development of several testing protocols for estimating VO_2 max especially on the field like the cooper 12 minute run test, 1-mile run, etc.

Aerobic power, aerobic capacity and maximal oxygen uptake are all terms used interchangeably with VO_2 max and VO_2 max has been defined as "the highest rate of oxygen consumption attainable during maximal or exhaustive exercise". VO_2 max is usually expressed relatively to body weight because oxygen and energy need differ relative to size. It can also be expressed relatively to body surface area and this may be more accurate when comparing children and oxygen uptake between sexes.

The process of work in which oxygen is utilized is known as aerobic process and the capacity of the individual to utilize aerobic process is called aerobic power. The maximal oxygen consumption (VO_2 max) for any individual is a good criterion of how well various physiological functions can adapt to the increased metabolic needs of work or exercise. Thus, availability of oxygen in the muscle and elimination of the product of metabolism (particularly lactic acid) has been regarded as a vital factor in the physiological performance of work.

Adequate supply of oxygen is necessary for normal life activity. It is used by all the cells for oxidative process in the metabolic changes from which energy is derived. Whenever energy is required, metabolism is increased, and hence the need for oxygen is also increased.

DiNallo, Jackson and Mahar (2000) contends that in relation to performance, oxygen has very important relationship with performance of work. It has been shown that oxygen is utilized in the metabolic process involved in the conversion of glycogen and fats as energy sources for ATP generation through a series of reactions that take place in the mitochondria of the muscle cells.

Research studies by Novak et.al (2004) and Loftin, Southern, Troselair, Hanlon, Miller and Hudal (2001) have shown that when the oxygen available for work process is adequate, the adaptation of cardiac output, heart rate and pulmonary ventilation reach a steady state, and there is no accumulation of lactic acid in the body. Thus, in light exercise, the energy output during the first minute can be delivered anaerobically since oxygen is stored in the muscles bound to myoglobin and in the blood perfusing the muscles. They further said that the more severe the supply of oxygen, many become inadequate to meet the requirements for production of work. Therefore, anaerobic (without oxygen) process must supply part of the energy and lactic acid may be produced. When blood lactate concentration increases, through high accumulation of lactic acid, work becomes subjectively very strenuous and a decrease in the body's pH affects muscular tissue, respiration and other functions.

Exercise and heart rate in children

Heart rate has been defined as the number of times the heart beats in a minute (Amusa Abass, 2002). The impact the blood makes on the arteries as the heart contracts in a certain period when converted to standard measures in beats per minutes is called heart rate.

Many researchers have reported reduced heart rate at rest and at fixed intensities of sub maximal exercise following aerobic training. Training decreased heart rate by 6.6 bpm under resting conditions and by 3-9bpm during maximal exercise. Amusa and Abass (2002) agreed to the aforementioned statement and said that training gives an excellent resting condition. This excellent cardio respiratory condition is due to increased efficiency of the heat muscles and changes in the nervous system. Also, they further maintained that heart rate of fit individuals return to normal more rapidly than the heart rate of sedentary persons after exercise stimulus.

Research evidence by Tipton And Sanders (2004) shows that in both female and male endurance athletes resting, highly trained female heart rate may approach 40 b – min – 1 or less. They maintained that during exercise, heart rate increase linearly with increasing work or Vo_2 and maximal heart rate is slightly lower, if any, in trained versus untrained persons, most especially among eighteen to thirty year old persons, maximal heart rate may approach or exceed 200b. min^{-1}, and thereafter it generally decreases with age. According to them, they showed that once maximal stroke volume is achieved (which generally occurs between 40% and 60% of maximum work rate), further increases in cardiac output are caused by increase in heart rate alone.

During sub-maximal exercise, females tend to have a higher heart rate at any given work rate than their male counterparts. This is because females tend to have a greater cardiac output and smaller stroke volume for the same Vo. Freedson and Miller (2000) in their study show that following exercise, heart rate follows a two phase recovery pattern. Initially (i.e within seconds up to two minutes), heart rate decreases rapidly after exercise is stopped (phase I response), which is followed by a slower decline to near pre-exercise values over the next 2 to 10 minutes (phase II responses).

According to them, they pointed out that a relatively slow heart rate coupled with a relatively large stroke volume indicates an efficient circulatory system. This is true because for a given cardiac output, the heart does not beat often. It is evidently clear that one can use heart rate response guide intensity or severity of exercise and also assess the effect of a training regimen. However, these uses should be applied on an individual basis only, because heart rate responses to both acute exercise and exercise training differs very considerably from one person to another.

Cardiac Output During Prolonged Exercise

Certain changes have been observed in cardiac output, stroke volume and heart rate for short term (5 to 10 minutes). Like Vo_2 and pulmonary ventilation, in each case, there is a sharp rise at the onset of exercise followed by a more gradual rise and then a leveling off or steady state plateau.

Markoff and Schoenfield, (2004) revealed that during prolonged submaximal work (over 30 to 60 minutes) in a warm environment, cardiac output is maintained over the course of the exercise but stroke volume and heart rate are not. Stroke volume gradually decreases and heart rate gradually increases as exercise progresses. This is sometimes referred to as cardiovascular drift, because the changes are opposite in direction and equal in magnitude; cardiac output remains fairly constant. Thus, in prolonged efforts, they express that it is not surprising to find near maximal heart rates by the end of the performance. It has been estimated in their reports that during a 2 ½ hour marathon race, in which energy requirements are about 75% to 85% of maximum, heart rate was maximal for as long as 1 hour or so.

Research evidence by Okely and Patterson (2001), Ustalo and Rusko (2008) and Tiplon and Sanders (2004) show that the reason behind the increase in stroke volume during prolonged exercise has to do with both body temperature and plasma volume. According to them, during moderate intensity exercise in a warm environment, blood is distributed to both the skin and active skeletal muscles. The increase in cutaneous blood flow helps lessen through conduction, convection and evaporation, the increase in body care temperature. However, because of this, less blood is returned to the heat. Additionally, they said that during exercise, fluid (water) moves from the blood into the surrounding cells and tissue. This is due in part, to increase in mean arterial pressure and the compression of venules due to muscle action. This shift in blood fluid decreases plasma volume which further reduces the amount of blood returned to the heart.

Systolic and Diastolic Pressures

Research report by Lurbe, Sorof and Daniel (2006) shows that pressures fluctuate in the cardiovascular system, with the highest values noted in the left ventricle during systole. During any cardiac cycle, the highest arterial pressure obtained during the contraction phase is called the systolic pressure. According to them, as blood drains from the arteries during ventricular diastole, the intra-arterial pressure decreases to a minimum (diastolic pressure). These pressure fluctuations are minimized, and infact are absent in the capillaries, because the arteries are elastic and recoil during diastole. The elasticity of the arteries plus an added arterial resistance to flow insures a steady flow of blood in the capillaries that diffusion of gases and other nutrients take place.

Exercise and blood pressure in children

Blood is the liquid medium that circulates within the vascular system which can be divided into cellular and non-cellular components and functions to transport gases, nutrients, and waste products; clot and decrease injury severity; aid in acid-base buffering, immune functions, tissue repair, and thermoregulation.

The pressure within the cardiovascular walls is termed blood pressure. Blood pressure (Bp) is a measure of the force or pressure exerted by the blood on arteries. The highest pressure (systolic Bp) reflects the pressure in the arteries during systole of the heart when myocardial contraction forces a large volume of blood into the arteries. Following systole, the arteries recoil and the pressure drops during diastolic or the filling phase of the heart diastolic. Blood pressure is the lowest pressure in the artery during the cardiac cycle.

Regular moderate intensity aerobic activity (40% to 60% of maximum aerobic consumption) may be beneficial for both the prevention and treatment of hypertension, lowering SBP (Systolic blood pressure) by approximately 10mmHg. This position was corroborated by Markoff's (2007) study, that clinical trials have shown that aerobic activity may reduce blood pressure in hypertensive and non hypertensive (normal blood pressure) individuals independent of changes in weight.

Kelly & Kelly (2000), Adefuye & Akeredolu (2006) and Markoff & Schoefodd (2004) in their research finding, concluded that a reduction in blood pressure is associated with aerobic exercise in hypertensive participants. The mechanisms by which aerobic exercise may lower blood pressure has been shown to be due to the fact that aerobic exercise can reduce the blood level of nor-epinephrine which limits the vasoconstriction of the arterioles allowing for less peripheral resistance to blood flow. Kravitz (2007) went further that "in addition, there is an increase in the parasympathetic activity with a minor decrease in sympathetic discharge leading to a lowered resting heart rate which leads to reduction of high blood pressure. Markoff (2007) stated that studies have demonstrated that aerobic exercise reduces insulin resistance and insulin levels in hypertensive patients. He concluded that this effect of aerobic exercise on insulin therefore might be one possible explanation for the beneficial effects of regular exercise on blood pressure.

Many recent studies have shown that regular aerobic exercise (work outs like brisk walking, that use large muscles for an extended period) over several months may modestly lower blood pressure. Hoeger and Hoeger (2000) further contended that without changes in body weight, those children who participate in aerobic exercise regularly tend to have reductions in resting blood pressure. Makoff and Schoenfield (2004) reported that a two-week regular exercise programme revealed insignificantly greater reduction in diastolic (bottom chamber) blood pressure as compared to white participants. The result of the study shows that aerobic exercise is a suitable treatment and can even play a role in the prevention of hypertension.

According to Kelley and Kelley (2000), blood pressure is a measure of the force or pressure exerted by the blood on the arteries. The highest pressure (systolic BP) reflects the pressure in the arteries during systole of the heart when myocardial concentration forces a large volume of blood into the arteries. Following systole, the arteries recoil and the pressure is the lowest pressure in the artery during the cardiac cycle. Resting systolic BP usually varies between 110 and 140mmHg, and diastolic BP between 60 and 80mmHg. Usually a person is not classified as hypertensive unless the BP remains elevated (>140/90mmHg) on two occasions. The difference between systolic and diastolic blood pressures is known as the pulse pressure (Heyward, 2002).

Wilmore et al (2001) warned that during aerobic exercise bout, systolic and diastolic blood pressures may show dramatic increases, which suggest that caution should be observed in persons with cardiovascular disease. The extent of the increase in blood pressure is dependent on the time the contraction is held, the intensity of the contraction, and the amount of muscle mass involved in the contraction. They further said that the more dynamic forms of aerobic training such as circuit training that involves moderate resistance and high repetitions with short rests are associated with reductions in blood pressure.

Wilmore et al (2001) in their study, show decrease in diastolic blood pressure, while others, in a research study discovered no change in blood pressure, Heyward (2002) therefore noted that the effect of aerobic training on blood pressure varies largely due to difference in study design, which suggests that more research is necessary to clearly understand the role of exercise training in blood pressure management.

It has been shown that the rise in blood pressure depends on the type and intensity of exercise. Amusa and Abass (2002) went further to state that because mean arterial pressures is equal to cardiac output times total peripheral resistance, the observed increase in mean arterial pressure results from an increase in cardiac output that overweighs a concomitant decrease in total peripheral resistance. They continued that this increase in mean arterial pressure is a normal and desirable response to exercise. From their results, they asserted that “without such a resetting, the body would experience severe arterial hypertension during intensive exercises”. Amusa and Abass (2002) showed that “resting blood pressure is generally lower in the trained and conditioned individual than in the sedentary person”. This, they said is because cardiac muscle being a skeletal muscle, displays adaptations to exercise after exposure to several bouts of exercise by using stronger beats, larger stroke volume and greater cardiac output.

Effect of Aerobic Training on Blood Pressure

Blood pressure (BP) is a measure of the force or pressure exerted by the blood on the arteries. The highest pressure (systolic BP) reflects the pressure in the arteries during systole of the heart when myocardial contraction forces a large volume of blood into the arteries.

Management of Blood Pressure

Blood pressure is measured in millimetres of mercy (mmHg) and is written:

Systolic

Diastolic

A sphygmomanometer is used to measure blood pressure. McGlynn (2001) provided the following steps for measuring blood pressure:

1) Have the individual sit comfortably on a chair with the left arm at heart level and supported on a table.
2) Place the air-tight blood pressure cuff on the arm just above the elbow and securely wrap it round.
3) Place the stethoscope over the artery in the centre of the elbow crease and hold it firmly.
4) Hold the bulb in your hand so that you can open and close the screw valve with one hand.
5) Close the valve and pump air into the cuff by pressing the bulb. As the cuff becomes tighter, it compresses a large artery in the arm - the brachial artery. This temporarily cuts blood flow to the foreman. Inflate the pressure to approximately 160-180 mm Hg as read on the pressure gauge.
6) Slowly open the screw valve, letting air escape and watch the fall on the pressure gauge.
7) Listen for the pressure of a beat or thumping sound (Korotkoff Sound) and mark the pressure at which the sound was first heard. This will be systolic pressure.
8) Continue to decrease the cuff pressure while listening for the beat sound. When the beat sound disappears, mark the pressure level and record the number as diastolic pressure.
9) Record as shown below:

Blood Pressure (BP) = Systolic BP = mmHg

Diastolic

BP=mmHg

Anatomy and Physiology of the Respiratory System

The upper respiratory tract includes the nose, nasopharynx, larynx, and trachea. The volume of gas that fills the upper respiratory tract, down to and including the larynx, constitutes about half of the volume of inhaled gas that does not exchange with blood.

The trachea with its cartilaginous rings, extend from the lower part of the larynx (at the level of the sixth cervical vertebrae) to the upper border of the fifth thoracic vertebrae. Here it divides into two main-stem (bronchi). The right main-stem bronchus is wider and shorter than the left. Since it deviates less from the axis of the trachea than the left, foreign bodies enter the right main-stem bronchus more easily than the left.

The right main-stem bronchus gives rise to

1) the lobar bronchus of the right upper lobe and
2) intermediate bronchus, which then divides into bronchi supplying the middle and the lower lobes.

The left main-stem bronchus gives rise to the upper and lower lobar bronchi, since the left lung has only two lobes.

The conducting airway includes the trachea, the main-stem bronchi, the lobar and segmental bronchi and additional branches down to and including the terminal bronchioles.

In man, each lung has its own separate pleural sac. The intra-pleural sac is located between the visceral and parietal membranes. It is a true space in healthy individuals averaging some 20 micrometers in thickness. The inter-pleural space contains a small amount of fluid, which is thought to arise from the parietal pleural and visceral pleural surfaces of the lung. This fluid is transported downward and removed by lymphatic-like structure located in the parietal pleural and diaphragm. The pleural fluid is sub-atmospheric at the top of the lung relative to the bottom of the lung.

Blood Supply: The lung is served by two sets of blood vessels. One set of the vessels is derived from the low-pressure pulmonary arteries and is responsible for supplying the blood involved in gas exchange. The other group of vessels arises from the high-pressure bronchial arteries and supplies the blood to meet the metabolic needs of the larger airways, visceral pleural and large pulmonary vessels. The pulmonary arterial system accompanies the bronchial tree down to the level of the alveolar ducts where it terminates in a dense network of capillaries in the alveolar walls.

The surface area of the alveolar capillaries is tremendous and facilitates gas exchange in the lung. The pulmonary venules arise primarily from the pulmonary capillaries of the alveoli. They coalesce into the pulmonary veins, which do not accompany the corresponding bronchial and arterial tree, but instead the pulmonary veins course in the intralobar septa to the hilus.

The bronchial arteries generally arise from the thoracic aorta but can originate from the intercoastal, the internal mammary, and subclavian arteries.

The bronchial arteries accompany airways down to the level of the terminal bronchioles, where they merge with the pulmonary capillaries and venules. There are extensive post-capillary anastomoses between the pulmonary and bronchial circulation, but venos blood from the large bronchi drains into the bronchial veins, which empty into the azygous and hemi-azygous veins.

Lymphatics: Pulmonary lymphatics, which remove fluid from the pulmonary interstitium, are found superficially in the visceral pleural as well as deep within the lung in the peribronchial and perivascular spaces. These lymphatics surround the blood vessels and bronchi and extend down to respiratory bronchioles. No lymphatic have been found within alveolar walls. The larger lympahtics contain one-way valves, which prevent reflux of lymph from the superficial back to the deep lymphatics. The lymphatics have an intrinsic pumping action that provides the pressure necessary to propel lymph through these valvular structures. In human, most lung lymph enters the right lymphatic duct, and only the left upper lobe drains into the thoracic duct. In contrast to pulmonary interstitial fluid, the pleural fluid is cleared via the extensive lymphatic system in the chest wall through structures called Lacunae, which are most abundant in the lower region of the chest wall.

Functions of the Respiratory System

The functions of the respiratory system according to Christopher, Aaron, Kelly, Dan & Kaiser (2007), include the following:

1. Gas exchange
2. Speech

Gas exchange: This is the major function of the lung. They further said that the lung makes essential oxygen (O_2) available to the body and it carries away carbon Dioxide (CO_2) resulting from respiration processes within the cells of the body. This process is what has been described as external respiration.

The normal human usually breathes 15 times per minute and each breath contains approximately 500 ml of air. Thus, the lung ventilates at least 10,800 1/day. About 600 of oxygen are transferred from the inspired into the pulmonary blood, whereas 460 1/day is combined with hydrogen (H_2) to form water (H_2o).

Speech: The thoracic cage can be thought of as a respiratory bellows that supplies expiratory gas flow to the vocal apparatus for speech. This gas flow is generated by the elastic recoil of the lungs and chest wall and by contraction of the contraction of the expiratory muscles. The inspiratory muscles can modify the expiratory forces in order to fine-tune the driving pressure that forces gas through the vocal cords. Experienced speakers and trained singers exert precise control over the size of the glottis and supravocal tracts. Pitch, loudness, and quality of the voice depend upon an exact interaction of the functions of the chest cage with those of the glottis and supravocal cord tract. This precise control of speech requires that carefully programmed sets of nerve impulses be relayed to the speech apparatus.

Physiological basis of respiration

According to Christopher et al (2007), the respiratory system consists of two parts: a pump (the chest wall) and a gas exchanger (the lungs). The study of the lung mechanics deals with the pressures acting on this system and the exchanges in volume that they produce.

The pressures developed by the respiratory muscles are necessary to overcome:

1) The elastic properties of the lung and the chest wall and
2) The flow-resistive properties of the airways

The respiratory pump consists of three parts:

a) the rib cage and its associated muscles,
b) the diaphragm
c) the abdomen and its muscles

Inspiration: the major muscle of inspiration is the diaphragm, which is made of two functionally distinct parts that have different segmental innervations and embryologic origins. The crural portion of the diaphragm extends from the spinal column to the central part tendon and lies in the posterior portion of the thoracic cavity. The coastal portion of the diaphragm attaches to the ribs at one extreme and to the central tendon at the other. As the coastal portion contracts, the abdominal contents resist displacement and act as a fulcrum. Thus, as the diaphragm shortens the ribs are lifted up, increasing the transverse diameter of the thoracic cavity. Contraction of the crural portion only displaces the abdomen, since it lacks attachment to the rib cage.

During exercise and vigorous breathing manoeuvres, the accessory inspiratory muscles are brought into play. These are the scalene muscles, which elevate the first two ribs and the stennum and the sternocleidomastoids, which elevate the sternum.

According to Christopher et al (2007), the role of internal and external intercoastal muscles in breathing process has been questioned. The muscles are now believed to play more of a role in posture than in breathing. The scalene muscles act to elevate the sternum causing the anterior-posterior diameter of the rib cage to increase during inspiration.

Expiration: Expiration is normally a passive process but with exercise or increased demands on the system, expiration becomes an active process. In conditions that require active expiration, the major expiratory muscles are those of the abdominal wall:

1) the rectus abdominis

2) the internal and external oblique muscles

3) transverses abdominis

Contraction of the abdominal muscles increases the intra-abdominal pressure, forcing the diaphragm upward. The internal intercoastal muscles, which displace the ribs down and backward also assist in expiration.

Exercise training program for improving Cardio-Respiratory Function

Active aerobic activities bring about adaptation in the functioning of the respiratory system. Thus, at rest, there is increase in the depth of respiratory and respiratory rate is reduced.

A well planned aerobic training programme brings about an improved respiratory function enhancing the achievement of the set objectives. Research evidence by Sonetti, Wetter, Pegelow and Dempsey (2001) reveal that respiratory muscle fatigue can lead to exercise limitations even in normal young subjects, but there is evidence that the diaphragm and other respiratory muscles are trainable like other skeletal muscles. Furthermore, studies have shown that exercise needs to be of sufficient duration and intensity to produce physiological effect. ACSM (2009) recommended the following for an exercise programme for healthy individuals to develop and maintain total fitness:

1. Frequency of training 3 to 5 days per week

2. Training intensity of at most 60-90 percent of maximum heart rate (HR) or 85 percent of VO_2 max or maximal HR reserve
3. Duration of training: This should be at least 15 to 60 minutes continuous aerobic activity. Thus, activity of lower intensity should be conducted over a longer period of time. This enhances the effect of total fitness as it more easily attainable in longer duration programme. Low to moderate intensity activity of longer duration is recommended for non athletic adults due to the potential hazards and problems associated with high intensity exercise.
4. Mode of activity: Any activity that uses larger muscle groups that can be maintained continuously and is rhythmical and aerobic in nature is recommended - exercises such as running, jogging, walking, swimming, skiing, bicycling, rowing, cross-country, rope-skipping and various endurance game activities. They could also be dancing and stair-climbing.

Relevance of Aerobic Exercise to Respiratory function indices

Forced vital capacity

The indices have been known to be the total volume of air that can be exhaled from the lungs during a forced expiration following maximal inhalation. It is usually measured in liters. The mean values obtained from a reported study by Orie (1999) for Kenyans male and female participants are 4.31±0.08 and 3.19±0.09 respectively.

Forced expiratory volume in 1st second is the maximum volume of air, which can be expelled in the first second of maximal expiration after a maximal inspiration and it indicates how quickly full lungs can be emptied.

Orie (1999) in a study assessing the respiratory function of African participants used FEV_1 as a fractional percentage of vital capacity or forced vital capacity to show the influence of age, sex and subject's stature.

Forced Vital Capacity (FVC) and Forced Expiratory Volume in 1st second (FEV_1) are strong indicators of lung functions, which decline due to obesity and sedentary lifestyle. Inselma, Milanese and Deurloo (1993) and Jakes, Day, Pate, Khaw, Oakes and Luben, et al. (2002). Research indicates that men who remained in the active lifestyle during the follow up (19months) showed 50ml improvement in their FEV_1 and 70ml in their FVC, whereas subjects who remained in sedentary lifestyle had 30 and 20ml reduction in their FEV_1 and FVC respectively.

These observations suggests that young overweight and Obese subjects with sedentary lifestyle are at a higher risk for deterioration of their respiratory indices and may be at risk for developing chronic obstructive pulmonary disease in adulthood. Hence, appropriate interventions, such as prescribed physical activity programs, may prevent lung function deterioration in these young subjects.

Recent studies have shown that VC of female college student progressively decreased yearly in China, and the decreased VC has recently been substantiated to induce the respiratory and cardiovascular diseases. Clinic trials have shown that aerobic exercise plays an important role in improving the function of respiratory system.

Previous studies provide conclusive evidence that supervised physical activity like Yoga and Taichi chuan exercise can improve lung function in men and asthmatic children. Charavinut, Khadjaphu, Jaree and Pongnaraton (2006) and Chang, Yang, Chen, Chang and Tai (2008). Radovanovic, Alksandrovic, Stojiljkovic, ignsatovic popovic and Marinkovic (2009), reported FVC and FEV_1 enhancement after programmed physical activity in preadolescents.

Courteix, Obert, Lecoq Guenon and Koch (1997) found that intensive swimming pre-puberty enhances static and dynamic lung volumes. Khalil, Elkins, (2009) showed that an 8-week programme of aerobic exercise can improve lung function in children with intellectual disability.

Other studies by Reza-Farid et al. (2012) revealed that measurement of FEV_1 showed an increase in the case group but decrease in the control group after engaging in an eight week aerobic exercise plan. It can be explained that as both groups had similar conditions at the beginning of the study, aerobic exercise caused the increase among the asthmatic patients.

Other results correspond with Emtner, who prescribed 10 week rehabilitation exercise in water for asthmatic patients Emtner, Herala and Stalenheim (1996) and also with Beri who showed an increase in FEV_1 in fourteen patients after doing swimming exercise. Berry, and Walschiager (1998). However, the result obtained by Reza Farid, et al. (2012) had no conformity with the study done by Farzard Ghafoori (1993). This could be attributed to the difference in the administrative protocol (sport program) in the two studies. In Reza Farid, et al. (2012) study patients performed aerobic exercise three sessions in every week for eight weeks, but in (Farzard Ghafoori, 1993) study, asthmatic patients did tensile exercise for one session after which effects of such an exercise on FEV_1 changes were measured.

Research evidence by Swan, Ruby, Sharkey and Puchkoff (2009) revealed that improvement in exercise to FVC shared direct link to long term effect of exercise than the short term. They concluded that without immediate demand on cardiovascular functions such as stroke volume, cardiac output, there may not be any need for increment in the high oxygen uptake that usually propel content of the air in the lung. Results from their study further submitted that a person who is born and dwell at sea level (as applicable to the participants in this study) may develop a slightly smaller lung capacity than a person who spends their life at high altitude. This is simply because the partial pressure of oxygen is lower at higher altitude, which by implication means that oxygen les readily diffuses into the blood stream. In response to higher altitude, the body's diffusing capacity increases in order to enhance more oxygen consumption.

This further implies that athletes that hails from higher altitude regions of the world may possesses higher lung capacity than their counter parts in the lower altitude regions, this has nothing to do with clinical malfunctions but rather related to physiological adaptations.

One of the important advantages of sport activity or aerobic exercise in asthmatic patients is their accumulative desensitization on fear of dyspnea. The aerobic exercises can increase the asthmatic patient's residual air flow and decrease ventilation with reinforcement of bronchi expansion during an exercise. This makes an asthmatic patient save a air flow during exercise. Less than five minute sport activities with low severity can improve asthma and it's symptoms.

Research reports by William, Katch, Katch (2000) in a study showed patients started the exercise with four and half minutes of walking and thirty seconds of jogging in the first week. In the next weeks, walking time was decreased and jogging time was increased gradually as in the end of the eight week, patients had no discomfort feeling or dyspnea with the pattern of ten minute walking and ten minute jogging.

Studies show that sport exercises can increase residual airflow in asthmatic patients. William, Katch and Katch (2000). Other studies by Reza Farid, Farahzad, Ahmad, Mahmoud, Asghar Mojtaba, Javad and Ramon (2012) also showed that asthmatic patients were able to have more powerful and more effective inspiration and expiration after three sessions of eight weeks of aerobic sport exercises as opposed to what they had been able to do before participating such aerobic sport exercises.

It can be concluded that this study shows that a course of aerobic, aerobic sport exercise causes an obvious increase in FEV_1, FVC, PEF and FEF 25%, 75% in asthmatic patients, and a regular aerobic sports program can be complementary to medical treatment in asthma rehabilitation.

It may also be suggested that the method of exercising and regular short duration sports activity are involved in the improvement of pulmonary function. By implication, it shows that aerobic exercise in asthmatic patients lead to an improvement in pulmonary functions, and that aerobic exercise rehabilitation can be a complement to medical treatment of asthma.

Peak Expiratory Flow Rate (PEFR)

This is the maximal expiratory flow obtained at any point during a forced expiratory maneuver. It is recorded in liters/second. Report evidence by Lee & Shy (1999), Orie (1999), and Jaja & Fagbenro (1995), reveal that low values of peak expiratory flow are obtainable when expiratory muscles activities are weak or when there is an obstruction to expiratory air flow as identified in asthma patient.

Peak Expiratory Flow Rate

The peak expiratory flow rate (PEFR, also known as a peak flow) is the maximal rate that a person can exhale during a short maximal expiratory effort after a full inspiration. In patients with asthma, the PEFR percent predicted correlates reasonably well with the percent predicted value for the forced expiratory volume in one second (FEV_1).

Peak Expiratory Flow Rate (PEFR) is the maximal expiratory flow rate achieved and this occurs very early in the forced expiratory maneuver. The peak expiratory flow rate measures how fast a person can breathe out (exhale) air. It is one of many tests that measures how well your airways work. It is a simple method of measuring airway obstruction and it will detect moderate or severe disease David, Johns and Rob (2003).

Impaired pulmonary functions are associated with increased mortality and morbidity Blair, Kampart and Kohl (1996). Schineman, Don and Grant (2000), and Neas and Schwartz (2009). Physical activity is known to improve physical fitness and to reduce morbidity and mortality from numerous chronic ailments USDHHS (1996). There are few studies on aerobic exercise and pulmonary function in general populations Twisk Staal and Brinkman (1998). Most studies on the effect of physical activity are cross-sectional ones on special populations such as athletes or patients with chronic obstructive pulmonary disease Burchfiel, Enright and Sharp (1997); Doherty and Dimitriou (1997) and Malkia and Impivaara (1998).

Physical activity rehabilitation is widely used in patients with pulmonary diseases. Exploration of the relation between aerobic exercise and respiratory functions will aid in understanding the mechanisms of how aerobics improve patient's quality of life and in finding a better way to evaluate the effects of rehabilitation.
Physical activity and low cardiorespiratory fitness are recognized as important causes of morbidity and mortality US DHHS (1996); Twisk Staal and Brinkman (1996). It is generally accepted that people with higher levels of physical activity tend to have higher levels of physical fitness and that physical activity can improved cardio-respiratory fitness. Burchfiel, Enright and Sharp (1997).

In a prospective study, PEFR increased significantly in the experimental group after 16weeks of aerobic exercise plan. They maintained that as both group had similar conditions at the beginning of the study aerobic exercise caused the increase among the experimental group. Thus, an association between aerobic exercise training and improvement of lung function was supported by the data.

Other studies comparing respiratory function among men and women engaged in various sports found that sports persons have higher level of function Mehrotra, Varing and Tiwari (1998) than sedentary people. The result of their study which correlates with Chang, et al. (2003) who showed that physical activity improved pulmonary function in healthy sedentary people.
The result of their study also corresponds with Reza Farid, et al. (2005) who have showed on improvement in pulmonary function with aerobic exercise training in asthma patients. Nourrey, and Deruella (2005) showed in a prospective study that aerobic exercise improves pulmonary function and alters exercise breathing pattern in children. Other research reports by Fitch and Mortan et al. (2001) who studies the effect of 5 month swimming training on school children with asthma and found improved lung function, and improved posture and fitness.

Other studies have shown in their study that distance running programme improve fitness in asthmatic children without pulmonary complications or changes in exercise induced bronchospasm. Similarly, Clark (1998) in his study found that cardiorespiratory fitness significantly improved and breathlessness decreased over a wide range of work corresponding to activities of daily living. Brutsaert, et al. (2006)

in agreement with the above statement, opined that the school children are in high risk of pulmonary complication with impaired respiratory functions and inefficient respiratory muscles, leading to decrease in lung volume and respiratory muscle performance. It is believe that with increase inactivity level and sedentary lifestyle, respiratory muscles get in filtrated with fat and becomes flabby and weak and hence ineffective. Christopher Kaufman, et al. (2007) studied the effect of aerobic training on ventilatory efficiency in overweight children, and found that the training helped to reverse the decrement in cardiopulmonary function observed in overweight children.

Monitoring the PEFR is useful for detecting changes or trends in a patient's asthma control, although significant testing variability makes it important to confirm or exclude airflow limitation with a more reliable test, such as spirometry.

Role of PEFR Monitoring

The optimal role of long-or-short-term daily monitoring in the ongoing management of asthma is unknown. The theoretic advantage is that daily PEFR monitoring can provide the patient and clinician with objective data upon which to base therapeutic decisions (1). However, adherence to long-term monitoring is difficult to maintain (2). According to some reports, adherence with home PEF recording is satisfactory in the short term, but falls off considerably after several months. This suggests a significant limitation to this form of monitoring (3,4). While patient adherence to PEFR monitoring is highly variable, connecting its use to the production of data relevant to concrete self-management activities may increase adherence (5).

Studies evaluating the efficacy of PEFR monitoring for improving various outcome measures in asthma have yielded conflicting results (6-19). A number of studies failed to demonstrate an advantage of using PEFR monitoring over symptom monitoring to guide self-management actions (6-8, 11, 13-5). Studies that demonstrated an improvement in outcomes, such as decreased health care utilization and improved quality of life, included a comprehensive management approach, which did not separate out the specific effect of PEFR monitoring (9, 12, 19). Further research on the efficacy of regular peak flow monitoring by patients is needed.

Peak expiratory flow rate monitoring in asthma (predictors of Asthma and Respiratory health in children)

What is Peak Flow Measurement

Peak flow measurement is a procedure in which air flowing out of the lungs is measured. The measurement obtained is called the peak expiratory flow rate (PEFR), or peak expiratory flow (PEF).

Peak flow measurement may be obtained using a spirometer, an instrument with a mouth piece that measures the amount of air breathed in and/or out and the rate at which the air is inhaled and expelled from the lungs. Peak flow may also be measured with a peak flow meter (PFM), a portable, hand-held device. Both devices take the measurement as an individual forcefully blows into the mouthpiece of the device.

Spirometry is usually performed in a doctor's office, clinic, or a hospital. A peak flow meter is small and light enough to be used almost anywhere.

There are several types of PFMs available. However, it is important that one continues to use the same type of PFM on a consistent basis, as the PEFR can vary among different brands and types of meters.

Peak flow measurement using a peak flow meter is particularly useful for individuals with asthma. During an asthma flare-up, the large airways in the lungs slowly begin to narrow. This slows the speed of air leaving the lungs. A peak flow meter, when used properly, can reveal narrowing of the airways well in advanced of an asthma attack. Peak flow meters can help determine:

- When to seek emergency medical care
- The effectiveness of an asthma management and treatment plan
- When to stop or add medication as directed by a doctor what triggers the asthma attack (such as exercise-induced asthma)

Other related procedures that may be used to diagnose problems of the lungs and respiratory tract include chest X-rays, bronchoscopy, bronchography, chest fluoroscopy, chest ultrasound, lung biopsy, lung scan, mediastinoscopy, oximetry, positron emission tomography (PET scan), pleural biopsy, pulmonary angiogram, pulmonary function tests, sinus X-ray, and thoracentesis. Please see these procedures for additional information.

A peak flow meter (PFM) can assist with the management of asthma. It can provide you and your doctor with information about how open the airways are in your lungs. The PFM can detect small changes in the large airways before you start to wheeze.

Using a PFM every day will let you know when your peak flows are starting to drop. This allows you to make early changes in your medication or routine to help prevent asthma symptoms from worsening. The PFM can also identify the value at which you will need to call your doctor or go to the emergency room.

Peak flow meters are primarily used for individuals who have asthma. Your doctor may not recommend that a PFM be used unless your asthma is considered moderate or severe and you are managed with medication(s). Peak flow meters are also useful in children who have asthma.

The measurements obtained by PFMs may also be useful in evaluating other conditions such as:

- **Emphysema:** A chronic lung condition that affects the alveoli, the smallest air sacks in the lungs.
- **Chronic Bronchitis:** Long-term inflammation of the bronchi, which results in the increased production of mucous and a recurrent cough.

Risks of the Procedure

Because obtaining peak flow measurement is a noninvasive procedure, it is safe for most individuals. It is quick and inexpensive. However, the individual must be able to follow clear, simple directions.

Having to take in deep breaths to perform the procedure may cause you to feel dizzy, light-headed, or short of breath.

The procedure may trigger coughing and/or wheezing.

There may be risks depending on your specific medical condition. Be sure to discuss any concerns with your doctor prior to the procedure.

Certain factors or conditions may interfere with the accuracy of peak flow measurement. These factors may include, but are not limited to, the following:

- Coughing during the procedure
- Poor seal around the mouthpiece while performing the procedure
- A dirty meter
- Blocking the mouthpiece with the tongue
- Use of bronchodilator (opens the airways) medication

- Use of a different type or brand of PFM, as the measurements may vary among brands and types of meters.

Before the Procedure

- Your doctor will explain the procedure to you and offer you the opportunity to ask any questions that you might have about the procedure.
- Generally, no prior preparation, such as fasting, fluid restriction, or sedation is required. However, you may be asked to avoid eating a heavy meal before the test.
- Notify your doctor of all medications (prescription and over-the-counter) and herbal supplements that you are taking.
- Prior to beginning routine daily PFM monitoring, your doctor may instruct you to perform PFM on a more detailed schedule over two to three weeks in order to establish your "personal best" peak flow measurement. This personal best value will be used as a baseline for your routine measurements.
- Based on your medical condition, your doctor may request other specific preparation.

During the Procedure

Peak flow measurement may be performed one or more times daily at the same time of day, whenever you are experiencing early warning signs of an asthma attack, or as otherwise directed by your doctor. You should always use the PFM before taking asthma medication. Your doctor may recommend other times when using a PFM is useful.

Generally, peak flow measurement follows this process:

1. Before each use, make sure the sliding pointer on the PFM is reset to the zero mark.
2. Hold the PFM by the handle.
3. Stand up straight.
4. Remove chewing gum or any food from your mouth.
5. Take a deep breath and put the mouthpiece in your mouth. Seal your lips and teeth tightly around the mouthpiece.
6. Blow out as hard and as fast as you can. Remember, a "fast blast" is better than a "slow blow."
7. Note the number where the sliding pointer has stopped on the scale.

8. Reset the pointer to zero.
9. Repeat this routine three times. You will know you have done the technique correctly when the three readings are close together.
10. If you cough during a measurement, you should repeat it.
11. Record the highest of the three readings on a graph or in a notebook. Do not average these numbers together. This is called your peak flow.
12. Use the peak flow meter once a day, or as directed by your doctor. Measure peak flows about the same time each day. A good time might be when you first wake up or at bedtime.

Blood Pressure (BP)

Blood Pressure (BP) is a measure of the force or pressure can be indirectly measured by using a sphygmomanometer, an externally applied inflatable cuff attached to a pressure guage and a stethoscope.

The pressure at which the 1st sound (Korot Kuff) is heard is recorded as the systolic blood pressure, while the least sound heard is denoted as diastolic blood pressure. They are both measured in mmHg milligraph.

Systolic Blood Pressure (SBP)

This is the maximum pressure exerted in the arteries when blood is ejected into during systole. It averages 120 mmHg. On other hand, diastolic blood pressure (DBP) is the minimum pressure within the arteries when blood is draining off into the reminder of the vessels during diastole; it averages 80 mmHg.

Blood pressure refers to the force by which the blood exerts against the wall of the vessels in which it is contained. It is this pressure that moves the blood through the circulatory system. Kelly and Kelly (2000). According to them, Blood pressure rises considerably during exercise as a result of cardiac output and nervous influences which affects systolic pressure more than diastolic pressure.

Review of research evidence by Laurent, Boutouyrie, Asmar, Gautier, Laloux and gaze, et al. (2001) and Milla, Kelly, Ritter, Chowienczyk (2002) showed that age-related increases in large artery combined with sedentary lifestyles has a direct effect on Cardiovascular mortality in hypertensive patients. High blood pressure among others has been found to cause severe anaemia, aortic regulation and extreme techy cardia. These conditions can cause restriction of blood supply to the myocardium because of the coronary arteries blockade. Lurbo, Sorof and Daniels (2006). They further stressed that patients with cases of coronary arterial diseases were found to have normal partial oxygen pressure (PO_2), but reduced partial carbondioxide pressure (Pco_2). The high blood pressure (SBP) increased with workload. These factors all combined can contribute to insufficient blood supply.

Guerra, Riberto, Casta, Duarte, and Mota (2002) and Dasgupta, O' Loughlin and Chem (2006) previous studies provided conclusive evidence that variations in the value of SBP is relative and specific with different age bracket. They further explained that the absolute values for boys and girls were identical up to age nine and clearly so to age 14, and that because of morphological changes taking place in this age-range, values for girls may slightly increase up to age 16.

They further showed that SBP of healthy children between 100-120mmHg is considered as being normal for this class of young school children, and there was no significant difference between the male and female children of similar age groups.

Other reported studies by Boroface, et al. (2002) on mean SBP of 115.72mmHg, they reported 5.7% reduction in resting systolic blood pressure, according to them these effects are pointers that regular exercise contributes positively to health and wellness of individuals. The outcome of this study was consistent with the observation made by Guerra, Ribero, Costa, Duarte, and Mota (2002) that the values for girls may slightly increase up to 16. It further justify that 8-week intervention training may not have significant changes in the resting systolic blood pressure of performer who shared the same age range in the temperate region of the world.

Research evidence by Markoff and Scheonfield, (2004) showed that the rise in Blood pressure with exercise depends on the type and intensity of exercise. Isometric exercise brings about higher rise in blood pressure than dynamic exercise. They further stressed that high intensity exercise has higher effect than low intensity exercise. Blood pressure is measured in millimeters of mercury (mmHg) with the arterial blood pressure exposed as the systolic value over the diastolic value.

Some recent studies have shown that Resting Systolic Blood Pressure using varies between 110mmHg and 140mmHg and diastolic BP between 60mmHg and 80mmHg. Usually a person is not classified as Hypertensive unless the BP remains elevated (2140/90mmHg) on two occasions. The difference between systolic and diastolic blood pressure is known as the pulse pressure. Heyward (2002).

Diastolic Blood Pressure

Diastolic blood pressure is known to be ---------- recent reports have shown that aerobic exercise improves DBP in children. Rowland, et al. (2005) and Kelly and Kelly (2002) who found a mean of 82.11 ± 8.41mmHg, observed that these effects are pointers to the fact that regular exercise contributes positively to health and wellness of individuals, most especially with the children population, and also as a way of avoiding or reducing the risks of hypertension among this group.

The key observation is that positive. Lurbe, Sorofs and Daniels (2006) reported that exercise have little or no effect on the likely changes related to diastolic blood pressure except in low humid environment where slight changes are noted.

They further state that similar separation of age-specific values by sex occurred with DBP but not until age 16, after which DBP decreased for girls, DBP values were noted to be more nearly equal for boys and girls at all ages, but did separate at age 12, with girls having the higher values and DBP have more lesser slopes of changes than did SBP across the whole age range. RSBP was consistently noted to be about 5mmHg lower than RDBP.

Resting Heart Rate (RHR)

This is the number of times the heart beats in a minute. It is usually measured with the aid of a stethoscope on the apex of the heart and counting the number of beats for 15 seconds, after the subject has rested quietly for at least 20 minutes. The value obtained is multiplied by four to get the number of beats per minute.

Physical activity and exercise have profound effects on the cardiovascular system. Rosner, Prineas, Loggie and Daniels reviewed evidence showing that highly trained athletes can record RHR less than 46 beats per minute. The participants in this study may not be rated as highly trained athlete because of undue interferences associated with their academic work and training commitment they engaged in.

Recent studies have shown that maximal heart-rate value has been very difficult to predict even in healthy individuals, because of such factors like age, sex, motivation and measurement techniques which influence it.

Another study carried out by Ustalo and Rusko (2008) revealed that the nature of physiological changes may often not be consistent between male and female subjects, especially when similar training is involved. They further suggest that VO_2 max may reduce in some athletes, as it remained static with others. They advocated for global and regional concerns towards achieving universal standard for gender responses for different training protocol.

The mean heart-rate value of the present study was compared with other reported studies by O’ Neill (2000) who also reported a reduction in resting heart-rate of 73.65 ± 5.8 (bpm), differences between the means were observed. Heart rate at rest is an important index for evaluating the cardiac function. When cardiac function was improved with adaptation to exercise, HR at rest is lower.

Tipton and Sanders (2004) reported from a prospective study that the restoration of HR is another index to evaluate cardiovascular function after an acute exercise. Cardiovascular system with good functions shows a faster recovery after a set of acute exercise.

Maximum Oxygen Consumption (VO_2 max)

This is the maximum amount of oxygen that can be taken up the by the blood and delivered to the cells (also called maximum aerobic power). It is the volume of oxygen consumed by the body under given conditions. It is best indicator of cardiovascular (or aerobic) fitness. The VO_2 max is measured in liters per minute, mi/kg/min.

The highest rate of oxygen consumption attainable during maximal or exhaustive exercise has been defined as VO_2 max. Recent studies have shown that in previously sedentary people, training at 75% of aerobic power, for 30 minutes, 3 times a week over 6 months increases VO_2 max an average of 15-20%. However, this is an average and there are large individual variations with increases as wide ranging as 4% to 93% reported. Research scholars (Novak Ladislav, Bier Haumm and Mellerowicz 2004) portrayed that amongst groups of people following the same training protocol, there will be responders - those who make large gains, and non-responders-those who make little or no gain. Other researchers emphasized that this was originally put down to a simple issue of compliance but more recent research suggests that genetics play a role in how well any one individual responds to an endurance training program. Genetics play a major role in a person’s VO_2 max and heredity can account for up to 25-50% of the variance seen between individuals. According to them, the highest ever recorded VO_2 max is 94ml/kg/min in men and 77ml/kg/min in women. Both were cross country skiers.

Research reports by Ekelund, poortrilet, Nilson, Yngve, Holmberg and Sjostron (2001) reveal that the extent to which VO_2 max can change with training also depends on the starting point. They further stated that there also seems to be a genetic upper limit beyond which further increases in either intensity or volume have no effect on aerobic power. This upper limit is thought to be reached within 8-18 months. Mc Ardle, Katch and Katch (2000) pointed out that crucially, once a plateau in VO_2 max has been reached, further improvement in performance is still seen with training. This is because the athlete is able to perform at a higher percentage of their VO_2 max for prolonged periods. Two major reasons for this are improvement in anaerobic threshold and running economy.

According to them, they maintained that resistance training and intense "burst-type" anaerobic training have little effect on VO_2 max. Any improvement that does occur is usually small and in subjects who have a low level of fitness to begin with. Resistance training alone does not increase VO_2 max even when short rest intervals are used between sets and exercises. Considerable training is required to reach the upper limit for VO_2 max. In fact, peak aerobic power can be maintained even when training is decreased by two-thirds. According to them, runners and swimmers have reduced training volume by 60% for a period of 15-21 days prior to competition (a technique known as tapering) with no loss in VO_2 max.

A number of workers has demonstrated that aerobic capacity of children is highly predictable and that comparison can be made between children of different body weights and the amount of oxygen available for each unit, body unit can be determined.

Laboratory studies and epidemiological investigation have provided convincing evidences that maximal oxygen uptake contributes to the physical work capacity of the active total body mass. This is possible through changes in stroke volume, heart rate and arterious-venous oxygen difference. However, the values of these variables can be affected by coronary diseases. Springer, et al. (2004) they studied the values of maximal oxygen uptake to predict values for various levels of the individuals of the same age, sex and workload. They suggested that training improves the rate of VO2 max by 25%. This also depends on the initial physical fitness of the individual. They reported maximal oxygen consumption normal values are $40ml/02/kg.min^{-1}$ for minimal physically fit individuals while the long distance runners have been observed to consume as high as between 60 and 80ml/02/kg.min-1. The sedentary individuals consumed very low, only about 30ml/02/kg.min^{-1}.

They further showed on PWC 170 that were determined in four sedentary subjects that respiratory training increased between endurance from 4.2(SD1.9) min to 15.3 (SD 38) min on cycle endurance, whereas physical work capacity 170 remains essentially the same.

Furthermore, cardiorespiratory function is also related to the incidence of coronary or circulatory diseases. Health professionals, physiologists and cardiologists are convinced that a developed cardiorespiratory system is a potent factor for either preventing or reducing diseases associated with coronary system. It has also been shown that over 55% of all deaths in some of the industrialized countries of the world are attributed to cardio-vascular diseases. Stampfer, Hu, Manson, Rimm and Willet (2000).

Research study by Carter, et al. (2000) reported that with regular participation in aerobic exercise programme, individuals can increase his/her maximum oxygen uptake as much as 30% within 8-weeks period, depending on individual initial level of fitness. For example, Mc Weigh, (2004) reported VO2 max of 38.51±3.75ml/kg/min from a direct measure of maximal oxygen uptake as opposed to estimates as in the case of this studies. The present study demonstrates that participants in this study had significantly improved in their oxygen uptake capacity than those of the reported studies. The difference might be due to either the conditioning process or fitness and racial difference of the participants. The difference might also partly depends upon a difference in body size, since there is a good correlation between VO_2max during running and body size in these participants.

Effect of Aerobic Exercise Training on Pulmonary Function Test

Forced vital capacity is the volume of the air that can be expired rapidly with a maximum force following a maximal inspiration.

The American College of Sports Medicine (ACSM) defines aerobic exercise as any activity that uses large muscle groups, can be maintained continuously, and is rhythmic in nature. It is a type of exercise that overloads the heart and the lungs and cause them to work harder than at rest.

Research efforts have shown the positive relationship between aerobic training and pulmonary function, other studies comparing respiratory function among men and women engaged in various sports found that sports person have better level of pulmonary function than sedentary people. Mehrotra, Varma and Tiwari et al. (1998). Another study by Cheng, et al. (2003) in which the physical activity improved pulmonary function in healthy sedentary people. Farid, Farahzad, Ahmad et al. (2005) showed an improvement in pulmonary function with aerobic exercise training in asthma patients. Nourrey, Deruelle and Guinhouya et al. (2005) showed in a prospective study that aerobic exercise improves pulmonary function and alters exercise breathing pattern in children. Other studies have shown the effect of 5-months swimming training on school children with asthma and found improved lung function, and improved posture and fitness. Nickerson, Bruce, Daisy, Bautista, Marla and Namey, et al. (1983) have shown in their study that distance running program improved fitness in asthmatic children without pulmonary complication. Clark (1992) found that cardiorespiratory fitness significantly improved and breathlessness decreased over a wide range of physical work corresponding to activities of daily living, and Christopher Kaufman, Aaron, Kelly, Dan and Kaiser et al. (2007) studied the effect of aerobic training on ventilatory efficiency in overweight children, and found that the training helped to reverse decrement in cardiopulmonary function observed over a period of time in overweight children.

Hypoxic Drive during Exercise

Hypoxia is lack of adequate oxygen due to a reduce oxygen due simply means law oxygen tension in the inspired air. Hypoxic is pertaining to hypoxia.

Attitude exposure causes wide-ranging physiological responses. Changes occur in ventilation, heart rate, Acid-base regulation, body composition and substrate metabolism.

If during exercise, the normal air is replaced by oxygen, the ventilation drops within seconds, and the effect is particularly marked during heavy exercise (Forte, et. Al. 1997). The reaction is so rapid an effect via the chemo receptors in the carotid and aortic bodies has to be assumed. This ventilation reducing effect of O_2 breathing is marked, however, even if the arterial po_2 is at a normal level.

Chemoreceptors has been known by Hanson (1998) to have a relatively large blood flow and high oxygen uptake. They are innervated by sympathetic nerve fibers which supply the arterioles of the carotid and aortic bodies with vasoconstrictor fibers. When these fibers are fibers are activated there is a reduction in the blood flow through the chemoreceptor areas, possibly by the blood being diverted through adjacent arterio-venous anastomoses. It is possible that a change in the Pco_2 and H^+ concentration and Hypoxia of the arterial blood may contribute to modify the blood flow to the epitheloid cells of the chemoreceptive areas.

It has been observed by research studies that during exercise, the ventilation increases relatively rectilinearly, but this increase is relatively steeper during very heavy exercise. How this increase in ventilation is elicited is unknown. Forte, Leith, Muza, Fulco and Cymerman (1997).

The comparatively small changes which are observed in the PO_2, PCo_2 and H^+ concentration in the arterial blood cannot explain the increase in ventilation. It is therefore suggested as a hypothesis that muscular activity as such, through a motoneurons of the respiratory muscles and through spinal and supraspinal reflex centres, and thus in a coordinated manner produces an increase in the frequency and depth of respiration, often in pace with the muscular movements. Green, Sutton, WOlfel, Resles and Butterfield (1992).

Studies have shown that the actual regulation of the respiratory volume then takes place through a negative feedback mechanism, primarily determined by the Co_2 production in relation to Co_2 elimination during expiration, Cogo legnani & Allegra (1997) according to them, in this manner, the PCo_2 of the arterial blood will, via a respiratory pattern generator, determine the magnitude of the ventilation.

During an aerobic exercise, the H^+ concentration of the blood will increase, which represents a further stimulation of respiration. The peripheral chemoreceptor in the carotid and aortic bodies will also stimulate respiration, possibly because an increased sympaticus activity will reduce the blood flow to the chemoreceptor areas so that the local Po_2 drops inspite of an almost normal value for PO_2 in the arterial blood.

Research studies by Bowe (1996) and Boning (1997) have shown the effect of hypoxic drive during maximal exercise to reduce, there is a reduction in PaO_2 which should further reduce increase ventilation. The hyperventilation. The hyperventilation which follows may even produce a drop in $PaCo_2$, but the arterial pH inevitably drops.

Systemic Responses to Attitude

Research evidence by Forte, Leith, Muza, Fuko and Cymerman (1997) indicates that ventilation increases at rest and during submaximal exercise as attitude increases. Ventilation increases further during the first two weeks of exposure to a particular attitude. Hypoxia, by it's effect on the aorta and carotid bodies is the driving force for this increase in ventilation. Bicarbonate is excreted in the urine and there is increased central and peripheral chemosensitivity.

At sea level, in addition to central nervous system drive, the most important factors regulating ventilation are PCo_2 and H^+, through their effect on the central chemoreceptors located in the medulla. These controls are diminished at altitude because hyperventilation result in a decrease in PCo_2. Research reports shows that the practical effect of these changes is that ventilator stimulation occurs at a lower level of carbon dioxide. Some of the adaptive changes that occur with exposure to altitude are aimed at increasing respiratory responsiveness to PCo2.

Research reports by Garrido, Rodas, Javierre, Segura, Estruch and Ventura (1997) and Boning (1997) shows that changes in ventilation in response to hypoxia (i.e. hypoxic ventilatory response, HVR) is one of the most important elements determining successful adaptation to high altitude. According to them; elevated ventilation helps preserve alveoli and arterial oxygen pressure and maximize arterial oxygen content (Cao_2). They further revealed that Cao_2 (determined) by po_2 and hemoglobin content is the most important factor determining maximal oxygen consumption at altitude.

It has been observed that people with a blunted HVR are more susceptible to high altitude illness and not poor physical performance at altitude. They observed that fit endurance athletes often exhibit a blunted ventilatory response to exercise at sea level. They showed that such response seems to be an advantage at sea level (i.e. lower work of breathing) it is a disadvantage at altitude.

Scientific investigation of the effect of heavy exercise at altitude have been shown to stress lung capacity to the limit. Arterial oxygen partial pressure (Pao_2) decreases during exercise at altitude. At sea level, maximum exercise Pao_2 remains at resting levels, except in some elite endurance athletes. Also pulmonary gas exchange may be affected by incomplete diffusion or a mismatch between alveolar ventilation and cardiac output due to pulmonary of vascular shunting could be caused by broncho constriction due to how levels of Co_2, vasoconstriction in the lung circulation or pulmonary edema. Beidleman, Muza, Rock, Fulco, Lyons, Hoyt and Cymerman (1997).

It has been known for some time that physical performance is reduced in areas above sea level. This is particularly evident at altitudes above 4,000 to 5,000 feet (1,3000 + 1,650 meters). This reduction in performance is due to hypoxia, a decrease in the partial pressure of oxygen in the inspired air. The PO_2 gradients between lung and blood and between blood and tissue are vitally important with respect to the capacity of the oxygen transport system. The more severe the hypoxia i.e. the greater the altitude – the greater the decrement in performance.

Research reports by Loudon, Cagle, Figoni, Nau and Klein (1998) and Mc Naughton, Hall and Cooley (1998) stressed that since the oxygen transport system is more and more handicapped at higher and higher attitude, it is not surprising to find that the VO_2 and max declines as elevation increases; and this is known to be true for both well-trained athletes and unconditioned subjects.

According to them, they assert that on the average, VO_2 max for untrained individuals maybe expected to decrease about 3 percent for every 1,000 feet (305 meters) above 5,000 feet (1,524 meters). For example, at 10,000 feet (3,050 meters), VO_2 max would be 15 percent below that measured at sea level. They further maintained that for well-trained athletes, the rate of decrease in VO_2 max may not be as great however, it start to decrease sooner – i.e. at a lower altitude. The decrease is about 2 percent for every 1,000 feet above sea level. Thus, at 10,000 feet, the VO_2max of well-trained athletes, would be about 20percent lower than the value measured at sea level.

At how to moderate altitude (5,000 to 10,000 feet) sports activities that can be performed in two minutes or less are generally not adversely affected by hypoxia. In fact, theoretically, because air is less dense at sea level. Sprinters and field athletes should have an advantage due to less resistance. However, at higher altitudes, performance of activities lasting around one minute may suffer.

Anatomy of the respiratory system

The respiratory system

The respiratory system is made up of the organs involved in the exchange of gases, and consists of the:

- Nose
- Pharynx
- Larynx

- Trachea
- Bronchi
- Lungs

The upper respiratory tract includes these:

Reasons for the Procedure

- Nose
- Nasal cavity
- Ethmoidal air cells
- Frontal sinuses
- Maxillary sinus
- Larynx
- Trachea

The lower respiratory tract includes the lungs, bronchi, and alveoli.

What are the functions of the lungs?

The lungs take in oxygen, which cells need to live and carry out their normal functions. The lungs also get rid of carbon dioxide, a waste product of the body's cells.

The lungs are a pair of cone-shaped organs made up of spongy, pinkish-gray tissue. They take up most of the space in the chest, or the thorax (the part of the body between the base of the neck and diaphragm).

The lungs are enveloped in a membrane called the pleura.

The lungs are separated from each other by the mediastinum, an area that contains the following:

- The heart and its large vessels
- Trachea (windpipe)
- Esophagus
- Thymus
- Lymph nodes

The right lung has three sections called lobes. The left lung has two lobes. When you breathe, the air enters the body through the nose or the mouth. It then travels down the throat through the larynx (voice box) and trachea (windpipe) and goes into the lungs through tubes called mainstem bronchi.

One mainstem bronchus leads to the right lung and one to the left lung. In the lungs, the mainstem bronchi divide into smaller bronchi and then into even smaller tubes called bronchioles. Bronchioles end in tiny air sacs called alveoli.

Cardiorespiratory Fitness

Cardiorespiratory fitness refers to the ability of the circulatory and respiratory systems to supply oxygen to skeletal muscles during sustained physical activity. Regular exercise makes these systems more efficient by enlarging the heart muscle, enabling more blood to be pumped with each stroke, and increasing the number of small arteries in trained skeletal muscles, which supply more blood to working muscles. Exercise improves the respiratory system by increasing the amount of oxygen that is inhaled nad distributed to body tissue.

There are many benefits of cardiorespiratory fitness. It can reduce the risk of heart disease, lung cancer, type 2 diabetes, stroke, and other diseases. Cardiorespiratory fitness helps improve lung and heart condition, and increases feelings of wellbeing.

The American College of Sports Medicine recommends aerobic exercise 3-5 times per week for 20-60 minutes per session, at an intensity that maintains the heart rate between 65-90% of the maximum heart rate.

1. Cardiovascular system
2. Respiratory system adaptations
3. Temperature regulation

Cardiovascular System

The cardiovascular system is responsible for a vast set of adaptations in the body throughout exercise. It must immediately respond to changes in cardiac output, blood flow, and blood pressure. Cardiac output is defined as the product of heart rate and stroke volume which represents the volume of blood being pumped by the heart each minute. Cardiac output increases during physical activity due to an increase in both the heart rate and stroke volume. At the beginning of exercise, the cardiovascular adaptations are very rapid: “Within a second after muscular contraction, there is a withdrawal of vagal outflow to the heart, which is followed by an increase in sympathetic stimulation of the heart. This results in an increase in cardiac output to ensure that blood flow to the muscle is matched to the metabolic needs”. Both heart rate and stroke volume vary directly with the intensity of the exercise performed and many improvements can be made through continuous training.

Another important issue is the regulation of blood flow during exercise. Blood flow must increase in order to provide the working muscle with more oxygenated blood which can be accomplished through neural and chemical regulation. Blood vessels are under sympathetic tone, therefore the release of noradrenaline and adrenaline will cause vasoconstriction of non-essential tissues such as the liver, intestines, and kidneys, and decrease neurotransmitter release to the active muscles promoting vasodilatation. Also, chemical factors such as a decrease in oxygen concentration and an increase in carbon dioxide or lactic acid concentration in the blood promote vasodilatation to increase blood flow. As a result of increased vascular resistance, blood pressure rises throughout exercise and stimulates baroreceptors in the carotid arteries and aortic arch. “These pressure receptors are important since they regulate arterial blood pressure around an elevated systemic pressure during exercise.”

Respiratory System Adaptations

Although all of the described adaptations in the body to maintain homeostatic balance during exercise are very important, the most essential factor is the involvement of the respiratory system. The respiratory system allows for the proper exchange and transport of gases to and from the lungs while being able to control the ventilation rate through neural and chemical impulses. In addition, the body is able to efficiently use the three energy systems which include the phosphagen system, the glycolytic system, and oxidative system.

Temperature Regulation

In most cases, as the body is exposed to physical activity, the core temperature of the body tends to rise as heat gain becomes larger than the amount of heat lost. “The factors that contribute to heat gain during exercise include anything that stimulate metabolic rate, anything from the external environment that causes heat gain, and the ability of the body to dissipate heat under any given set of circumstances. In response to an increase in core temperature, there are a variety of factors which adapt in order to help restore heat balance. The main physiological response to an increase in body temperature is mediated by the thermal regulatory centre located in the hypothalamus of the brain which connects to thermal receptors and effectors. There are numerous thermal effectors including sweat glands, smooth muscles of blood vessels, some endocrine glands, and skeletal muscle. With an increase in the core temperature, the thermal regulatory centre will stimulate the arterioles supplying blood to the skin to dilate along with the release of sweat on the skin surface to reduce temperature through evaporation. In addition to the involuntary regulation of temperature, the hypothalamus is able to communicate with the cerebral cortex to initiate voluntary control such as removing clothing or drinking cold water. With all regulations taken into account, the body is able to maintain core temperature with about two or three degrees Celsius during exercise.

Positive Impacts of Exercise For Children With Autism

Autism

Autism is a developmental disorder that is distinguished by it's impairment of social interface and compunction and restrictive and repetitive patterns of behavior, interests, and activities.

Autism now affects close to 20 out of every 10,000 children and is diagnosed by the presence or absence of certain developmental behaviours (Ospina et al. 2008) (Fact experts estimate that two to six children out of every 1,000 will have autism, males are four times more likely to have autism than females. Also more autism facts and statistics).

Children that do not have the social and behavioural deficits of autism generally get their physical activity form playing with other children. Because children with autism have trouble participating socially making eye contact, playing creatively and making friends they have fewer occasions to partake in physical activities than their socially able peers and are generally less active.

Exercise not only affects the child's physical health, but also serves to combat the manifestations of the disorder. In addition, opportunities available involve extensive cues. More supportive exercise would include adapted and integrated sports focused on inclusion, and in general preferred lifetime activities (Reid, 2005)

The most effective therapies for children with autism are those that involve movement. Along with the social and behavioural effects of autism, children also have vestibular system dysfunction. This obstruction is caused by ineffective sensory processing which manifests itself in "problems in attention, behavior, learning, speech development, movement and coordination. Bhojne and Chitnis (2002). Szot, (2005) in a prospective study looked at the effects of target oriented kinetic exercises on the specialization of static balance, an important factor in coordination and the normal development of a child in order to function in their environment. The children carried out repetitive kinetic exercises five times a week for the duration of months programme. Their results were determined using the stato-kinetics-metric test, which graphically determines the child's sway during balancing. Children's balance after the kinetics exercise program improved by 47.9%. the obtained result showed that such repetitive kinetic exercises include serial symnastic exercises. As the intensity and repetition of the chosen movement increase, changes in the child's behavior beign to occur based on the feedback ot the vestibular system.

They showed that appropriate intensity to maintain cardio respiratory fitness, and therefore improve a few studies demonstrate that exercise can improve decrease maladaptive behaviours in children with Autism, the findings by Elliot, Dobbin, Rose and Soper (1994) agree that vigor of the activity is responsible for the decrease in behaviours. These findings was corroborated by ACSM (1990) that the appropriate intensity to maintain cardio respiratory fitness, and therefore improve disruptive behaviour, is calculated a s60-90% of the heart rte maximum for a maximum of 20 minutes of exercise, where 60-79% is moderate and 80-89 is heavy, therefore, any form of vigours aerobic exercise can therefore be utilized to control nonfunctional behaviours associated with Autism so that individuals can function more easily in the workplace, social and academic settings, and beyond.

Exercise that capitalizes on the movement itself and deemphasizes social communication, can also be used as therapy to achieve social gains, the use of creative dance as a therapy for children with autism is based on it's opportunity for social feedback. Greer-Paglia (2006) in a perspective study compared social competence during creative dance and classroom simulation "circle-time" verbal and non-verbal students benefitted primarily from creative dance.

Research evidence by Mason (2005) showed that Horse riding, or hippotherapy, is also an exercise that offers benefits ranging form the therapeutic effects of the repetitive movement of the horse gait, to the gradual social interaction that if provides to the rider. This exercise is also generally nonverbal, and allows for the child to interact with the horse and others without anxieties caused by their social and communicative deficits.

Research efforts has shown that performing physical activities in a pod also provides added benefits for children with autism. The weight lessness of the water allows for greater range of the motion and fluidity and ease of movements. Yilmaz, Yanardag, Birkan and Bumin (2004) showed the effects of ten weeks of various swimming training lessons on general physical fitness and orientation in the water children were found to have increased balance speed, agility, power, hand groups, arm and leg muscle strength, flexibility and endurance after training. Greater orientation in the water was also observed along with a decrease in self simulator, stereotypical behaviours.

Exercise provides so many positive outcomes for children with autism. Lewis (2004) and Groft Jones and |Block (2006) emphasize anxiety, depression, sleeping and eating disturbances, attention uses temperantriums seen improvement with exercise. Ospina, et al (2008) hormones such as endorphines that are released during exercise block pain, create a sense of euphoria, and also alleviate tension and stress. In addition, the motor competency, social competency, attention and interaction that children with autism build and receive from exercise helps them gain confidence and self awareness, which may have some greater effect on alleviating the above disorders (personalized) ventilator threshold.

Subjects with asthma frequently present with a paradoxical response to physical activity. Although vigorous exertion and increase post exercise aorwaus resistance, regular physical activity may be useful in the management of asthma. Orestin, (1996). Unfortunately, the fear of inducing breathlessness inhibits many patients must taking part in regular play and sports withy their peers. Croft and Lloyd (1989) a low level of regular physical activity in turn, leads to chronic reconditioning. It is not surprising therefore that some studies have found that patient with asthma tend to have lower cardio respiratory fitness than their healthy counterparts. Garfinkel, Kesten and Champman Rebuck (1992); Neda, Nery, Silva Carbral and Fernandes (1999).

Physical training programs in asthma have been designed to enhance aerobic power, neuromuscular coordination, and self confidence. Orestein (1996) although such programs seems to be effective in improving physical work capacity, they effects on health related quality of life (HOoL) or disease control as reflected by the daily use of inhaled steroids, for example are still uncertain. Ram, Robinson, Black and Pieot (2005). Moreover, the value of physical training in ameliorating exercise induced brochoconstriction (EIB) remains controversial. Matsumoto, Araki and Tsuda et. al (1999). As stated in a recent Cochrane review about the effects of exercise training asthma. Ram, Robinson, Black and Picot (2005). It is still currently unclear what the precise role si of this intervention in the clinical management of the disease, especially in more severe patients.

Asthma, a chronic condition has become increasingly common in recent decades, the review's authors affecting 350 million people worldwide and accounting for 1 in every 250 deaths. The authors note that the benefits of exercise persist despite the fact that exercise is itself a common trigger of asthma attacks, along with others including pollen, and other airborne allergens. The results of their study showed that participants tolerated the exercise well, suffering no adverse effects due to the exertion. None of the study participants experienced worse symptoms after participation.

Asthma is a manufactorial disease with genetic, environmental and inflammatory components in it's etiology.

The principal pathophysiology of asthma is chronic inflammation of the lower respiratory tract; Hargreave & Nair, (2009). Pharmacotherapy and avoidance of allergens are the primary therapies emphasized in all asthma guidelines. Global initiative for asthma Report (2012); Laugheed, Lemiere, Ducharme, Liczkal, Del & Rowe, et.al. (2012). In addition, airway remodeling in established asthma respond poorly to current medicinal therapies. Sumi & Hamid (2007). Current asthma therapies have not achieved asthma prevention or asthma cure and there are currently no medications that can alter the natural history of the disease. Editorial (2008). Potential long term side-effects, prohibiting costs, and suboptimal adherence to asthma medications are on-going challenges to therapies, such as Omalizumab, only a very small sub population refractory or severe asthma appears to respond. Pakhale, Mulpuru & Boyd (2011); Holgate (2011). Treatment options are therefore quite limited for asthma and the need to search for other therapies has been recognized by many experts in the field. Charkir, Hamid, Bosse, Boulet and Laviolette (2002)l Sumid and Hamid (2007) and Holgate (2011).

Physical exercise training is thought to be beneficial in asthma management, at least in children, but it has not been extensively studied. Chandratileke, Carson, Picot, Brim, Esterman and Smith (2012). There are no specific recommendations on physical training type, intensity, duration or frequency in any asthma guidelines. Global initiative for asthma report (2012); Laugheed, Lemiere, Duchame, Licskal, Dell and Rowe, et. al. (2012). Moreover, low physical activity in asthmatics is a reality because they usually avoid exercise. Williams, Powell, Hoskins, Neville, (2008).

Asthma and chronic obstructive pulmonary disease (COPD) are according the Dutch hypothesis. Van Erdewegh, little, Dupuis, Del Mastol, Falls and Simon, et al. (2002), different manifestations of the same disease entity. In addition, asthma and COPD might share common pathogenetic pathways. Hunninghake, Chu, Tesfaigzi, Soto-Quiros Avila, and Lasky et. al (2009), positive impacts of physical exercise training and rehabilitation in COPD have been extensively studied. O'Donnl, Hemandor, Kaplan, Aeron Bourbeau and Marcinduk et al (2008) and Maltais, Boubeau, Shapiro, Lacasse, Perault and Batzan, et al (2008), therefore, physical training is recommended in COPD guidelines. Lacasse, Goldstein, Lasserson, Fau and Martins, and Marcinluk, Brooks, Butcher, Degigare, Dechman and Ford, et al (2000). Given that asthma and COPD will share a common pathogenesis, and that both diseases are manifested by chronic airway inflammation, it is imperative that we discern the role of physical training in asthma management.

Health-related quality of life (HRQL) brings together various aspects of an individuals subjective experience that relate both directly and indirectly to health, disease; disability and impairment. Carr, Gibson, and Robinson (2001). Although asthma is the most common chronic disease in childhood, information on pediatric patient's views on asthma – specific HRQL has not been described before.

Dyspnea dependence on medication, and not being able to integrate with peers are among the many aspects that could negatively influence the life of asthmatic children. Studies have shown that since HRQL is a uniquely personal perception, the individual's view on the component of asthma specific HRQL is the preferred basis of a content valid HRQ L instrument. Carr, and Higginson (2001); Gill and Feinstein (1994). For asthma, several serf-administered questionnaires to assess disease specific HRQL in primary school-aged children with asthma have been developed, the most prominent one being the pediatric asthma Quality of Life Questionnaire (PAQL). Jumper, Guyatt and Feeny. (1996). The how are you (HAY) instrument. Le Cog, Colland, Boeke, Boeke, Bezener and Ejik (2000). The pediatric quality of Life Inventory (PEDsQL) Generic core scales and Asthma module. Varni, Burwinkle, Rapoff, Kamps and Olson (2004), and the childhood asthma Questionnaire (CAQ-B). Christie, French, Sowden and West (1993). The agreement on HRQL components between these questionnaires is rather low only some HRQL components of the symptoms domain and activity limitation domain are part of all questionnaires. Christie, French, and Sowden (1993). This is sticking, when one realizes that all instruments were developed to measure the same concept. The content validity of an instrument is influenced by the item selection procedure used to develop the questionnaire. Focus group methodology is especially useful to determine children's idea regarding HRQL this information is currently lacking. Heary and Hennessy (2002).

Asthma is a chronic inflammatory disease of the respiratory system. It's incidence has been increasing in the last 20 years in many countries all around the world. It is said that 10 percent of people in developed countries suffer from asthma. Moein (2003). The main goal in the treatment of asthma is to prevent signs and symptoms of asthma, decreasing medication intake, improvement of respiratory system and increasing the patient's function and quality of life.

Asthmatic patients do not intend to engage in sports and physical exercises due to dyspnea and it leads to decrease in their levels of physical abilities and thus increasing their respiratory problems. In a study, sport exercises were called to be the main cause of narrowness of airways in ninety percent of asthmatic patients Williams (1990).

Several studies were done to investigate the effects of physical activities and sport exercises on pulmonary function in asthmatic patients. These studies had different results which can be explained due to their variety in the kind of tests, measurement tools, exercise schedule and program, disease severity, pulmonary rehabilitation and environmental conditions. Emtner, Herala and Stalenheim (1996); Bendstrup, Ingemann, Jensen, Holm and Bengtsson (1997).

A regular short duration sports activity (less than a few minutes) has fewer problems than long duration sports activity. When courses of exercise within short intervals are embarked, narrowness of brochus increased gradually. On the contrary, doing light sport exercises before the strenuous sport activities can reduce stricture of respiratory airways to minimum.

Exercise Benefits People with Asthma

Appropriate exercise program can provide valuable benefits to people with asthma, helping to reduce severity of attacks or prevent them entirely. The Cochrane library review found that, contrary to fears that patients and parents of asthmatic children sometimes have, exercise does not generally worsen the condition.

Research evidence by Cochrane library (   ) showed that sometimes people with asthma don't like to use medications all the time. Some people simply forget to use them, whilst others use them but not regularly enough to prevent asthma attacks." Kristin Carson (   ) she considers physical exercise a valuable alternative approach to help control asthma attacks.

As a result of their age. Cardiovascular system without good functions shows a faster recovery after a set of acute exercise. Tipton and Sanders, (2004). This present data demonstrates that participants in experimental group significantly improved compare to control group.

Aerobic exercise did not significantly improve Maximum Oxygen Consumption after 8 weeks of training. This is contrary to findings of other reported studies. Carter, et al. (2000) showed in a prospective study that with regular participation in aerobic exercise programme, individual can increase his/her maximum oxygen uptake as much as 30% within 8 weeks period, depending on individual initial level of fitness, McWeigh, (2004) reported $V0_2$ max of 38.51 $\pm$ 3.75ml/kg/min from a direct measure of maximal oxygen uptake as opposed to estimates in the case of this study. It is important to note that the design and sample of some of this studies are not exactly the same with the current study.

The present study demonstrates that participants in this study had significantly improved in their oxygen uptake capacity than those of the reported studies. The difference might be due to either the conditioning process, or fitness or racial difference of the participants. The difference might partly depend upon a difference in body size, since there is a good correlation between max Vo_2 during training and body size in these participants.

Appraisal of literature

This review clearly shows that children need to regularly participate in physical activity and that all concerned individuals must first provide them with developmentally appropriate activities that will be enhanced to increase their physical skills and fitness levels respectively. Because children's interest and participation in aerobic exercises has increased dramatically in recent years, professionals must be knowledgeable in the areas of normal growth and development as well as the effects of exercise on young children.

Physical, active people outlive those who are inactive. Regular activity helps to maintain the functional independence and enhances the quality of life for children and younger adults of ages. The role of physical activity in preventing coronary heart disease (CHD) cannot be overemphasized. The risk possessed in physical inactivity is almost as high as several well known CHD risk factors, such as high blood pressure and high cholesterol. Physical inactivity though is more prevalent than any one of these other risk factors, people with other factors for CHD, such as obesity and high blood, may gain particular benefit from physical activity.

As researches continue to illustrate the links between physical activity and selected heath outcome, people will be able to choose physical activity patterns optimally suited to individual preferences, health risks, and physiologic and cardio-respiratory benefits.

Pulmonary function declines with age, with the most important changes being seen in vital capacity, Tidal volume and force expiratory volume at 1st second force vital capacity and peak expiratory flow rate (PEFR). During adulthood, there is a gradual decline in aerobic exercise. Evidence suggested the decline may be slower in those who are physically active. Important health benefits have been reported from the physical conditioning of the previously sedentary individuals, such benefits include:

- Improved O_2 transport and aerobic capacity, lowered blood pressure, improved breathing capacity, reduction in osteoporotic changes.
- Improved joints mobility, and a stranquilizing effect that reduces neuromuscular tension (anxiety)

CHAPTER THREE

RESEARCH METHODOLOGY

The chapter present the research methodology and procedure used under the following sub-heading

1 Research Design
2 Population
3 Sample and sampling technique
4 Research instrument
5 Validity of the instruments
6 Pilot study
7 Reliability of the instruments
8 Research schedule
9 Test location
10 Period of data collection
11 Procedure for training program
12 The order of exercise training
13 Procedure for Data Analysis

Research Design

The randomized pretest-posttest control group experimental design was used for this study. The design is considered to be appropriate, because the participants were randomly assigned into both experimental and control groups. The experimental group underwent the main intervention program, while the control groups were subjected to placebo (David, 2003; William & Tronchin, 2006). Prior to the commencement of the intervention program, pretest measurements for the two groups were taken, followed by a posttest measurement after the intervention. The difference between the pretest and the posttest among male and female experimental and control groups were compared to determine the effect of interventions on cardio-respiratory function indices tested.

Population of the study

The population for this study involved male and female primary school non-athletes in Ibadan, Nigeria.

Sample and Sampling Technique

A sample size for this study was 128 primary school pupils were purposely sampled, using the criteria of standard exercise tolerance test (Step Bench) to select the apparently active and healthy pupils.

Purposive sampling technique was used to select the respective public and private school for this study (Aiyekale Community Primary School, Aiyekale, Ibadan and Christ the King Primary School, Agugu-Oja, Ibadan). Using the criteria of those who have at least 10 years operational experience in running the school. Purposive sampling technique was used for selecting 128 participants who were randomly assigned into both experimental and control group, through the table of random numbers. (For equal representation of male and female) i.e. gender balance of participants that represent the respective levels of education.

A total of 360 participants were initially assessed from Ibadan north-east local government and 128 participants were purposively selected through a standard tolerance exercise test (Bench-step). The nature, benefits and duration of aerobic exercise was first explained and demonstrated to the prospective participants.

Relevant medical history and examination of the cardiovascular and respiratory systems was used in screening those that were found to be free from respiratory conditions were allowed to take part in this study.

All children presenting the following inclusion criteria were invited for study participation:

(1) free from any respiratory disturbances (such as: irritated coughing, and sneezing, running nose)

(2) cardiovascular disturbances (such as: abnormal breathing)

(3) those selected through the standard tolerance exercise tests (Bench step). Exclusion criteria included: (1) Those with respiratory and (2) Cardiovascular disturbances (such as stated above), (3) Vomiting, (4) High body temperature and (5) Regular absenteeism from school. Written informed consent was obtained from the children/parents before involvement in the study. No remuneration was offered.

No children/parents declined the invitation. All enrolled children concluded the trial (i.e. there were no dropouts during the study).

Ethical approval was sought and obtained from Ibadan North-east Universal Basic Education board to carry out this study.

Research Instruments

The following instruments were used to gather data for the study:

SECA standard Stadiometer: The SECA height scale manufactured by Vogel & Halk G mbH & Co. Germany was used to measure subject's height (Stretch height). The height scale is calibrated in centimeters from 60-200 centimeters. It has measurement precision to the nearest 1Kg. It has reliability coefficient of 0.99 as described by Willet (1990).

Hana portable weight: A measuring scale model No (RA9012) made in England was used to measure the total body weight of participants. The weight is calibrated in kilograms from 0-180Kg. It is accurate to the nearest 0.1Kg. and it has a reliability of 0.96 as described by Baumgartner et al (1999).

Stethoscope: The dual head stethoscope manufactured by Seward Limited London N20GN, cat No: KD = 3002 Batch No:Q04465, QA: 15105SO260 was used to monitor resting heart rate, blood pressure and VO_2 max respectively. It has a reliability of 0.98.

Internal Timer Clock: An internal Timer Clock, manufactured by English Clock System, Smidth Industries Limited, Great Britain was used to determine period of rest between bouts of activities.

Electronic Digital Stopwatch: A stop timer alarm digital stop watch made in China CHAOSU DA MODE 206240 Qc/WT RESET PC 2009 start chronograph 1/100 sec. was used for timing different running activities. It is accurate to the nearest 0.01 seconds.

Sphygmomanometer: The 2009 BOKANG Model of freestyle standing model, calibrated from 0-300mmHg made in China by W.B.I.C. Wenzhou (CE 197) was used in conjunction with the stethoscope for measuring the subjects blood pressure. It has a reliability of 0.97 (Bourbonnais 1998)

Dry (Pocket) Spirometer: The Dry Pocket Spirometer was used to measure vital capacity (VC). It is calibrated from 0-7000cm^3. It has a measurement precision to the nearest 100 cubic centimeters. It has a test retest reliability of 0.91 as described by Thomas et al (2001).

Mini Wright peak flow meter: A mini wright peak flow meter was used to measure peak expiratory flow rate (PEFR). It is calibrated from 0-800L/min and it has a measurement precision of 10L/min as well as a reliability of 0.91 It is manufactured by the Clement Clarke international limited 15 Wigmore Street, London, WIH 9 LA England.

Computerized micro spirometer: A computerized battery operated micro spirometer was used to measure both the Force Vital Capacity (FVC) and Forced Expiratory Volume 1st second (FEV_1). It is manufactured by the Micro Medical Ltd, P.O. Box 6 Rochester, Kent ME12AZ with age and height correction values (BTPS). It is calibrated from 0.10-9.99 liters and has a reliability of 0.90

Metronome: A pre-recording clapping sound was used to guide cadence during the cardiorespiratory fitness test and the aerobic exercise training programmes.

Step Bench Test: A standard step bench device with a height of 40 cm high for boys and 30 cm for girls, sturdily constructed with at least 25cm width on the plate form was used to carry out exercise for the cardio respiratory fitness test. (McArdle, 2000).

School Track: The school athletic track and classrooms were used for the training. Measurements taken includes the anthropometric measurements of age, height and weight, the cardio respiratory fitness test, the selected cardio-respiratory indices of forced vital capacity (FVC); forced expiratory volume at 1st second (FEV_1); ,Peak Expiratory Flow Rate (PEFR); systolic blood pressure (RSBP), Diastolic blood pressure (RDBP), resting heart rate (RHR) and maximum oxygen consumption ($V0_2$max), as well as the aerobic training programme.

Validity of the Instrument

Thomas and Nelson (2001) refers to validity as the degree to which an instrument measures what it is designed to measure. The instruments that were used for this study have already been validated and standardized by their manufacturers. However, the researcher and his supervisor made attempt to cross check the instrument to ensure that they are in proper working conditions prior to the commencement of their usage.

Reliability of the Instrument

Reliability refers to the accuracy and consistency of data collection instrument based on their stability, repeatability and precision which are anticipated attributes underlying excellent research procedure (Williams & Tronchin, 2006). The height stadiometer has a reliability coefficient of 0.99, weighing scale has a reliability of .96

(Baumgartner, et al 1999), spirometer has a test retest reliability of 0.97 (Thomas, et al 2001), aneroid sphygmomanometer has a reliability of 0.97 (Bournnais, 1998) while the stethoscope has a reliability of 0.98. To further ensure (reliability) that the instruments measure what they are to measure.

Ethical consideration for the study

An approval was obtained from the Oyo State Ministry of Education through the Education Secretary, Ibadan North-East Local Government Universal Basic Education Authority. A letter of identification which was signed by the Assistant Chief Authority (UBEA) Agugu Zone was collected and forwarded through the zonal coordinator Universal Basic Education Authority (UBEA). Agugu Zone to the respective schools where the study was carried out.

Order of testing

Testing was conducted in the following order:

a. Age
b. Weight
c. Height
d. Heart rate (HR)
e. Systolic and Diastolic Blood Pressure (SBP & DBP)
f. Maximum Oxygen Capacity (VO_2 max)
g. Forced Vital Capacity (FVC)
h. Forced Expiratory Volume at 1st second (FEV_1)
i. Peak Expiratory Flow Rate (PEFR)

Procedure for Training Program

1. The training programme for each apparently active and healthy primary school pupil undergoing aerobic exercise programme took place three times a week for eight weeks. The training days were Tuesdays, thrusdays and Fridays. The participants were grouped into four classes and a minimum of one class participated in aerobic exercise training at a time.
2. The training was done between 8.00 and 9.00 am
3. The training and measurement was administered by the researcher and recording was done by one trained research assistant who is an experienced primary school teacher

4. All training sessions were preceded by a warm up session including aerobic exercises such as brisk walking, hopping, running on the spot, bench stepping, rope-skipping and cycling in the air which ended up with cool-down exercises.

The order of exercise training

Aerobic exercise training programme

In designing an exercise training programme, it is recommended that exercises that will develop or improve the capability required is used (Fox, 1979). The aerobic exercises used were meant to develop cardio-respiratory functions. Six aerobic exercises were administered. The frequency, total time of each exercise and rest period between aerobic exercises were observed as recommended by Fox (1979).

The exercise training programme that was used in this study was made up of the following aerobic exercises:

Bench Stepping

Starting position: Standing in front of the step bench with feet apart.

Movement: The subject climbs on the bench with right foot up, left foot up and then right foot down, left foot down at the pace set by the metronome.

Running on the spot

Starting position: Standing upright with arms/hands by the sides.

Movement: Raising legs horizontally with high knees motioned upward and arms/hands swinging across the chest level alternatively to the legs.

Brisk walking

Starting position: Standing upright with arms/hands by the sides.

Movement: Raising legs vertically with knees moving forward swiftly and swiftly swinging the arms by the sides alternatively to the legs.

Rope-Skipping

Starting position: Standing upright with arms/hands spread.

Movement: Skipping can be done on the balls of the feet with the arms swinging to the shoulder height in opposition to the feet.

Hopping

Starting position: Stand upright with arms/hands by the side.

Movement: send the body up and down by one foot then body lean on the other foot and hop with foot forward motion and arms serve to balance the movement. Hopping on one foot should not be sustained too long but should change to the other foot after a short period of time. Reach for the sky when you hop.

Cycling in the air

Starting position: Lying supine on the back with the knees bent and hands clasped behind the neck.

Movement: Alternatively raising and lowering the two lower limbs while cycling in the air without the heels touching the exercise mat. The cadence was determined by the metronome.

At the beginning of the training, all the participants went through the aerobic exercise. Before the training began, the researcher demonstrated all the activities to be performed. The research assistants helped in monitoring the activities carried out by the participants to ensure that they are properly carried out. The training commenced when the researcher blew the whistle. The same whistle was used to indicate when the participants were to pause for a rest before going on the next aerobic exercise.

Procedure for data collection

Ethical approval was sought and obtained from Ibadan North East Local Government Universal Basic Education Authority before the commencement of this study.

The researcher administered the test and carried out all measurements. The research assistant helped in recording. Observing and timing the participants were necessary and all measurements were carried out in each of the schools used.

Data was collected in the following order:

Age: The age of the participants was recorded in years to their nearest birthdays.

Weight: Each participant was weighed bare-feet with light clothing, standing erect and looking straight ahead. They stood erect on the SECA weighing scale platform with feet together. Body weight was recorded to the nearest 0.05 kilogram.

Height: The participants were barefeet, standing erect and looking straight ahead while being measured for height. Their feet were together with heels touching the height meter bar. The horizontal bar of the scale was adjusted to rest on the participant's head without exerting pressure. The scale was read and recorded to the nearest 0.1 centimeter.

FVC

To obtain measurement for forced vital capacity (FVC), the micro-spirometer is switched to the VIEW position, the FVC appears on the screen. It is then recorded to the nearest 0.01 liters. The best of three trials was recorded.

PEFR

Peak Expiratory Flow Rate is measured with the subject in standing position, holding the peak flow meter in his hand and taking a deep inspiration. He expires with the mouth piece placed in the mouth without air leakage; he then blows out forcefully into the mini Wright peak flow meter. The test of three trials was recorded to the nearest 10L/min.

FEV_1: Forced Expiratory Volume at 1st second was measured with the switch on the instrument in the blow position. The subject was instructed to breathe in until the lungs were completely full. The lips were sealed around the mouthpiece and the participant exhaled through the mouth maximally and as fast as possible until air could not be pushed out anymore. Once this maneuver was completed, the FEV_1 measurement was displayed and recorded to the nearest 0.01 litre.

H.R.

Heart rate was taken with the participant in sitting position, dressed in light clothes and looking straight ahead. The researcher put on the headpiece of the stethoscope over the mitral area of the participant without too much pressure exerted and listened to the heart sound. The heart sound (lubb-dubb) was counted for fifteen (15) seconds and multiplied by four (4) to make one minute count. The realized figure was recorded.

Systolic and diastolic blood pressure: The participant was instructed to be in sitting position, with the cuff of the sphynomonometer wrapped evenly and singly around the right arm at 2.5 cm above the heart level. The pressure at which the 1st sound (Korot Kuff) is heard was recorded as the systolic blood pressure. While the researcher deflated the cuff, noting the point when the last sound was heard, it was recorded as diastolic blood pressure both in mmHg. The researcher finally deflated the cuff and removed it from the participant's arm.

Maximum oxygen consumption: Maximum Oxygen consumption was estimated using a standard exercise tolerance test (test bench) on a step height of 40 cm high for boys and 30 cm for girls. The step-height was sturdily constructed with at least 25 cm wide on the platform. Participants dressed in light clothes and stood bare-feet facing the step bench and perform the stepping cycle, stepping up to a four step cadence (up-up-down-down) for exactly 3 minutes. Boys performed 24 complete step-ups per minute which were regulated with a pre-recording clapping sound and girls performed 22 step-ups per minute or 88 beats per minute. Heart rate was taken for a 15-second interval from 5-20 seconds heart rate and was multiplied by 4. Maximal oxygen uptake (VO_2 max) in m/kg/min was estimated according to the following equation.

Male VO_2 max = 111.33 – (0.42 x recovery heart rate in beats per minute)

Female VO_2 max = 65.81 – (0.1847 x recovery heart rate in beats per minute)

Adapted from McArdle protocol (1986)

Experimental Intervention Programme

Week 1 and 2

- Frequency of training – 3 times a week
- Time allowed per aerobic exercise 1 min 45 secs.
- Rest between aerobic exercises – 15 secs.
- Time per session – 15 mins
- Number of cycles per session – 2
- Warm-up period – 5 mins
- Cool down period – 5 mins
- Total duration – 30 mins
- Desired heart rate – 65% of age predicted max H.R.
- **Week 3 and 4**
- Frequency of training – 3 times a week
- Time allowed for aerobic exercises - 1 min, 45 secs.
- Rest between stations – 15 secs.
- Time per session – 30 mins.
- Number of cycles per session – 3
- Warm up period – 5 mins
- Cool down period – 5 mins
- Total duration – 40 min.
- Desired heart rate – 65% of age predicted max H.R.
- **Week 5 and 6**
- Frequency of training – 3 times a week
- Time allowed per aerobic exercises 1 min, 45 secs.
- Rest between stations – 15 secs.
- Time per session – 40 mins.
- Number of cycles per session – 4
- Warm up period – 5 mins
- Cool down period – 5 mins

- Total duration – 50 mins
- Desired heart rate – 70% of age predicted max H.R.
- **Week 7**
- Frequency of training – 3 times a week
- Time allowed per aerobic exercises 1 min, 45 secs.
- Rest between stations – 15 secs.
- Time per session – 50 mins.
- Number of cycles per session – 6
- Warm up period – 5 mins
- Cool down period – 5 mins
- Total duration – 70 mins
- Desired heart rate – 75% of age predicted max H.R.
- **Week 8**
- Frequency of training – 3 times a week
- Time allowed per aerobic exercises 1 min, 45 secs.
- Rest between stations – 15 secs.
- Time per session – 70 mins.
- Number of cycles per session – 7
- Warm up period – 5 mins
- Cool down period – 5 mins
- Total duration – 80 mins
- Desired heart rate – 75% of age predicted max H.R.

Procedure for data analysis

The descriptive statistics range, mean and standard deviation was used to analyze age, weight and height. Inferential statistic of independent t-test, was used to compare the cardio-respiratory indices before and after aerobic exercise in all the participant categories based on gender, type of school and type of groups. Analysis of covariance (ANCOVA) was used to compare the cardio-respiratory indices change between the participant categories and respective control groups that went through aerobic exercise program using the pre-test as covariates. All hypotheses were tested at 0.05 alpha level.

CHAPTER FOUR

RESULTS, ANALYSIS AND DISCUSSION OF FINDINGS

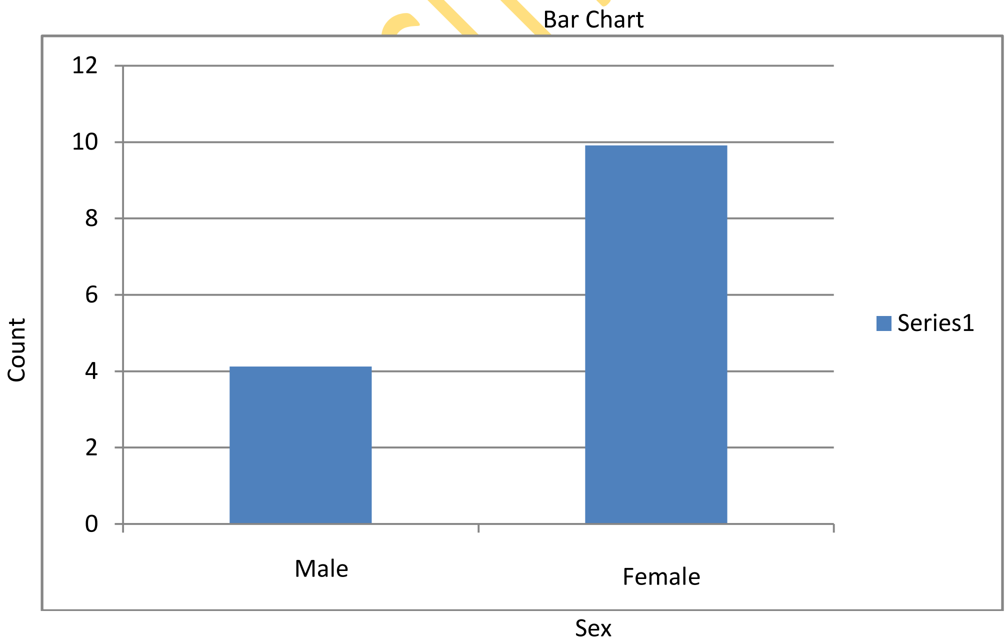
Results and Analysis

This study aimed at determining the effect of aerobic exercise on respiratory functions indices - (forced vital capacity (FVC), forced expiratory volume at 1st second (FEV_I) and peak expiratory flow rate (PEFR) and cardiovascular function indices - Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Heart Rate (HR) and Maximum Oxygen uptake (VO_2max) of primary school pupils following 8-weeks aerobic exercise. This chapter presents the results and discussions of this study as follows.

Table 4.1: Demographic Distribution of the Participants by Sex

Sex	Mean	N	Std deviation	Minimum	Maximum
Male	4.1250	64	1.84735	1.00	6.00
Female	9.9167	64	.96732	7.00	12.00

Demographic Distribution of the Participants by Sex



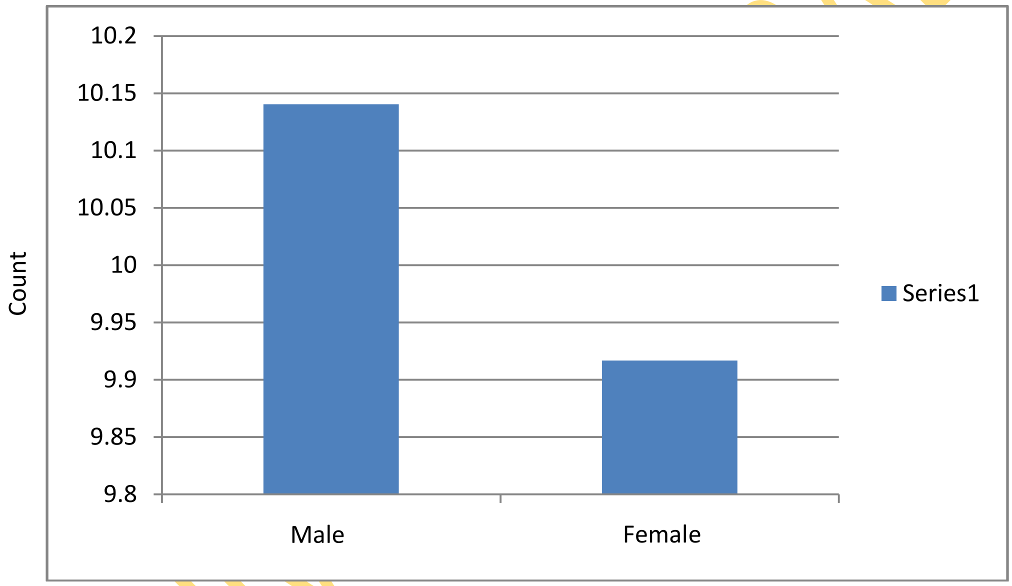
The study sample consisted of 128 male and female primary school pupils in Ibadan. A total of 64 (50%) participants were male, while 64 (50%) were female. The table further showed that the female participant were slightly older than their male counterpart.

Table 4.2: Demographic Distribution of the Participants by Age (In Years)

Age	Mean	N	Std deviation	Minimum	Maximum
Male	10.1406	64	1.02147	8.00	14.00
Female	9.9167	64	.96732	4.00	12.00

Demographic Distribution of the Participant by Age (in years)

Bar Chart



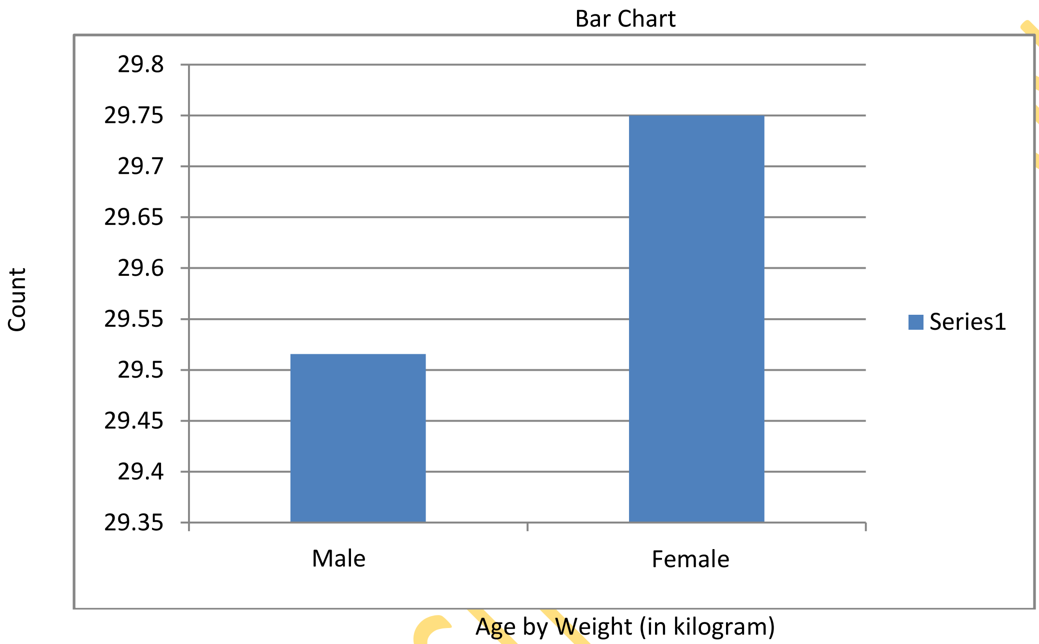
Ages in Year

The table on above show the male primary school pupils with a mean age of 10.1406 + 1.02147 and an age – range between 08-14.00 years. The table further showed that male participants were slightly holder in age than their female counterpart.

Table 4.3: Demographic Distribution of Participants by Body Weight (in Kilogram).

Weight	Mean	N	Std deviation	Minimum	Maximum
Male	29.5156	64	4.96972	20.00	42.00
Female	29.7500	64	4.58803	19.00	42.00

Demographic Distribution of the Participant by Body Weight (in kilogram)

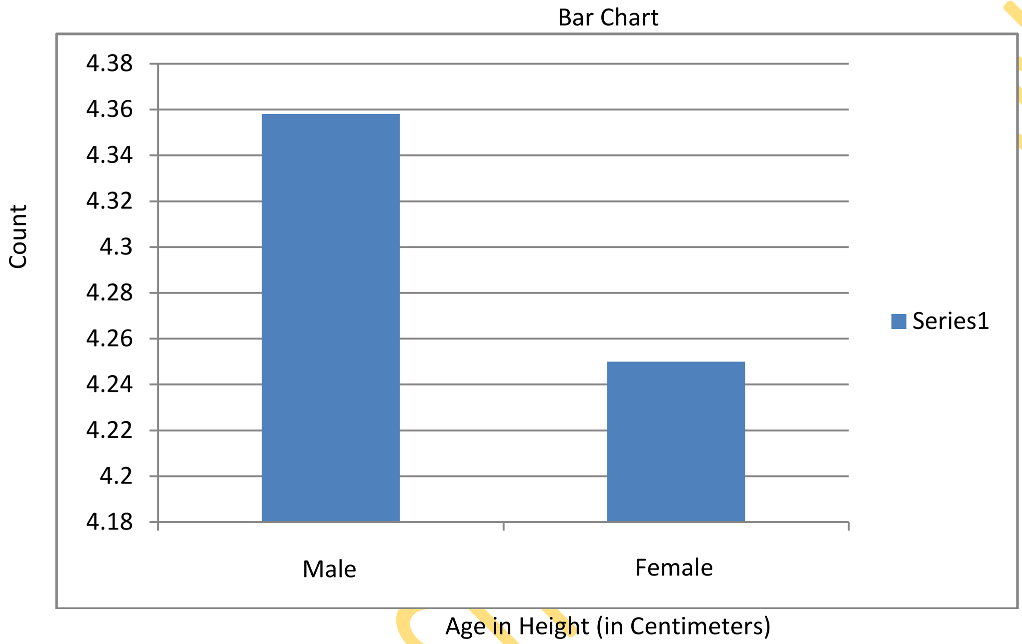


The table above reveals that the male primary school pupils had a mean body weight of 29.52 + 4.96 kilogram, and a range of body weight between 20-42 kilogram, while the female group had a mean of 29.75 + 4.58 kg with a range of body weight of between 19.00 – 42,00 kg. The table further showed that the categories of participants have similar body weight.

Table 4.4: Demographic Distribution of Participants by Height (In Centimeters).

Height	Mean	N	Std deviation	Minimum	Maximum
Male	4.3581	64	.17455	4.10	4.90
Female	4.2500	64	.35056	2.50	4.80

Demographic Distribution of the Participant by Height (in centimeters)



The table above indicate that the male primary school pupils had a mean height of 4.35 + .175 centimeters with a range of 4.10 – 4.90 centimenters while the female group had a mean score of 4.25 + .035, with a range of 2.50 – 4.80. The table further showed that the categories of participants have similar height.

Research Questions

Based on the analysis, the researcher provides answers to the research questions.

Research Question 1: Will there be any difference in the pre-test post-test cardiorespiratory function indices of primary school pupils based on gender?

Table 4.5: Table of Mean and Standard Deviation Values of Pre-test and Post-test Scores for FVC

GROUP	VARIABLES	PRE MEAN	SD	POST MEAN	SD	NOS
Male Expt/Children	FVC	1.2581	1.37790	1.0106	1.23661	32
Male control/children		2.0816	1.63310	0.8650	1.25411	32
Female Expt/Children		1.2581	1.37790	1.5681	1.79375	32
Female control/children		2.0816	1.63310	1.5334	1.78713	32

Table 4.5 indicates the indicate the effect of gender on Forced Vital Capacity (FVC) of participants. The FVC values for male experimental group were 1.2581±137790ml for pretest and a posttest value of 1.0106±1.23661ml. The male control group was 2.0816±1.63310 and 0.8650±1.25411 for their respective pre-test post-test values while the female experimental group obtained 1.2581±1.37790 for pre-test and a post-test value of 1.5681±1.79375. The female control group had 2.0816±1.63310 for pre-test and 1.5334±1.78713 for post-test respectively. This result shows that the participants did not perform better in the post-test.

Table 4.6: Table of Mean and Standard Deviation Values of Pretest and Post-test Scores for FEV_1

Male Expt/Children	FEV_1	1.5681	1.79375	1.3259	0.64576	32
Male control/children		1.5334	1.778713	1.3969	0.51454	32
Female Expt/children		1.5681	1.79375	1.2416	0.45695	32
Female control/children		1.5334	1.78713	1.3163	0.64001	32

Table 4.6 shows the effect of gender on Forced Expiratory Volume in 1^{st} second (FEV_1) of participants based on gender. The FEV_1 pre-test value is 1.5681±1.79375 litres for the male experimental group, with a post-test value of 1.3259±0.64576. The male control group had 1.5334±1.78713 and 1.3969±0.51454 for their respective pre-test and post-test value. The female counterparts in the experimental group obtained 1.5681±0.79375 for pre-test and obtained 1.5681±o.79375 for post-test. Their control group had 1.5334±1.78713 for pre-test and a post-test value of 1.3163±0.64001 respectively. The data shows that none of the participants' categories were significantly better than the other.

Table 4.7: Table of Mean and Standard Deviation Values of Pre-test and Post-test Scores for PEFR

Male Expt/Children	PEFR	1.3722E2	5.40649E	11.1944E2	3.46689E1	32
Male control/children		1.5734E2	4.84932E	11.1344E2	1.36286E1	32
Female Expt/Children		1.3722E2	5.40649E	1.1944E2	3.46689E1	32
Female control/children		1.5734E2	4.84932E	1.1344E2	1.36286E	32

Table 4.7 reveals the effect of gender on Peak Expiratory Flow Rate (PEFR) of participants based on gender. The PEFR pre-test value for the experimental group was 1.3722E2±5.40649E L/min and a post-test value of 1.1944E2±3.46689E1 L/min. The male control group had 1.5734E2±4.84932E1 L/min and 1.1344E2±1.36286E L/min for their respective pre-test post-test values, while their female counterparts in the experimental group obtained 1.3722E2±5.40649E1 L/min for their pre-test and a post-test value of 1.1944E2±3.46689E2 and their control group obtained 1.5734E2±4.84932E1 respectively. This means that none of the categories of these participants performed significantly better than the other. Thus, they did not differ much from their test measurement mean values.

Table 4.8: Table of Mean and Standard Deviation Values of Pre-test and Post-test Scores for RSBP

Male Expt/Children	RSBP	78.3072	4.80091E1	12.5944	3.05949E1	32
Male control/children		4.0803	1.60452E1	1.2909	0.10091	32
Female Expt/Children		66.2768	1.19457E1	12.5944	3.05949E1	32
Female control/children		68.5250	2.16244	1.2909	0.10091	32

Table 4:8 indicates the indicate the effect of gender on Resting Systolic Blood Pressure (RSBP) of participants. The table shows that the male experimental group had 78.3072±4.80091E1 for their pre-test value and 12.5944±3.05949E1 as their post-test values, the male control group had 4.0803±1.60452E1 for pre-test and post-test, 1.2909±0.10091. While their female counterparts in the experimental group had 66.2768±1.19457E1 for pre-test value and 12.5944±3.0594E1 for post-test, the female control group had 68.5250±2.16244 and 1.2909±0.10091 for their respective pre-test and post-test values. The result shows that the participants categories at the post-test were significantly lower than at pre-test.

Table 4.9: Table of Mean and Standard Deviation Values of Pre-test and Post-test Scores for RDBP

Male Expt/Children	RDBP	59.96888	2.36726E1	69.06258	5.65659	32
Male control/children		67.45008	1.57389	68.32508	2.68155	32
Female Expt/Children		68.11258	2.26617	67.67508	1.78145	32
Female control/children		69.57508	0.78695	68.52508	2.09472	32

Table 4.9 shows the effect of gender on Resting Diastolic Blood Pressure (RDBP) of participants. The RSDP pre-test value for the male experimental group was 59.96888±2.36726E1 mmHg with a post-test value of 69.06258±5.65659 mmHg. The male control group had 67.45008±1.57389 mmHg for pre-test and a post-test of 68.32508±2.68155 mmHg. The female experimental group had 68.11258±2.26617mmHg, for their pre-test, 67.67508±1.78695mmHg for post-test, while their control group obtained 69.57508±0.78695 for pre-test and a post-test value of 68.52508±2.09472mmHg. The result shows that none of the categories in the post-test value were significantly better than their female counterparts in the pre-test value.

Table 4.10: Table of Mean and Standard Deviation Values of Pre-test and Post-test Scores for RHR

Male Expt/Children	RHR	79.3750	1.13187E1	83.3750	1.03667E1	32
Male control/children		87.1563	8.83946	79.1250	1.26383E1	32
Female Expt/Children		72.8869	9.18260	83.3750	1.03667E1	32
Female control/children		67.2472	1.61124E1	79.1250	1.26383E1	32

Table 4.10 shows the effect of gender on Resting heart Rate (RHR)) of participants. The H.R pretest value for the male experimental group was 79.3750±1.13187E1 bpm and a posttest value of 83.3750±1.03667E1 bpm. The male control group obtained a pretest value of 87.1563±8.83946 bpm and a posttest value of 79.1250±1.26383E1 bpm. Their female counterparts in the experimental group obtained 72.8869±9.18260 bpm and 83.3750±1.03667E1 for their respective pretest and posttest values while the female control group obtained 67.2472±1.61124E1 for pretest and 77.1250±1.26382E1 as their posttest value. This means that the male and female experimental group performed significantly better than their counterparts in the control group. Thus, there is a slight difference between the male and female categories in their test measurement mean values.

Table 4.11: Table of Mean and Standard Deviation Values of Pre-test and Post-test Scores for VO_2 Max

Male Experimental	VO_2 max	72.8869	9.18250	32
Male Control		67.2472	16.11239	32
Female Experimental		72.8869	9.1820	32
Female Control		67.2472	16.11239	32

Table 4.11 portrays the effect of gender on Maximum Oxygen uptake (VO_2max) of participants. The table shows that the VO_2max value for the male experimental group was 72.8869±9.1820 L/kg/min^{-1}, and the male control group had 80.6000±9.43575 L/kg/min^{-1} for their respective pretest and posttest values while the female experimental group had 72.8869±9.18260 L/kg/min^{-1} for their pretest value and 54.8869±9.2320 L/kg/min^{-1} for their respective pretest and posttest values. The results

reveals that the participants' categories at the pretest were significantly higher than their counterparts at the posttest.

Research Question 2: Will there be any difference in the pretest posttest cardiorespiratory function indices of primary school pupils based on type of schools?

Table 4.12: Table of Mean and Standard Deviation Values of Pre-test and Post-test Scores for type of School on Cardiorespiratory Indices

Type of schools	Variables	Pre-mean	SD	Post-Mean	SD	Nos
Private	FVC	1.2443	1.55552	0.9344	1.23025	64
Public		1.6699	1.54911	1.5299	1.53030	64
Private	FEV_1	74.2736	81.91917	1.4230	1.32932	64
Public		1.5508	1.76925	1.5388	1.77798	64
Private	PEFR	61.6901	60.07264	1.1561E2	26.28997	64
Public		1.4728E2	51.74026	1.4602E2	53.55741	64
Private	RSBP	54.2973	39.10551	41.1937	51.57614	64
Public		6.9427	22.11712	7.1264	22.20593	64
Private	RDBP	66.9405	26.03253	52.6311	28.53170	64
Public		67.4008	8.55693	67.4008	8.59082	64
Private	RHR	76.6663	13.77767	83.2656	10.81040	64
Public		81.2500	11.61861	81.2500	11.66463	64
Private	VO_2max	68.5248	15.78710	68.5248	15.78710	64
Public		70.0670	13.31589	70.0670	13.31589	64

Table 4.12 shows significant differences on the type of school on cardiorespiratory pre-mean post mean values of RSBP, RDBP, and RHR. It further shows that pretest values on FEV_1, PEFR, RSBP, RDBP and RHR were significantly higher than the posttest values while pre-mean FVC and VO_2max were significantly lower than the values obtained in the private schools.

No significant difference was found in the mean values of all the cardiorespiratory function indices within the public schools. It means that the participants in the private schools responded better to the intervention program than their counterparts in the public schools.

Research Question 3: Will there be any difference in the pre-test posttest cardiorespiratory function indices of primary school pupils based on type of Group?

Table 4.13: Table of Mean and Standard Deviation Values of Pre-test and Post-test Scores for FVC

Group	Variable	Pre-Mean	SD	Post Mean	SD	Nos
Male experimental	FVC	1.2581	1.37790	1.0106	1.23661	32
Male Control		2.0816	1.63310	0.8650	1.25411	32
Female Experimental		1.2581	1.37790	1.5681	1.79375	32
Female Control		2.0816	1.63310	1.5334	1.78713	32

Table 4.13 shows the effect of type of group on Forced Vital Capacity (FVC) of participants. The FVC pretest value was 1.2581±1.37790 ml for the male experimental group, with a posttest 1.0106±1.23661 ml; the male control group had 2.0816±1.63310 ml as their pretest value and a posttest of 0.8650±1.25411 ml. On the other hand, the female experimental group had 1.2581±1.37790 for their pretest value, with a posttest value of 1.5681±1.79375 ml, and the control group had 2.0816±1.63310 as pretest and a posttest value of 1.5334±1.78713 ml. This indicates that the participants at the control group responded better to the intervention program at the pretest level than at the posttest.

Table 4.14: Table of Mean and Standard Deviation Values of Pre-test and Post-test Scores for FEV_1

Group	Variable	Pre-Mean	SD	Post Mean	Sd	Nos
Male Experimental	FEV_1	1.5681	1.79375	1.3259	0.64576	32
Male Control		1.5334	1.78713	1.3969	0.51454	32
Female Experimental		1.5681	10.7937	1.2416	0.45695	32
Female Control		1.5334	1.78713	1.3163	0.64001	32

Table 4.14 reveals the effect of type of group on Forced Expiratory Volume in 1st second (FEV_1). The table shows the FEV_1 of male experimental group to be 1.5681±1.79375 liters and 1.3259±0.64576 liters for their respective pretest and post-test values, and the male control group obtained 1.5334±1.78713 for their pretest value and 1.3969±0.1454 liters for their posttest. The female experimental group had 1.5681±0.7937 liters for their pretest and 1.2416±0.45695 liters for their posttest values, while the female control group obtained 1.5334±1.78713 liters and 1.3163±0.64001 liters for their respective pretest posttest values. This shows that the participants' responses in the posttest were not significantly better than the pretest.

Table 4.15: Table of Mean and Standard Deviation Values of Pre-test and Post-test Scores for PEFR

Group	Variable	Pre-Mean	SD	Post-Mean	SD
Male experimental	PEFR	1.3722E2	5.40649E1	1.1944E2	3.46689E1
Male Control		1.5734E2	4.84932E1	1.1344E2	1.36286E1
Female Experimental		1.3722E2	5.40649E1	1.1944E2	3.46689E1
Female Control		1.5734E2	4.84932E1	1.1344E2	1.36288E1

Table 4.15 indicates the effect of type of Group on Peak Expiratory Flow Rate (PEFR) of participants. PEFR is 1.3722E2±5.4064E1 L/min and 1.1044E2±3.46689E1 in the male experimental group pretest and posttest values. The male control group had 1.5734E2±4.84932E1 L/min and 1.1344E2±1.362865 L/min for the respective pretest posttest values. The female experimental group obtained 1.3722E2±5.4069E2 as their pretest value while the posttest value was 1.1944E2±3.46689E1 on the other hand, the female control group had 1.5734E2±4.84932E1 L/min and 1.1344E2±1.36286E1 for their respective pretest-posttest values. This result indicates that none of the participants' categories responded significantly better than the other.

Table 4.16: Table of Mean and Standard Deviation Values of Pre-test and Post-test Scores for RSBP

Group	Variable	Pre-mean	SD	Post-Mean	SD
Male Experimental	RSBP	1.3722E2	5.40649E1	1.1944E2	3.46689E1
Male Control		1.5734E2	4.84932E1	1.1344E2	1.3628E1
Female Experimental		1.3722E2	5.40649E1	1.1944E2	3.46689E1
Female Control		1.5734E2	4.84932E1	1.1344E2	1.36286E

Table 4.16 reveals the effect of type of group on Resting Systolic Blood Pressure (RSBP) of participants. It shows RSBP to obtain 1.3722E2±5.40649E1 mmHg for the male and female experimental group and 1.534E2±4.84932E1 mmHg for male and female control groups pretest-posttest values respectively. This shows that the participants did not differ very much from their test measurement mean values.

Table 4.17: Table of Mean and Standard Deviation Values of Pre-test and Post-test Scores for RDBP

GROUP	VARIABLE	PRE-MEAN	SD	POST-MEAN	SD	
Male Experimental	RDBP	59.9688	2.36726E1	69.0626258	5.65659	32
Male Control		67.45008	1.57389	68.32508	2.68155	32
Female Experimental		68.11258	2.26617	67.67508	1.78145	32
Female Control		69.57508	0.78695	68.52508	2.09472	32

Table 4.17 shows the effect of type of group on Resting Diastolic Blood Pressure on (RDBP) of participants. It indicates that the RDBP pretest value for male experimental group was 59.9688±2.36726E1 mmHg and a posttest value of 69.0688±5.65659 mmHg, while the male control group had 67.45008±1.57389 mmHg and 68.32508±2.68155 mmHg for their respective pretest posttest values. The female experimental group had a pretest value of 68.11258±2.26617 mmHg and a posttest value of 67.67508±1.78145 mmHg while their control group was 69.57508±0.78695 mmHg for pretest and 68.52508±2.09472 mmHg for posttest values.

Table 4.18: Table of Mean and Standard Deviation Values of Pre-test and Post-test Scores for RHR

Group	Variable	Pre-Mean	SD	Post-Mean	SD	
Male Experimental	RHR	79.3750	1.3187E1	83.3750	1.03667E1	32
Male Control		87.1563	8.83946	79.1250	1.26383E1	32
Female Experimental		72.8869	9.18260	83.3750	1.03667E1	32
Female Control		67.2472	1.61124E1	79.1250	1.26383E1	32

Table 4.18 reveals the effect of gender on Resting Heart Rate (RHR) of participants. This shows that RHR pretest value for the male experimental group was 79.3750±1.3187E1 bpm with a posttest value of 83.3750±1.03667E1 bpm; the male control group had 87.1563±8.83946 bpm for pre-test with a posttest value of 79.1250±1.26383E1. On the other hand, the female experimental group obtained a pre-test value of 72.8869±9.18260 bpm with a posttest value of 83.375±1.03667E1 bpm; the female control group had a pretest value of 67.2472±1.61124721 bpm and a posttest value of 79.1250±1.26383E1 respectively. This result shows that the male and female experimental group responded positively and significantly better than their counterparts in the control group.

Table 4.19: Table of Mean and Standard Deviation Values of Pre-test and Post-test Scores for VO_2 max

Group	Variable	Pre-Mean	SD	Post-Mean	SD
Male Experimental	VO_2 max	72.8869	9.18260	80.600	9.43575
Male Control		67.2472	16.11239	67.2472	16.11239
Female Experimental		72.8869	9.18250	72.8869	9.18250
Female Control		67.2472	16.11239	56.8869	5.48260

Table 4.19 shows the result of cardiorespiratory function of maximum oxygen consumption value for the male experimental group was 72.8869±9.18250 L/kg/min^{-1}. The male control group was 67.47±16.11239 L/kg/min^{-1}. The female experimental group was 72.8869±9.1820 L/kg/min^{-1}. The female control group was 67.2472±16.11239 L/kg/min^{-1}. The result revealed that the participants' categories at

the post-test were significantly higher than their counterparts at pre-test. This means that the male experimental participants perform significantly better than their counterparts in the control group.

Hypotheses Testing

Ho_1: There will be no significant differences in the pre-test post-test Forced Vital Capacity of primary school pupils following aerobic exercise.

Table: 4.20: Hypothesis One: Forced Vital Capacity

Tests of Between – Subject Effects

Dependent variable post primary school student athletes forced vital capacity in litres.

Source	Type III Sum of Squares	DF	Mean Square	F	Sig	Partial Eta Squared
Corrected model	24.1739[a]	4	6.043	2.649	.076	0.79
Intercept	243.601	1	243.601	106.784	.000	.465
CFVC	2.474	1	2.474	1.084	.300	.009
Trtgroup	21.363	3	7.121	3.122	.028	.071
Error	280.595	123	2.281			
Total	661.687	128				
Correct Total	304.768	127				

a R Squared = .079 (Adjusted R squared = .049)

Table 4:21 Scheffe Post Hoc Pairwise Multiple Comparison of Primary School Pupils Forced Vital Capacity (in litres).

(i) Participants categories	(j) Participants categories	Mean Difference (I-J)	Std Error	Sig	95% Confidence interval LowerBand	Upper Band
Male Expt Group	Male Control group	-8235	.36452	.197	-1.8940	.2471
	Female expt	.0000	.38872	.000	-1.0706	-1.0706
	Female cont	-8235	.38872	.000	-1.8940	.2471
Male cont Group	Male expt Group	8235	37772	.197	-2471	1.8940
		8235	38872	007	.2471	1.8940
	Female expt Group	0000	37772	1.000	-1.0706	1.0706
	Female Cont Group					
Female expt	Male expt Group	0000	37772	000	-1.0706	1.0706
				000	-1.8940	2471
	Male Cont Group	-8235	.37972	197	-8940	2471
	Female Cont	-8235	38872			
Female Cont	Male expt Group	8235	37772	197	-2471	1.8940
	Male Cont Group	0000	38872	1.000	-1.0706	1.0706
	Female expt	.8235	.37772	197	-2471	1.8940

Based on observed means, the error term is mean square (Error) = 2.283

Table 4:22 Summary of Scheffe Post Hoc Analysis for Participants Forced Vital Capacity (in litres)

Broad Classifications of Participants	**N**	**Subset for Alpha = 0.05** **I**
Male expt group	32	1.2581
Female expt group	32	1.2581
Male cont	32	2.0816
Female cont	32	2.0816
Sig.		.197

Means for groups in homogenous subsets are displayed. Based on observed means. The error term is means square (error) = 2.283.

The analysis of covariance on the above table shows that there is significant difference (FC4, 123) = 3.122, P < 0.05) in the pretest post test forced vital capacity (FVC) between experimental and control groups of primary school pupils following 8 – weeks aerobic exercise training programme. The null hypothesis is therefore rejected. Scheffe post hoc analysis however revealed that the significant differences occurred between male and female groups (P = 0.007).

Ho_2: There will be no significant differences in the pre-test post-test Forced Expiratory Volume at 1st second of primary school pupils following aerobic exercise.

Table 4.23 Hypothesis Two – Forced Expiratory Volume in 1st Second.

Tests of Between Subjects Effects.

Dependent variable post primary school children FEV_I

Source	**Type III Sum of Squares**	**Df**	**Means Square**	**F**	**Sig.**
Correct Model	9.078a	4	2.270	.719	.581
Intercept	16.772	1	16.772	5.310	.023
$Cfev_1$	9.040	1	9.040	2.862	.093
Trigroup	.200	3	.067	.021	.996
Error	388.464	123	3.158		
Total	705.372	128			
Corrected Total	397.542	127			

A R squared = .023 (Adjusted R square = -009)

The analysis of covariance in the table above shows that there is no significant difference ($F(4,123) = .021$, $P > 0.05$) in the pretest-posttest forced expiratory volume in 1st second (FEV_1) between experimental and control groups among primary school pupils following an 8 – week aerobic exercise training programme. The null hypothesis is therefore accepted.

Ho_3: There will be no significant differences in pre-test post-test peak expiratory flow rate of primary school pupils following aerobic exercise

Table 4:24 Hypothesis Three – Peak Expiratory Flow Rate.

Test of Between Subjects Effects

Source	**Type III Sum of Squares**	**Df**	**Means Square**	**F**	**Sig.**
Correct Model	15223.765a	4	3805.941	1.441	224
Intercept	99673.763	1	99673.763	37.750	.000
Cpefr	2263.265	1	2263.265	.857	.356
Trigroup	14056.015	3	4685.338	1.775	.156
Error	324762.110	123	2640.342		
Total	3116532.000	128			
Corrected Total	339985.875	127			

a R square = .045. (Adjusted R squared = .014)

The analysis of covariance in the table above shows that there is no significant difference (F (4, 123) = 1.775, p > 0.05) in the pretest-posttest peak expiratory flow rate (PEFR) between experimental and control group among primary school pupils following an 8 – week aerobic exercise training programme. The null hypothesis is therefore accepted.

Ho_4: There will be no significant differences in the pre-test post-test resting systolic blood pressure of primary school pupils following aerobic exercise

Table 4:25 Hypothesis Four – Resting Systolic Blood Pressure (In Hgmm)

Dependent variable post resting systolic blood pressure (in Hgmm).

Source	**Type III Sum of Squares**	**Df**	**Means Square**	**F**	**Sig.**
Correct Model	4529.663a	4	1132.416	2.418	.052
Intercept	210.868	1	210.868	.450	.503
Crsbp	441.096	1	441.096	.942	.334
Trigroup	2650.336	3	883.445	1.887	.135
Error	57594.536	123	468.248		
Total	68293.859	128			
Corrected Total	62124.198	127			

a R squared = 0.73 (Adjusted R squared = .043)

The analysis of covariance in the table above shows that there is no significant difference (F (4, 123) 1.887, P> 0.05 in the pretest-posttest resting systolic blood pressure (RSBP) between experimental and control groups of primary school pupils following an 8 – week aerobic exercise training programme. The null hypothesis is therefore accepted.

Ho_5: There will be no significant differences in the pre-test post-test resting diastolic blood pressure of primary school pupils following aerobic exercise.

Table 4:26 Hypothesis Five Resting Diastolic Blood Pressure (In Hg Mm)

Test of Between Subjects Effects

Dependent variable post primary school children resting diabolic blood pressure (in Hg mm)

Source	Type III Sum of Squares	Df	Means Square	F	Sig.
Correct Model	203.946a	4	50.986	.690	.601
Intercept	43710.586	1	43710.586	591.130	.000
Crdbp	42.171	1	42.171	.570	.452
Trigroup	122.712	3	40.904	.553	.647
Error	9095.119	123	73.994		
Total	590785.825	128			
Corrected Total	9299.065	127			

a R squared = .022 (Adjusted R squared = -010)

The analysis of covariance in the table above shows that there is no significant difference (F (4, 123) = .553, P >0.05) in the pretest-posttest resting diastolic blood pressure between experimental and control group of primary school pupils following an 8 – week aerobic exercise training programme. The null hypothesis is therefore accepted.

Ho_6: There will be no significant differences in the pre-test post-test resting resting heart rate of primary school pupils following aerobic exercise

Table 4:27 Hypothesis Six – Resting Heart Rate

Test of Between-Subjects Effects

Dependent variable post primary school children resting heart rate (in bpm)

Source	**Type III Sum of Squares**	**Df**	**Means Square**	**F**	**Sig.**
Correct Model	1814.011a	4	453.503	.3.639	.008
Intercept	29455,942	1	29455.942	236.339	.000
Crdbp	1236.011	1	1236.011	9.917	.002
Trigroup	883.217	3	294.406	2.362	.075
Error	15329.989	123	124.634		
Total	862144.000	128			
Corrected Total	17144.000	127			

a R squared = .106 (Adjusted R squared = .077)

Ho$_7$: There will be no significant differences in the pre-test post-test resting resting heart rate of primary school pupils following aerobic exercise

Table 4:28 Hypothesis Seven – Maximum Oxygen Uptake (in Litres)

Test of Between Subjects Effects

Dependent variable post primary school children resting heart rate (in bpm)

Source	**Type III Sum of Squares**	**Df**	**Means Square**	**F**	**Sig.**
Correct Model	2317.421a	4	579.355	3.559	.009
Intercept	22464.219	1	22464.219	137.989	.000
CVO_2 max	1299.627	1	1299.627	7.983	.006
Trigroup	2314.754	3	771.585	4.740	.004
Error	20023.995	123	162.797		
Total	650743.192	128			
Corrected Total	22341.417	127			

a R squared = -104 (Adjusted R squared = -.075)

Table 4:29 Scheffe Post Hoc Pairwise Multiple Comparison of Primary School Children Maximum – Vo2 (in Litres).
Primary School Children Maximum – Vo_2 (in litres)

(i) Broad Classification of Participants	(j) Broad Classification of Participants	Mean Difference (I-J)	Std Error	Sig	95% Confidence interval Lower Band	Upper Band
Male Expt Group	Male Control Group	5.6397	3.27838	.402	-3.6521	.14.9315
	Female expt	.0000	3.27838	1.000	-9.2918	9.2918
	Female control	5.6397	3.27838	.000	-3.6521	14.9315
Male Cont Group	Male expt Group	-5.6397	3.27838	.402	-14.9315	3.6521
	Female expt	5.6397	3.27838	.402	-14.9315	3.6521
	Female Control	.0000	3.27838	1.000	- 9.2918	9.2618
Female expt	Male expt Group	.0000	3.27838	.000	-9.2918	9.2918
	Male Cont Group	5.6397	3.27838	.402	-3.6521	14.9315
	Female Cont	5.6397	3.27838	.000	-3.6521	14.9315
Female Cont	Male expt Group	-5.6397	3.27838	.000	-14.9315	3.6521
	Male Cont Group	.0000	3.27838	1.000	-9.2918	9.2918
	Female expt	-5.6397	3.7838	.402	-14.9315	3.6521

Based on the means, the error term is mean square (error) = 171.965. The mean difference is significant at 0.05 level.

The analysis of covariance in the table above shows that there was no significant difference (F (4, 123) = 2.362, P >0.05) in the pre-test post-test maximum oxygen consumption between experimental and control group of primary school pupils following an 8 –weeks aerobic exercise training programme. The null hypothesis is therefore accepted.

Table 4.30: Summary of Scheffe Post Hoc Analysis for primary school pupils Maximum Oxygen Consumption (in litres) VO_2 Max.

Scheffe a.b

Broad Classifications of Participants	N	Subset I
Male Cont Group	32	67.2472
Female Cont Group	32	67.2472
Male expt Group	32	72.8869
Female expt Group	32	72.8869
Sig.		

The analysis of covariance in the above table shows that there is significant difference (F (4, 123) = 4.74, P <0.05) in the pretest-posttest maximum oxygen uptake between experimental and control group of primary school pupils following an 8 – week aerobic exercise training programme. The null hypothesis is therefore rejected. Scheffe post hoc analysis however revealed that the significant difference occurred between male and female pupil groups (P=0.000).

T-TEST COMPARISON BASED ON TYPE OF SCHOOL

T-test comparison on FVC, FEV_1, PEFR, RSBP and RHR based on type of school.

Table 4.31: T-Test Comparison On FVC, FEV_1, PEFR, RSBP and RHR Based on Type of School.

The independent t-test comparison below indicate that there were significant differences in type of school (between private and public school)

Groups	Variables	Mean Differences	Df	t-calculated	P-value
Public	FVC	0.93	127	2.095	<0.05
Private		1.53			
Public	FEV_1	1.42	127	10.06	<0.05
Private		74.27			
Public	PEFR	1.15	127	12.74	<0.05
Private		61.69			
Public	RSBP	41.19	127	12.93	<0.05
Private		54.29			
Public	RHR	88.27	127	2.60	<0.05
Private		81.25			

Table 4.30 above indicates the t-test comparison differences. The result between the public and private schools are as follows: FVC (t=2.095, df=127, p<0.05); Public(x=0.93), Private(x=1.24); FEV_1 (t=10.06, df=127; P<0.05) Public(x=1.42), Private(74.27); PEFR(t=12.74, df=127; P<0.05) Public(x=1.15), Private(x=61.69); RSBP(t=12.93, df=127; P<0.05); Public(x=41.19), Private(x=54.29) and RHR (t=2.60; df=127; P<0.05); Public (x=88.27); Private (x=81.25).

The t-test comparison below show that there were no significant differences.

Table 4.32: t-test comparison on RDBP and VO_2max based on type of school

Groups	Variables	Mean Difference	Df	t-calculated	P-value
Public	RDBP	52.63	127	0.19	>0.05
Private		66.94			
Public	VO_2max	70.07	127	0.60	>0.05
Private		70.07			

Table 4.31 above indicates the t-test comparison on Resting Diastolic Blood Pressure (RDBP) and Maximum Oxygen Consumption (VO_2max) based on type of school. However, the result indicates that there were no significant differences on RDBP (t=0.19; df=127; p>0.05); Public (x=52.63), Private (x=66.94) and VO_2max (t=0.60, df=127; P>0.05); Public(x=70.07); Private (70.07).

T-test Comparison based on Gender

The t-test comparison below indicate that there were significant differences in gender between male and female groups.

Table 4.33: t-test comparison on FVC, PEFR, RSBP, RDBP based on gender

Groups	Variables	Mean Differences	Df	t-calculated	P-value
Male	FVC	0.93	63	2.360	<0.05
Female		1.53			
Male	PEFR	1.46	63	4.26	<0.05
Female		1.49			
Male	RSBP	7.12	63	5.40	<0.05
Female		42.37			
Male	RDBP	67.40	63	3.84	<0.05
Female		52.63			

Table 4.32 above portrays the t-test comparison differences for FVC, PEFR, RSBP, RDBP based on gender. The result shows that significant differences were recorded on FVC (t=2.360; df=63; P<0.05) male (x=0.93) female (x1.53); PEFR (t=4.26, df=63, P<0.05) male (x=1.46) female (x=1.49), RSBP (t=5.40; df=63; P<0.05), male

(x=7.12) female (x=42.37) and RDBP (t=3.84, df=63, P<0.05) male (x=67.40) female (52.63).

The t-test comparison below reveal that there were no significant differences on FEV_1, HR, VO_2max based on gender.

Table 4.34: t-test comparison differences for FEV_1, HR, VO_2max based on gender

Group	Variables	Mean Differences	Df	t-calculated	p-value
Male	FEV_1	1.35	63	0.40	>0.05
Female		1.54			
Male	H.R	81.25	63	0.89	>0.05
Female		83.27			
Male	VO_2max	70.07	63	0.60	>0.05
Female		68.53			

Table 4.33 on above reveals the t-test comparison differences on FEV_1, HR, VO_2max based on gender. However the result showed that there were no significant differences on FEV_1 (t=0.40, df=63, P>0.05) male (x=1.35) female (x=1.54), RHR (t=0.89, df=63; P>0.05) male (x=81.25), female (x=83.27) and VO_2max (t=0.60, df=63, P>0.05) male (x=70.07) female (x=68.53). Though the results imply that children have more tendencies for cardiorespiratory adaptation and improvement, private school pupils had better responses to training than their counterparts in public schools. This implies that the female participants possess better adaptation than their male counterparts during training.

T-test comparison based on type of group

The t-test comparison differences below indicates that there were significant differences in type of group (between the experimental and control groups).

t-test comparison based on type of group

Table 4.35: t-test comparison differences for FVC, PEFR, RSBP, based on type of group

Group	Variables	Mean differences	Df	t-calculate	P-value
Male/female experimental	FVC	0.93	63		
Male/female control		1.53	63	2.360	<0.05
Male/female experimental	PEER	1.46	63		
Male/female control		1.49		4.45	<0.05
Male/female experimental		7.12	63		
Male/female control	RSBP	42.37		5.40	<0.05
	RDBP	67.40	63		
		52.63		3.84	<0.05

Table 4.34 on above reveal the t-test comparison differences on cardiorespiratory function indices based on gender.

However the result shows that there were no significant differences on FEV_1 (t=1.35, df = 63, P > 0.05) PEFR, RSBP, RDBP based on type of school

The t-test comparison on FEV_1, RHR and VO_2max based on type of group

Table 4.36: the t-test comparison differences on FEV_1, RHR and VO_2max based on type of group

Group	Variable	Mean Differences	Df	t-calculated	P-value
Male/female experimental	FEV_1	1.35	63	0.65	>0.05
Male/female control		1.54			
Male/female experimental	RHR	81.25	63	0.89	>0.05
Male/female control		83.27			
Male/female experimental	VO_2max	70.07	63	0.60	>0.05
Male/female control		68.53			

Table 4.35 above shows that the independent t-test for absolute values on cardiorespiratory function indices based on type of group. However, the result show that there was no significant difference on FEV_1, ($t = 0.65$, $df = 63$, $P < 0.05$) male ($x=1.35$) female ($x=1.54$), RHR ($t=0.89$, $df = 63$, $P <0.05$) P (0.05) male ($x=70.07$) female ($x = 68.58$). though the result imply that the children have tendencies for cardiorespiratory improvement and better response, control group student athletes had better responses to training than their counterparts in experimental group. This reveal that the control group participants possesses better adaptation than their counterparts in experimental group during training.

DISCUSSION OF FINDINGS ON RESEARCH QUESTIONS

Research Questions

Research Question 1: Will there be any difference in the pretest post-test cardiorespiratory function indices of primary school pupils based on gender.

Forced Vital Capacity (FVC)

Table 4.5 of research question one indicate the result of Cardiorespiratory functions of Forced Vital Capacity for male experimental group pre-test 1.2581±1.37790 and post-test 1.0106±1.23661. The male control group pretest was 2.0816±1.63310, and post-test 0.8650±1.254.11. The female experimental group pretest values were 1.2581±1.37790, and post-test values of 1.5681±1.79375, The female control group pre-test values were 2.0816±1.63310, and a post-test value of 1.5334±1.78713 respectively.

The present study demonstrates that participants in the male and female control group had a better response to training than their counterparts in the control group. However, the slight changes observed between the measurements in reference to forced vital capacity may be partly due to the result of aerobic exercise used in the study. Harabin, Homer, Weathersby and Flyn (2005) posited that reduction in vital capacity is considered to be an indicator of degree of lung damage that results from pulmonary O_2 toxicity.

Results from this study shows that aerobic exercise significantly improved Forced Vital Capacity after eight weeks of training. This is in line with recent studies which shows that aerobic exercise plays an important role in improving the function of respiratory function. Research reports by Nourry, Oerulle and Guinhouya (2005) supported this statement when they said that improvement in exercise to FVC shared direct link to long term effect to exercise than the short term. They concluded that without immediate demand on cardiovascular functions such as SV, cardiac output, there may not be any need for increment of the high O_2 uptake that usually propel content of the air in the lung.

Forced Expiratory Volume in 1st Second (FEV_1)

Table 4.6 of research question one shows the results of cardiorespiratory functions of forced Expiratory Volume in 1st second for male experimental group pre-test 1.5681±1.79375 and post-test 1.3259±0.64576. The male control group pre-test 1.53334±1.778713 and post-test 1.3969±0.51454. The female experimental group pretest 1.5681±1.79375 and post-test 1.2416±0.45695. The female control group pre-test 1.5334± 1.78713 and post-test 1.3163±0.64001. Physical inactivity and low cardiorespiratory fitness are recognized as important causes of morbidity and mortality. USDHSS (1996) Twisk, Staal & Brinkman, et. al. (1998).

It seems likely that reduced FEV_1: $p = 0.05$; Table 4.33. in the present study are results of respiratory muscle weakness due to sedentary lifestyle. Therefore, it was postulated that this insignificant increase in FEV_1 had been resulted from repeated respiratory testing effects in the experimental group in comparison with pre-exercise group.

Sindes, et. al. (2010), Xian, et. al. (2000) and Jakes, et. al. (2002) found that those who participated in vigorous physical activity showed a slower rate of decline in FEV_1 after 37 years follow-up. Jakes, et. al. (2002); Holman, et. al. (2002) found smaller lung capacity (FVC and FEV_1) independent of age in non-smokers with lower levels of physical activity Kaufman, et. al. (2007) studied the effect of aerobic training on ventilator efficiency in Overweigh children, and found that the training helped to reverse the decreament in Cardiopulmonary function observed over a period of time in Overweight children.

The findings of the present study have been rejected by the findings of Prajapati (2008) who evaluated some parameters of pulmonary status cardiorespiratory fitness in Nepal medical students and showed that the mean FVC, FEV_1 VO_2 max and PEFR of the subjects were in normal range and significant changes were not observed. Also, Rogers (2001) investigated changes in lung function of the multiple desert endurance athletes and reported significant reduction in FEV_1 and FVC of the sample. Williams (2002) used different levels of intensity and duration of exercise to study pulmonary function and showed that 5-10 minutes after the exercise. FEV_1 decreases significantly rather than affecting FVC. This decrease beads to a decline in FEV_1/FVC ratio. He further showed that combination of duration and intensity of exercise is important and necessary for lung elasticity after exercise.

The present study reported a mean height of 4.35 cm (Table …). Height has been established by Courteix, Obert, Lecoq, Guenon and Koch (1997) and Kaplan and

Montana (1993) as the best predictor of lung function. cross-sectional and longitudinal studies have shown that height increment stops between the age 16 and 17. Xian, Peat, Toelle, Marks, Berry and Woolcock (2000). Xian, et. al. found that pulmonary function (FVC and FEV_1) continued to grow after the cessation of height growth. For example, the change in expected FEV_1 after age 17 is reported to be about 200ml/yr.

It seems that excessive repeated respiratory testing and short duration of the exercise training are probable mechanism for insufficient FEV_1 improvements in the intervention group.

Peak Expiratory Flow Rate (PEFR)

Table 4.7 of research question one postulates the effect of gender on Cardiorespiratory functions of peak expiratory flow rate (PEFR) (L/min) for male experimental group pre-test had a mean value of 1.3722E2±54.06492E1 and post-test value of 1.1944E2±3.46689E1 (L/min), and the male control group pretest with a mean value of 1.5734E2±4.84932E1 and post-test 1.1344E2±1.36286E1 (L/min). The female experimental group pretest with a mean value of 1.3722E2±5.40649E, and post-test value of 1.1944E2±3.46689E1. The female control group pre-test with a mean value of 1.5734E2±4.84932E and a post-test value of 1.1344E2±1.36286E respectively. The PEFR of participants in both pre-test and post-test group of this study was almost similar.

After 8-weeks of continuous aerobic exercise training post exercise PEFR was not significantly higher than the baseline in the intervention, (PEFR ($t = 4.26$, $df = 63$, $p < 0.05$, Table 4.32).

Respiratory system is important among vital body system that work to exchange gases required for daily activities and human survival. Indeed physical inactivity and Overweight can negatively affect pulmonary function. The present study showed that exercise has a positive impact on pulmonary functions and thus, inspiring about exercise may be helpful to reduce respiratory complications in primary school pupils.

Previous studies by Courteix, Obert, Lecoq, Guenon and Koch (1997) have reported larger respiratory function in the intervention group compared to the control group. This discrepancy can be attributed to the lack of larger change in the post exercise BMI and short exercise training course in the intervention group.

The findings of this study observed a non-significant improvement in PEFR with a mean value 11.1944±3.4668 (Table 4.7). The exact mechanism of the PEFR improvement in this study is unknown, but respiratory muscles function, and weight loss possibly affect this variable. Repeated exercise may result in respiratory muscle hyperthrophy, and it is obvious that respiratory indices are related partly to respiratory muscle power. The results of this study showed that inactivity and sedentary lifestyle significantly reduced respiratory function Brutsaer, Tom, Esterbar & Parra (2004) showed that primary school pupils are in high risk of pulmonary complications with impaired respiratory function and inefficient respiratory muscles, leading to decrease in lung volume and respiratory muscle performance

Resting Systolic Blood Pressure (RSBP)

Table 4.8 of research question one shows the result of cardiorespiratory functions of resting systolic blood pressure for male experimental group pretest 78.3072±4.80091E1 and post-test 12.5944±3.05949E1. The male control group pre-test 4.0803±1.60452E1 and post-test 1.2909±0.10091. The female experimental group pre-test 66.2768±1.19452E1 and post-test 12.5944±3.05949E1. The female control group pre-test 68.5250±2.16244 and post-test 1.2909±0.10091 mmHg.

Resting Systolic Blood Pressure

Table 4.8 of research question one shows the results of cardiorespiratory functions of resting systolic blood pressure for male experimental group pre-test 78.3072±4.80091E1 and post-test 12.5944±3.05949E1. The male control group pre-test 4.0803±1.60452E1 and post-test 1.2909±0.10091. Female experimental group pre-test-66.2768±1.19457E1 and a post-test 12.5944±3.05405949E1. Female control group 68.5250±2.16244 and post-test 1.2909±0.10091. The result showed that none of the categories in the post-test value were significantly better than their female counterparts in the pre-test value.

The mean values obtained from each of the groups provides a justification that the treatment on both groups had little or no effect in the resting systolic blood pressure of participants in this study. The outcome of this study was considered to be consistent with the observation made by Dasgupta, O'Loughlin and Chen (2006) who stressed that variations in the value of SBP is relative and specific with different age bracket. They further explained that the absolute values for boys and girls were identical up to age nine and clearly so to age 14, and that because of morphological changes taking place in this age-range values for girls may.

However,, the slight changes observed between the pre-test and post-test measurements in reference to resting systolic blood pressure may be due to the progressive and integrative nature of the intervention modality used in the study. This is in agreement with the research studies carried out by Lurbe, Sorof and Daniels (2006) that the SBP of healthy children between 100-120 mmHg is considered as being normal for this class of young school children as found in this study. They further state that there was no significant difference between the male and female children of similar age groups.

The result of this study showed that the participant's categories at the post-test were significantly lower than at pretest based on gender and group after aerobic exercise. The SBP is more pronounced at pre-test male and female experimental group with higher mean value than at post-test 78.3072±4.80091E1 and 68.5250±2.16244, this is in line with the reported study of Wilmore & Knuttgen (2006) that children have natural fitness, as general activity does not provide a training stimulus, and suggests that children have inferior cooling mechanisms due to low blood volume and high skin temperature. They also expend more energy per kilogram of body weight, and that children have a higher VE/VO_2 ratio due to their inferior lung function and they rely more on fat metabolism.

Resting Diastolic Blood Pressure

Table 4.9 of research question one shows the result of cardiorespiratory functions of Resting Systolic Blood Pressure for pretest value for the male experimental group was 59.96888±2.36726E1 mmHg with a post-test value 69.06258±5.65659 mmHg. The male control group had 67.45008±1.57389 mmHg for pre-test and a post-test of 68.32508±2.68155 mmHg. The female experimental group and 68.11258±2.26617 mmHg for the pre-test, 67.67508±1.78145 mm Hg. For the post-test, while their control group obtained 69.57508±1.78695 for pre-test and a post-test value 68.52508±2.09472 mmHg. The results revealed that none of the categories in the post-test value were significantly better than their female counter-parts in the pre-test value.

This is in line with Aniodo, Aos (2003) reported that individuals may not usually have high DBP if their fitness level is average and their SBP is normal. On the other hand, physical inactivity and low level of fitness among the participants might be responsible for the non-significant difference observed between the pre-test and post-test values respectively. Many others have shown that regular aerobic activities (workouts like brisk walking that use large muscles for an extended of time) over several months may modestly lower Blood pressure. For example, Markoff & Schoenfield (2004) reported that a two-week regular exercise prograin revealed benefits in children with high blood pressure.

Resting Heart Rate

Table 4.10 of research question one shows the results of cardiorespiratory functions of Resting heart rate for pre-test value for the male experimental group was 79.3750±1.13187E1 min with a post-test 83.3750±1.03667E1. The male control group had 87.1563±8.83946 for pre-test and a post-test of 79.1250±1.26383E1 bmp. The female experimental group had 72.8869±9.18260 bpm for the pre-test, and 83.3750±1.03667E1 for the post-test. The female control group had 67.2472±1.61124E1 bpm for the pre-test, and 79.1250±1.26383E1 bpm for the post-test.

There is a slight difference between the male and female categories in their test measurement mean values.

Studies have shown that exercise training results in many long-term physiological adaptations, which improve the body's ability to maintain homeostasis. Nabofa and Muoboghere (2006) reported a mean resting heart rate of 71.7, for a group of combat athletes, Boroffice, Adeogun, and Idowu also reported a mean resting heart rate of 75b/min for Lagos state sports council coaches. These should be expected since these populations are regular at exercise and physical activity.

Similarly, O'Neill (2000) reported a significant improvement in resting heart rate of selected famales who were engaged in eight-week exercise programme. He further reported 9% reduction in resting heart rate. The need to maintain relatively low resting heart rate among elementary exercise behaviour.

The present study has clearly shown that aerobic exercise affects the heart rate responses and cardiorespiratory fitness in primary school pupils under effective supervision.

Other studies have recorded reductions in mean heart rates of 159-141 beats per minutes in habitually sedentary females on fixed ergometer test. this change was observed following a five week aerobic training programme, involving rope-skipping. This findings is similar to that of the present study, the non-significant improvement observed was indicated by a decrease in their resting heart rates.

Maximum Oxygen Consumption

Table 4.11 of research question one shows the result of cardiorespiratory functions of maximum Oxygen Consumption Value for the male experimental group was 72.8869±9.18250 L/kg/min. The male control group was 67.2492±16.1123 L/kg/min. The female experimental group was 72.8886±9.1820 L/kg/min. The female control group was 67.2472±16.11239 L/kg/min. The results reveals that the participant's categories, particularly the male experimental group at the post-test were significantly higher than their counterparts at the pretest.

The results indicate that the male experimental group had a slightly better response in the intervention than their female counterparts. A number of workers have demonstrated the aerobic capacity of children is highly predictable, and that comparison can be made between children of different body weights and the amount of oxygen available for each body unit can be determined. Carter et. al. (2000) in their study have shown that with regular participation in aerobic exercise programme, a person can increase his/her maximum Oxygen Consumption by as much as 30% within 8-week period depending on his/her initial level of fitness.

Maximal Oxygen Consumption contributes to the Physical Working Capacity of the active total body mass. This is possible through changes in stroke volume, heart rate and arteries – venous oxygen difference. However, the values of those variables can be affected by coronary diseases, Mac Weigh (2004) studied the values of maximal oxygen uptake to predict values for various levels of the individuals of the same age, sex and workload. They suggested that training improves the rate of maximum oxygen consumption.

Research Question Based on Type of School.

Research Question 2: Will there be any difference in the pre-test post-test cardiorespiratory function indices of primary school pupils based on type of school?

Public and Private Schools

Table 4.30 of research question two on t-test Analysis of Comparison of the primary school pupil's responses on Cardio-respiratory functions (FVC, FEV_1, PEFR, RSBP, and RHR) based on type of school.

The results showed there were significant differences between participants in the public and private schools with FVC ($t=2.095$; $df= 127$; $P<0.05$); FEV, Second ($t=10.06$; $df=127$;$P<0.05$); PEFR ($t=12.74$; $df=127$; $P<0.05$); SBP ($t=12.93$; $df= 127$; $P<0.05$) and RHR ($t=2.60$; $df= 127$; $P<0.05$).

However, the result indicate that there was no significant differences on RDBP ($t=0.19$; $df=127$; $P<0.05$) Pub ($x=52.63$); Priv ($x=66.94$) and Vo_2 max ($t=0.60$; $df = 127$; $P<0.05$); Pub ($x=70.07$; Priv (70.07). Though the results indicated that children had more tendencies for cardio-respiratory adaptation and improvement, private school pupils had better responses to training than their counterpart in public schools. This implies that the female participants possesses better adaptation than their male counterpart during aerobic training. The result of the present study further revealed that no significant difference was found in the mean values of all cardio-respiratory function indicates within the public school. It means that the participants in the private school responded better to the intervention programme than their counterparts in the public school.

VC is equivalent to the inspiratory reserve volume (IRV) plus the tidal volume (TV) plus the expiratory reserve volume (ERV). It is intimately correlated with body mass, age and respiratory muscle fitness. Novak, et al (2004). Sonnetti, Wetter, Pegalow and Dempsey (2001) and Huang (2005) posited that pulmonary ventilation for 0_2 under exercise condition decreases as a result of training but this improved efficiency in breathing is not the result of reduced metabolic acidosis and thus a lower drive ventilation. In the type of school, significant improvement were found in FEV, second, PEFR and RSBP, most especially with the private school.

Other studies have shown that dynamic pulmonary variables are affected by different factors, and that endurance exercise can affect these parameters. Pekonen, et al. (2003), Abdul (2003), and Ucok, (2004). Other studies shows that submaximal aerobic training leads to bronchospasm. Fateni, 2010; Fateni and Ghanbarzedeh,

(2010) showed that $FECV_1$ and FVC decrease significantly after a single sub maximal aerobic exercise in non-athletes participants.

The present study indicates that private school pupils had significant better improvement in FEV_1, PEFR and RSBP than their counterparts; while public school participants showed significant greater improvement in FVC, RDBP and $V0_2$, Max after eight weeks of aerobic exercise.

There were significant differences between the participants in the public and private schools on RSBP and RHP. Private school had better mean performance in RSBP and RHR.

GENDER

Table 4.32 of research question two on t-test Analysis of Comparison of Primary School Pupils responses on Cardio-respiratory functions (FVC, PEFR, RSBP and RDBP) based on gender.

The results showed there were significant differences between male and female participants with FVC (t=2.360; df=63;P<0.05) male (x=0.93) female (x=1.53). PEFR (t=4.26; df = 63; P<0.05) male (x=1.46), female (x=1.49). RSBP (t=5.40; df= 63; P<0.05) male (x=7.12) female (x=42.37_ and RDBP (t=3.84;df=63; P<0.05) male (x=67.40) female (x=52.63).

However, the result showed that there were no significant differences on FEV_1 (t=0.40; df= 63; P>0.05) male (x=1.35) female (x=1.53). HR (t=0.89; df=63; P<0.05) male (x=81.25) female (x=83.27) and Vo_2 max (t=0.60; df=63; P<0.05) male (x=70.07) female (x=68.53).

The present study showed that it was also significant when the participants were exposed along the gender basis with FVC females better than the males. This implies that the female participants possess better adaptation than their male counterparts during aerobic training.

Results from this study shows that aerobic exercise significantly improved forced vital capacity after eight weeks of training. This is in line with recent studies which shows that aerobic exercise plays an important role in improving the function of respiratory function. Research reports by Noury, Oerulle and Guinhouga (2005) supported this statement when they said that improvement in exercise to FVC shared direct link to long-term effect to exercise than the short term. They concluded that without immediate demand on cardio-vascular functions such as SV, cardiac output, there may not be any need for increment of the high 0_2 uptake that usually propel content of the air in the lung.

Results from this study shows that aerobic exercise did not significantly improved FEV_1 after 8 weeks of training. Jakes, et. Al (2005) reported that those who participated in vigorous physical activity showed a slower rate of decline in FEV_1 during 37 years old follow-up. However, Holmen, et al (2002) in a prospective study, very young female competitive swimmers, recorded contrary findings when they recorded an increase in FEV_1. In this study there is a slight significant decline in $FEV_{1,}$ the reason of the significant decline in FEV_1 may be related to respiratory muscle fatigue in these participants as a result of age.

Noury, et al (2005), and Khalili, et al (2009) showed in a prospective study that aerobic exercise improves pulmonary function and alters exercise improvement in children. Khalili et al (2009) and Radovamovic, et al (2009); Brutsaert et al (2006) who found that aerobic training over a period of time generally improved lung function including peak Expiratory Flow Rate. It is important to note that the design and sample of some of the studies are not exactly the same with the current study. Although, there were no significant differences in performance in all the respiratory variables based on gender, it is interesting to note that female participants had better performance across board in all the respiratory indices.

Research Question Based on Type of Group

Research Question 3: Will there be any difference in the pre-test post-test cardiorespiratory function indices of primary school pupils based on type of group?

Table 4.34 of research question three on t-test Analysis of Comparison of the Primary School Pupils responses on Cardio-respiratory functions (FVC, PEFR, RSBP and RDBP) based on type of Group. The result showed that significant differences existed between experimental and control groups with FVC ($t=2.360$; $df=63$;$P<0.05$) exp. ($x=0.93$) Cont ($x=1.53$). PEFR ($t=4.45$; $DF=63$; $p<0.05$) EXP ($X=1.46$) Cont ($x=1.49$). RSBP ($t=5.40$; $df= 63$; $P<0.05$) exp ($x=7.12$) Cont ($x=42.37$) and RDBP ($t=3.84$; $df=63$; $P<0.05$ exp ($x=67.40$) Cont ($x=52.63$).

However, the result revealed that there was no significant differences on FEV_1 ($t=0.65$; $df=63$;$P>0.05$) Exp ($x=1.35$) Control ($x=1.54$). RHR ($t=0.89$;$df=63$;$P>0.05$) Exp ($x=81.25$) Cont ($x=83.27$). Exp ($x=81.25$) Cont ($x=83.27$). Vo_2 max ($t=0.60$; $df=63$; $P>0.05$) Exp ($x=70.07$) Cont ($x=68.53$).

The result of this study demonstrates that aerobic exercise is capable of improving cardio-respiratory indices of participants between the experimental and control groups in the variables, however, experimental group participants had better mean performance in RHR and Vo_2 max.

The results obtained in this also showed that primary school participants cardio-respiratory function parameters were significantly higher than the control group especially in the RHR and $V0_2$ max,. This implies that experimental group respiratory adaptation was higher.

Results from this study shows that aerobic exercise positively affects resting systolic blood pressure after eight weeks of training. This is in line with recent studies which shows that aerobic exercise plays an important role in improving the function of cardio vascular function. Research reports by Baroface, et. al (2002) on 115.72 mmttg supported this statement when they said that 5.7% reduction in resting systolic pressure, these effects are pointer that regular exercise contributes positively to health and wellness of individuals. They concluded that eight weeks intervention training may not have significant changes in the resting systolic blood pressures of performers who shared the same age-ranges in the temperate regions of the world.

Furthermore, aerobic exercise significantly improved Resting Diastolic blood pressure after eight weeks of training. This is slightly contrary to the research evidence of Lurbe, et al. (2006) who reported that exercise has little or no effects on the likely changes related to diastolic blood pressure except in low humid environment whose slight changes are noted. They further showed that similar separation of age specific values by sex occurred with DBP but not until age 16, after which it decrease for girls. DBP values were noted to be more nearly equal for a boys and girls at all ages. SBP was consistly noted to be about 5mmHg lower than DBP.

The result of the present study also portrayed that aerobic exercise did not significantly improved heart rate after eight weeks of training. Although the experimental group participants obtained better mean performance in RHR. Research efforts by O'Neill (2000) recorded a reduction in resting heart rate and differences between these means were observed. However, Ustalo and Rusko (2008) in a perspective study reported that the nature of physiological changes may often not be consistent between male and female participants, especially when similar training is involved. In this study, there is a slight decline in RHR and this may be related to the nature of physiological changes in these participants.

Control Group

Randomized pre-test post test control group experimental research design was used for the study. It involves one experimental group and one control group, the two groups went through pre-training evaluation, but the control did not go through an exercise training programme for eight weeks.

The control did not go through any of the six aerobic exercises levels or receive any institution about the training programme, other than their normal school physical education activities and normal daily chores. They went through a placebo which mimicked resistance training.

The control group along with their counterparts in the experimental group on demographic distribution of participants showed a mean value participants by sex, age, height, and weight (Tables 1-4).

Table 1: Demographic distribution of the participants

Table 1 Sex	Mean age	N	Std D	Minimum	Maximum	Table 2 Age	Mean age	N	Std D	Minimum	Maximum
Male	4.1250	64	1.84735	1.00	6.00	Male	10.1406	64	1.02147	8.00	14.00
Female	9.9167	64	.96732	7.00	12.00	Female	9.9167	64	.96732	4.00	12.00

Table 3 weight	Mean age	N	Std D	Minimum	Maximum	Table 4 Height	Mean age	N	Std D	Minimum	Maximum
Male	29.5156	64	4.96972	20.0	42.00	Male	4.3581	64	.17455	4.10	4.90
Female	29.7500	64	4.58803	19.00	42.00	Female	4.2500	64	.35056	2.50	4.80

The control group were no assigned to any exercise throughout the eight weeks duration of non-exercise. However, they were allowed to take part in their normal school activities, but quite a number of participants in the control group were piping and gazing at the activities of the experimental group during the training programme on this shows that the control group were not actually under control.

DISCUSSION OF FINDINGS ON HYPOTHESIS

Hypothesis

Forced Vital Capacity (FVC)

Table one of hypothesis one showed the result of cardiorespiratory function indices of forced vital capacity [F(4,123)=3.123, P<0.05] of the primary school pupils experimental and control groups to be statistically significant. However, the Scheffe post Hoc multiple comparison analysis revealed that the significant difference noted on the forced vital capacity of the participants existed between the male and female control group. In further comparison, the male control group with the mean of 2.0816 ± 1.63310 ml 0.8650 ± 1.25411 ml pretest and posttest, the male experimental group with the mean of 1.281 ± 1.37790 ml and 1.0106 ± 1.23661 ml share similarities with their female counterparts with the mean of 1.28 ± 1.37790 and 1.5681 ± 1.79375 ml. In contrast, the main treatment has similar physiological effect in forced vital capacity function indices of primary school pupils with their male and female experimental groups. The present study demonstrates that aerobic exercise did not significantly improve FVC in the male and female participants of the experimental group as compared to the control group. However, the slight changes observed between the measurements in reference to forced vital capacity maybe as a result of modality used in the study. VC is the maximal volume of air that people can forcefully (expirate) expire after maximal inspiration. VC is equivalent to the inspiratory reserve volume (IRV) plus the tidal volume (TV) plus the expiratory reserve volume (ERV). It is intimately correlated with body mass, age and respiratory muscle fitness (Novak et.al 2004). Recent studies have shown that VC of female college students progressively decreased yearly in China and the decreased VC has recently been substantiated to induce the respiratory and cardiovascular diseases. Clinic trials have shown that aerobic exercise plays an important role in improving the function of respiratory indices. The result further revealed that the male experimental group did not differ much from their posttest mean score. This may be attributed to the fact that aerobic training program was conducted in the lower altitude with a long time effect of training. Research reports by Nourry, Oerulle and Guinhouya (2005) supported this statement when they said that improvement in exercise to FVC shared direct link with long term effect to exercise than the short term. They concluded that without immediate demand on cardiovascular functions such as SV, cardiac output, there may not be any need for increment of the high O_2 uptake that usually propel content of the air in the lung. Results from their study further submitted that a person who is born and lives at sea level (this is applicable to the participants in this study) may develop a slightly smaller lung capacity than a person who spends his life at high altitude. This is simply because the partial pressure of oxygen is lower at higher altitude, which by implication means that oxygen less readily diffuses into the bloodstream. The present data thus demonstrates that aerobic exercise tolerance test of step bench can significantly affect cardiorespiratory function indices after an 8-week exercise.

Forced Expiratory Volume in 1st Second (FEV_1)

Table two of hypothesis two showed the result of cardiorespiratory function indices of forced expiratory volume in 1st second [F(4,123)=0.021]=P>0.05] of the primary school pupils experimental and control group to be statistically insignificant. However, the mean comparison shows that male experimental group with the mean of 1.5681 ± 1.79375 liters and 1.3259 ± 0.64576 liters for their respective pretest and posttest responded better to the treatment than their female counterparts in the control group with the mean of 1.5334 ± 1.78713 liters and 1.3969 ±0.5454 liters. Sonnetti Wetter, Pegelow and Dempsey (2001) and Huang (2005) posited that pulmonary ventilation for O_2 under exercise condition decreases as a result of training, but this improved efficiency in breathing is not the result of reduced metabolic acidosis and thus a lower drive ventilation. In the intervention group significant improvement were found in FVC and VO_2max especially with the male experimental group, compared with participants pre-exercise values. By contrast, there were insignificant improvements in FVC and VO_2max of the control group at the 8th week. Inselma et al (1993) reported that obese children have altered pulmonary function, which is characterized by reduction in lung function capacity, ventilator muscle endurance and airway narrowing. Some studies have reported a positive association between physical activity, physical fitness and lung capacity. Cross-sectional studies have reported that regular physical activity and good physical fitness have been related to better pulmonary function. Sindes et al (2010), Xian et al (2000) and Jakes et al (2002) reported that those who participated in vigorous physical activity showed a slower rate of decline in FEv_1 after 37years follow-up. Jakes et al (2002). Holman et al (2002) found smaller lung capacity (FVC and FEV_1) independent of age in non-smokers with lower level of physical exercise. Holmen et al (2002) in a perspective study, very young female competitive swimmers were found to have an increase in their vital training Marinov & Kostanev (2003) and William et.al (2002) suggested that larger lung volumes in swimmers may be due to the impact of training on the lung growth. The mechanism by which physical inactivity might influence FVC and FEV_1 are unclear. According to them, the relationship of muscular force with FVC and FEV_1 is established. In this study however, there is a slight significant decline in FEV_1 and the reason of the significant decline may be related to respiratory muscle fatigue in these participants.

The finding of the present study in reference to effect of aerobic exercise on cardiorespiratory function indices have been rejected by the findings of Prajapati (2008) who evaluated some parameters of pulmonary status cardiorespiratory fitness in Nepal medical students and showed that the mean FVC, VO_2max and PEFR of the subjects were in normal range and significant changes were not observed. Rogers (2001) investigated changes in lung function of the multiple desert endurance athletes and reported significant reduction in FEV_1 and FVC of the sample. According to William et al (2002) and Xian et al (2000), long development is done under favourable conditions of nutritional health and physical activity. Overall, physical activity may improve respiratory muscles endurance during growth.

Dynamic pulmonary variables are affected by different factors. Some studies have shown that endurance exercise can affect these parameters (Pekonen et al, 2003; Abdul, 2003; Ucok, 2004). Other researchers showed that sub-maximal aerobic training leads to bronchospasm (Fatemi, 2010). Fateni and Ghanbarzadeh (2010) showed that FEV_1 and FVC decrease significantly after a single sub-maximal aerobic exercise in non-athletes subjects.

William (2002) used different levels of intensity and duration of exercise to study pulmonary function and showed that 5-10 minutes after the exercise, FEV_1 decreases significantly rather than affecting FVC. This decrease leads to a decline in FEV_1/FVC ratio. He also stated that combination of duration and intensity of exercise is important and necessary for lung elasticity after exercise. In the present study, pulmonary function improved significantly after 8-weeks of aerobic exercise. Thus, positive relationship between aerobics training and pulmonary function was supported by the data in this study. Other studies comparing respiratory function among men and women have observed that persons who engage in various sports have better level of pulmonary function than sedentary people (Huang, 2005). Other researchers have shown in their study that distance running program improve fitness in asthmatic children without pulmonary complications. They found that cardiorespiratory fitness significantly improved and breathlessness decreased over a wide range of physical work corresponding to activities of daily living. The present study also showed that the subjects were able to have more powerful and more effective inspiration and expiration as opposed to what they have been able to before participating in such aerobic training. One limitation of this study is that most of the participants were from lower to mid-socioeconomic strata and all the categories of pupils were included in this study. This short-coming may affect the generalization of the results to other sections of the society.

PEFR

Table three of hypothesis three showed the result of cardiorespiratory function indices of peak expiratory volume in 1st second (L/min) [F(4,123)=1.775, P>0.05] of primary school students' athletes experimental and control groups was not statistically significant. However, the mean comparison shows the male experimental group with a mean value of 1.3722E2 ± 54.06492E1 and 1.1944E2 ± 3.46689E1 (L/min) for their respective pretest and posttest and the male control group with the mean of 1.5734E2 ± 4.84932E1 and 1.1344E2 ± 1.36286E1 (L/min) for their respective pretest posttest. From this result, it is observed that the female counterparts in the experimental group did not differ very much from their test measurement mean values and this may be attributed to the fact that aerobic training program was not conducted in the lower altitude with long term effect of exercise rather than the short term. The present study corresponds with Farid et al (2005) who have showed improvement in pulmonary function with aerobic exercise training in asthma patients. Furthermore, Nourry et al (2005) showed in a prospective study that aerobic exercise improves pulmonary function and alters exercise improvement in children. Khalili et al (2009) & Radovanovic et al (2009) studied the effect of 5-month swimming training on school children with asthma and found improved lung function and improved posture and fitness. Nourry et al (2005) and Kelund et al (2007) in their study found that cardiorespiratory fitness significantly improved and breathlessness decreased over a wide range of work, corresponding to activities of daily living. The present study demonstrates that inactivity and sedentary lifestyle significantly reduces respiratory function. Brutsaert et al (2006) in agreement with the above statement, opined that the school children are in high risk of pulmonary complications with impaired respiratory functions and inefficient respiratory muscles, leading to decrease in lung volume and respiratory muscle performance. It is believed that with increased inactivity level and sedentary lifestyle, respiratory muscles get infiltrated with fat and becomes flabby and weak; hence ineffective. The result of this study correlates with Cheng et al (2003) who showed in their study that physical activity improved pulmonary function in healthy sedentary people. Kaufman et al (2007) studied the effect of aerobic training on ventilator efficiency in overweight children, and found that the training helped to reverse the decrements in cardiopulmonary function observed over time in overweight children. This study also correlates with the above findings.

In the present study, PEFR increased slightly in the experimental group after 8-weeks of aerobic exercise plan. It can be explained that as both groups had similar conditions at the beginning of the study, aerobic exercise caused the increase among the experimental group. Thus, an association between aerobic exercise training and improvement of lung function was supported by the data.

Resting Systolic Blood Pressure

Table four of hypothesis four showed the result of cardiorespiratory function indices of resting systolic blood pressure [F(4,123)=1.887, P>0.05]of the primary school students' athletes experimental and control groups not to be statistically significant. However, the mean comparison shows the male experiment and control group with a mean value of 78.3072 ± 4.80091E1 and 112.5944 ±3.0594E1 mmHg for their respective pretest posttest. Also, the female experiment and control groups obtained with a mean of 66.2766 ± 8.3072 ± 4.1945 and 12.5944 ± 3.05944 mmHg for their respective pretest posttest. From this result it can be seen that the female experimental and control groups significantly improved over their counterparts in the male experimental and control groups respectively. When the mean systolic blood pressure was compared with other reported studies by Boroface et al (2002) on 115.72 mmHg, there was a report of 5.7% reduction in resting systolic blood pressure, these effects are pointers that regular exercise contributes positively to health and wellness of individuals, as it is in this present study. The outcome of this study was consistent with the observation made by Guerra, Ribero, Costa, Duarte and Mota (2002). Furthermore, the results from their students revealed that exercise may have little or no increases in the amount of RSBP among the male athletes whose ranges fall between 14 and 19 years old. The participants in this study exhibited the normal systolic blood pressure of 110-120 mmHg considered to be appropriate for healthy individual participants according to Guerra, et.al. (2002). The outcome of this study further justified the fact that 8-weeks intervention training may not have significant changes in the resting systolic blood pressure of performers who shared the same age ranges in the temperate regions of the world.

They further showed that the SBP of healthy children between 100-120 mmHg is considered as being normal for this class of young school athletes as found in this study, and that there was no significant difference between the male and female children of similar age-groups.

Resting Diastolic Blood Pressure

Table five of hypothesis five showed the results of cardio-respiratory function indices of resting diastolic blood pressure [F(4,123)=0.553, P>0.05] of primary school pupils experimental and control groups not to be statistically significant. However, the mean comparison revealed that the male experimental group had a mean value of 1.8721E2 ± 54.06492 mmHg and 67.8969 ± 2.40852 mmHg for their respective pre-test post-test. Also, their female experimental and control group with a mean of 1.4728E2 ± 5.174026 mmHg and 68.1000 ± 2.12406 mmHg for their respective pre-test post-test. When this result was compared with results of study carried out by Rowland et.al (2005) and Kelly & Kelly (2002) who found a mean of 82.11 ± 8.41 mmHg, it was observed that these effects are pointers to the fact that regular exercise contributes positively to health and wellness of individuals, most especially with the children population, and also as a way of avoiding or reducing the risk of hypertension among this group. In contrast, Lurbe et al (2006) reported that exercise has little or no effect on the likely changes related to diastolic blood pressure except in low humid environment where slight changes are noted. They further show that similar separation of age-specific values by sex occurred with DBP but not until age 16, after which DBP decreased for girls. DBP values were noted to be more nearly equal for boys and girls at all ages, but did separate at age 12, with girls having the higher values and DBP have more lesser slopes of changes than did SBP across the whole age-range. RSBP was consistently noted to be about 5mmHg lower than RDBP.

RHR

Table six of hypothesis six showed the results of cardio-respiratory function indices of resting heart-rate F(4,123)=2.362, P>0.05 of primary school pupils experimental and control groups was not statistically significant. However, the mean comparison shows the male and female experimental group with the mean value of 83.3750 ± 10.36666 and 80.000 ±11.44975 bpm for their respective pre-test and post-test measurement value exhibited significant positive responses to treatment than their counterparts in the control group with a mean value of 79.1250 ± 12.63827 bpm and 81.6250 ± 10.8875 bpm for their respective pretest-posttest scores. This result was found to show a close tie, although maximal heart-rate value has been very difficult to predict even in healthy individuals, because of such factors like age, sex, motivation, and measurement techniques which influence it. Research evidence by Ustalo & Rusko (2008) revealed that the nature of physiological changes may often not be consistent between male and female athletes, especially when similar training is involved. They further show that VO_2 max may reduce in some athletes, as it remained static with others, and that physiological reaction to training is considered to be relative to individual athletes. They advocated for global and regional concerns toward achieving universal standard for gender responses for different training protocol. This mean value of heart rate was compared with other reported studies by O'Neill (2000) who reported a reduction in resting heart rate of 73.65 ± 5.28 (bpm) and differences between the means were observed. Heart rate at rest is an important index for evaluating the cardiac function. When cardiac function was improved with adaptation to exercise, HR at rest is lower. The present study shows that exercise has little or no effect on cardiac function at resting state, but significantly enhanced HR in these children after the starting of exercise training. The restoration of HR is another index too evaluate cardiovascular function after an acute exercise. Cardiovascular system with good function shows a faster recovery after a set of acute exercise (Tipton and Sandals, 2004). This present data demonstrates that participants in the experimental group significantly improved compared to those in the control group ($P<0.05$).

VO_2max

Table seven of hypothesis seven showed the result of cardio-respiratory function indices of maximal oxygen uptake [$F(4,123)=4.740$, $P<0.05$] of the primary school pupils experimental and control groups to be statistically significant. However, the Scheffe post-Hoc multiple comparison analysis revealed that the significant difference observed on the maximal oxygen uptake of the participants existed between the male experimental and female control group. In further comparison, the male experimental group with a mean of 72.8869 ± 9.18260 80.600 ± 9.43575 (ml/kg/min) for their respective pre-test and post-test, responded better than their female counterparts in control group with a mean value of 67.2472 ± 16.11239 and 56.8869 ± 5.48260 for their respective pre-test post-test. When these means were compared with other studies, differences between the means were observed. The obtained value by female control group was not too different from the other 67.2472 ± 16.11239. In contrast, all the participants exhibited similar degree of responses to the treatment. However, Uristalo, Uristalo and Rusko (2008) observed that the nature of physiological changes may often not be consistent between the male and female athletes, especially, when similar training is involved. They further stated that VO_2max may reduce in some athletes, as it remains static with others and that physiological reactions to training is considered to be relative to individual athlete. They therefore advocated that global and regional concerns toward achieving universal standard for gender responses for different training protocol is of paramount importance. A number of workers have demonstrated that aerobic capacity of children is highly predictable and that comparison can be made between children of different body weights and the amount of oxygen available for each unit body unit can be determined. Carter et al (2000) reported that with regular participation in aerobic exercise program, individuals can increase his/her maximum oxygen uptake as much as 30% within 8-weeks period, depending on individual initial level of fitness. For example, Mc Weigh (2004) reported VO_2max of 38.51 ± 3.75 ml/kg/min from a direct measure of maximal oxygen uptake as opposed to estimates as in the case of this study. The present study demonstrates that participants in this study had significantly improved in their oxygen uptake capacity than those of the reported studies. The difference might be due to either the conditioning process or fitness and racial difference of the participants. The difference might also partly depends upon a difference in body size, since there is a good correlation between max VO_2 during running and body size in these participants.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

Insufficient physical activity (sedentary lifestyle) has been described as a risk factor for over-weight or obese persons for having many related diseases. Excess weight is known to be associated with respiratory complications and these complications can be reversed with active aerobic exercise. In elementary children, aerobic exercise has been found to improve cardio respiratory function capacity. This study compared the effect of aerobic exercise on cardio respiratory capacity among the primary school students' athletes.

The review of literature focused on benefit of physical activity to children, exercise and health, inactivity and sedentary, respiratory and cardio vascular functions, exercise and heart rate, blood pressure and VO_2 max. The research design for this study was the randomized pretest posttest control group experimental design. Ethical approval was sought and obtained from Ibadan North East Local Government Universal Basic Education Authority. Signed consents of all the participants were also obtained. Participants were primary school pupils with an age range between 05 and 13 years old. One hundred and twenty eight participants were recruited into the study and their baseline data were measured. The aerobic exercise programme was conducted at the Aiyekale Community and Christ the King Primary Schools, Agagu Oja. Oremeji Ibadan. Each participant went through an 8-week aerobic exercise programme.

The data obtained were analyzed using descriptive statistics of percentages, mean, range and standard deviation. Inferential statistics of independent t-test and ANCOVA were also used for analysis. Alpha level was set at 0.05.

Results obtained showed that primary school participants improved significantly in cardio respiratory functions parameters following the eight week aerobic exercise programme. Post-test participant's respiratory function parameters was significantly higher than for pretest participants ($P \leq 0.05$) especially in the PEFR.

Conclusion

Based on the finding of this study, the following conclusions were drawn:

1. There were significantly improvement in RDBP, RHR and FVC ($P<0.05$) following 8-weeks of aerobics training.

2. Aerobics training significantly improved on gender, male participants showed a statistical significant changes on FVC, PERF, RSBP, RHR and VO_2 max than their counterparts following 8-weeks of aerobic exercise training.
3. Aerobics training programme has shown statistical significant changes in female primary pupils performed significantly better in FVC & VO_2 max than their male counterparts 8-weeks of aerobics training.
4. Private school athletes had significantly better improvement in RSBP than their counterparts. While the public pupils showed significantly greater improvement in FVC, RDBP & VO_2 max following 8-weeks of aerobics training.

Recommendations

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

1. Both male and female primary school pupils participants should participate regularly in aerobic exercise programme so as to improve and maintain good cardiorespiratory function.
2. Universal Basic Education Authority should create a conducive atmosphere that will encourage primary school pupils to participate in aerobic exercise programme regularly. Parents and school pupils masters should also enhance increasing their physical activity levels at every spectrum of their developmental growth.
3. To attain good health-status and wellbeing for the primary school pupils, exercise should be a must, not just a matter of will, this will invariably enhance an increase improvement on the cardiorespiratory indices of FVC and VO_2 max.
4. In addition to these, an habitual and daily traditional physical activities that have contributory effects on FVC and VO_2max. All these strategic can only be effective, if the interest of these athletes are sustained in the activity.

Contributions to Knowledge

1. The result of this study demonstrates that aerobic exercise is capable of improving cardiorespiratory indices of FVC and VO_2max under effective supervision.

2. The study establish a baseline data which may provoke other researchers to investigate more on cardiorespiratory function indices of FVC and VO_2max in primary school pupils.
3. The outcome of this study clearly showed that aerobic exercise training has the ability to significantly increase the indices of FVC and VO_2max more in the female participants than their counterparts, this can only be effective, if they are built around regular participation in aerobic exercise.
4. The result of this study revealed that aerobic exercise is capable of enhancing significant treatment effect on FVC, RDBP and VO_2max in the public school than their counterparts in the private school, to achieve this, a rigorous exercise training that brings about a physiological effect is expected to be establish.

Further Research Study

Research study should be carried out on the precise circumstances under which Aerobic Exercise may be served as outcomes write of increase physical activities levels for positive health and wellness for the type of school, gender, and type of group amongst the Primary School Pupils in Ibadan and other areas of interest.

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APPENDIX 1
INFORMED CONSENT FORM

The participants were given consent form in which the nature, benefits and duration of aerobic exercise tests were explained to the pupils. The forms were duly signed by the pupils/parents.

INFORMED AND UNDERSTOOD CONSENT FOR RESEARCH STUDY

I having been duly informed and fully understood the involvement of the proposed study, voluntarily present myself to participate as a subject in this project work dealing with the effect of aerobic exercise on cardiorespiratory functions in primary school pupils in Ibadan North-east Local Government Area, Oyo State.

I also agree to abide by the simple instructions concerning the training programme and to perform the various procedures to the best of my ability.

Name:____

Address:____

____

Signature:____

Date:____

School ___________ **Date of Birth** ___________ **Sex (Gender)**___________

Signature/Date ___________

APPENDIX 2

VI. INFORMED CONSENT/INFORMATION SHEET SAMPLES

A. Where do I find Templates for Consent Documents?

https://oprs. usc. Edu/review/forms/

B. Sample of an IRB-approved Consent Document

Page 1of2

University of Southern Califomia. The Department of Politics and International Relations
INFORMATION SHEET FOR NON-MEDICAL RESEARCH

*All appro
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will have
stamp

Political Activitism among Women in Turkey between 1990 and 200.9

You are invited to participate in a research study conducted by Ph.D. Candidate, from the University of Southern California. You must he 18 years or older to participate in the study. Your participation is voluntary. Please take as much time as you need to read the information sheet. You may also decide to discuss it with ‘your family or friends. You will be given a copy of this form.

PURPOSE OF THE STUDY

We are asking you to take part in a research study because we are trying to learn more about women's political experiences in Turkey as well as patterns of women's participation into electoral politics.

Completion and return of the questionnaire or response to the interview questions will constitute consent to participate in this research project.

PROCEDURES
You will he asked to be interviewed as one of the male politicians in Turkey. The interview will take approximately one hour and the location will be determined according to your preference. It may be conducted in your office, nearby coffee shop, or other locations you prefer. You will be asked some questions regarding how you perceive women's political participation in electoral politics.

POTENTIAL RISKS AND DISCOMFORTS
There are no anticipated risks to your participation. When you feel sonic discomfort at responding sonic questions, please feel free to ask to skip the question.

POTENTIAL BENEFITS TO SUBJECTS AND/OR TO SOCIETY
You will not directly benefit from your participation in tins research study.

This research will not provide a benefit to you. The overall goal is to reveal the experiences of female politicians. The findings may provide better understanding of "being a woman and being politician in the Turkish context". Thus, it may give an outlook to young women who aim to be involved in Turkish politics.

PAYMENT/COMPENSATION FOR PARTICIPATION
You will not receive any payment for ‘tour participation in this research study.

POTENTIAL CONFLICTS OF INTEREST
The investigators of tins research do not have any financial interest in the sponsor r in the product being studied.

CONFIDENTIALITY
Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. The information collected about you will be coded using a fake name (pseudonym) or initials and numbers, for example abc-123, etc. The information which has your identifiable information will be kept separately from the rest of your data.

Study ID: UP-08-00003 Valid From: 1/15/2008 To: 1/14/2009

The data will the stored in the investigator's office in a locked file cabinet/password protected computer.

The data will be stored for approximately seven years after the study has been completed and then destroyed. Your consent will be asked for audio recording. You may decline to be taped.
The Principal Investigator will transcript the tapes and may provide you with a copy of the transcripts upon request. You have right to review and edit the tapes. Sentences that you ask investigator to leave out will not be used and they will be erased from all relevant documents.

When the results of the research are published or discussed in conferences, no information will be included that would reveal your identity, If photographs. videos, or audio-tape recordings of you will be used for educational purposes. your identity will be protected or disguised.

PARTICIPATION AND WITHDRAWAL
You can choose whether to be part of this study or not. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind. You may also refuse to answer any questions you are reluctant to answer and still remain in the study. The investigator may withdraw you from this research if circumstances arise which warrant doing so,

ALTERNATIVES TO PARTICIPATION
Your alternative to participation is not to participate.

RIGHTS OF RESEARCH STBJECTS
You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving am' legal claims, rights or remedies because of your participation in this research study. If you have any questions about your rights as a study subject or you would like to speak with someone independent of the research team to obtain answers to questions about the research, or in the event the research staff can not be reached, please contact the University Park IRB, Office of the Vice Provost for Research Advancement. Credit Union Building, Room 301, Los Angeles, CA 90089 213) 821-5272 or upirb@usc.edu

IDENTIFICATION OF INVESTIGATORS
If you have any questions or concerns about the research, please feel free to contact the Principal Investigator, Ph.D. Candidate or Faculty Advisor, Dr. Advisor:

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APPENDIX 3

INFORMED CONSENT FORM/INFORMATION SHEET

University of Ibadan Department of Human Kinetics and Health Education

Aerobic Exercise among Primary School Pupils in Ibadan Nigeria 2014

You are invited to participate in a research study conducted by M'Phil. Candidate, from the University of Ibadan Nigeria. Your age range must be between 05-17 years to participate in the study. Your participation is voluntary. Please take as much time as you need to read the information sheet. You may also decide to discuss it with 'your class teacher or pariends. You will be given a copy of this form.

PURPOSE OF THE STUDY

We are asking you to learn more take part in a research study because we are trying to learn more about effect of aerobic exercise on cardiorespiratory functions of primary school children in Ibadan Nigeria as well as patterns of primary school pupils participation in the six aerobic exercise levels.

Completion and return of the questionnaire or response to the interview questions will constitute consent to participate in this research project.

PROCEDURES

You will he asked to be interviewed/questioned as one of the male and female primary school subjects in Ibadan. The interview/questions will be brief and the location will be determined according to your preference. It may be conducted in your classroom, your school play ground, or other locations you prefer. You will be asked some questions regarding how you perceive aerobic exercise participation in your school.

POTENTIAL RISKS AND DISCOMFORTS

There are no anticipated risks to your participation. When you feel sonic discomfort at responding sonic questions, please feel free to ask to skip the question.

POTENTIAL BENEFITS TO SUBJECTS AND/OR TO SOCIETY

You will not directly benefit from your participation in tins research study.

This research will provide a benefit of physical fitness to you. The overall goal is to reveal the practical experiences of your participation in aerobic exercise. The findings may provide better understanding of "being a subject and a participating pupil in the Ibadan aerobic exercise training programme. Thus, it may give an outlook to young pupil who aim to be involved in Ibadan aerobic exercise programme.

PAYMENT/COMPENSATION FOR PARTICIPATION

You will not receive any payment for 'tour participation in this research study.

POTENTIAL CONFLICTS OF INTEREST

The investigators of this research do not have any financial interest in the study or in the product being studied.

CONFIDENTIALITY

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. The information collected about you will be coded using a fake name (pseudonym) or initials and numbers. For example abc-123, etc. The information which has your identifiable information will be kept separately from the rest of your data.

The data will the stored in the investigator's office in a locked file cabinet/password protected computer.

The data will be stored for approximately seven years after the study has been completed and then destroyed.

When the results of the research are published or discussed in conferences, no information will be included that would reveal your identity, If photographs. videos, or audio-tape recordings of you will be used for educational purposes. your identity will be protected or disguised.

PARTICIPATION AND WITHDRAWAL
You can choose whether to be part of this study or not. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind. You may also refuse to answer any questions you are reluctant to answer and still remain in the study. The investigator may withdraw you from this research if circumstances arise which warrant doing so.

ALTERNATIVES TO PARTICIPATION
Your alternative to participation is not to participate.

RIGHTS OF RESEARCH STBJECTS
You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study. If you have any questions about your rights as a study subject or you would like to speak with someone independent of the research team to obtain answers to questions about the research, or in the event the research assistants cannot be reached, please contact the University of Ibadan, Human Kinetic and Health Education Department (Exercise Physiology) Faculty of Education, University of Ibadan, Ibadan Nigeria.
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IDENTIFICATION OF INVESTIGATOR
If you have any questions or concerns about the research, please feel free to contact the Principal Investigator, M'Phil. Candidate or Exercise Physiology Unit, Professor A.O. Abass. (Supervisor).

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+233547037223, 0007070039.

Source: Political Activitism in Turkey between 1990 and 2009

APPENDIX 4

All participants are expected to cooperate and comply with the measuring procedure. All information and scores will be recorded accurately.

1) Age (to the nearest birthday)______________________________ (years)

2) Stature______________________________ (meters)

3) Weight ______________________________ (kilograms)

4) Respiratory indices ______________________________

a) measurements (l/min)	**1st**	**2nd**	**3rd**	**Average**
b) Forced Vital Capacity l/min				
c)Forced Expiratory Volume in 1st second				
5) Peak expiratory flow rate	**1st**	**2nd**	**3rd**	**Average**
6) cardio-vascular indices				
a) resting systolic blood pressure mmHg				
b) resting diastolic blood pressure mmHg	**1st**	**2nd**	**3rd**	**Average**

c) resting heart rate bpm				
d) VO_2max l/kg/min:1				

APPENDIX 5

AEROBIC EXERCISE TRAINING PROGRAM

Exercise Modality

Aerobic exercise one:	**Bench stepping**
Aerobic exercise two:	**running on the spot**
Aerobic exercise three:	**Brisk walking**
Aerobic exercise four:	**Rope skipping**
Aerobic exercise five:	**Hopping**
Aerobic exercise six:	**Cycling in the air**

APPENDIX 6

8 WEEK – LONG SCHEDULE FOR AEROBIC EXERCISE TRAINING PROGRAMME FOR MALE AND FEMALE CHILDREN

EIGHT WEEK AEROBIC EXERCISE TRAINING GUIDE

Day	Mode of exercise	Set per work out	Intensity of exercise heart rate	Repetition per work out	Duration	Raining frequency	Training time	Repetition per set	Work relief ratio
Week 1									
1	Bench stepping	1	60%	2	15mins	3 x per week	3-4 mins	4	1.1
2	Running on the spot	1	60%	2	15mins	3 x per week	3-4 min	4	1.1
3	Hopping	1	60%	2	15 mins	3 x per week	3-4 min	4	1.1
4	Rope skipping	1	60%	2	20	3 x per week	`3-4 min	3	1.1
5	Cycling in the air	1	60%	2	20	3 x per week	3-4 min	3	1.1
6	Brisk walking	1	60%	2	20	3 x per week	3-4 min	3	1.1

Work relief ratio minutes seconds
Source: MCAdle Protocol (1986)

Day	Mode of exercise	Set per work out	Intensity of exercise heart rate	Repetition per work out	Duration	Raining frequency	Training time	Repetition per set	Work relief ratio
Week 2									
1	Bench stepping	1	60%	2	15mins	3 x per week	3-4 mins	4	1.1
2	Running on the spot	1	60%	2	15mins	3 x per week	3-4 min	4	1.1
3	Hopping	1	60%	2	15 mins	3 x per week	3-4 min	4	1.1
4	Rope skipping	1	60%	2	20	3 x per week	`3-4 min	3	1.1
5	Cycling in the air	1	65%	2	20	3 x per week	3-4 min	3	1.1
6	Brisk walking	1	65%	2	20	3 x per week	3-4 min	3	1.1

Work relief ratio minutes seconds
Source: MCAdle Protocol (1986)

Day	Mode of exercise	Set per work out	Intensity of exercise heart rate	Repetition per work out	Duration	Raining frequency	Training time	Repetition per set	Work relief ratio
Week 3									
1	Bench stepping	3	65%	6	35	3 x per week	3-4 mins	4	1.1
2	Running on the spot	3	65%	6	35	3 x per week	3-4 min	4	1.1
3	Hopping	3	65%	6	35	3 x per week	3-4 min	4	1.1
4	Rope skipping	4	65%	5	35	3 x per week	`3-4 min	4	1.1
5	Cycling in the air	4	65%	5	35	3 x per week	3-4 min	4	1.1
6	Brisk walking	4	65%	5	35	3 x per week	3-4 min	4	1.1

Work relief ratio minutes seconds
Source: MCAdle Protocol (1986)

Day	Mode of exercise	Set per work out	Intensity of exercise heart rate	Repetition per work out	Duration	Raining frequency	Training time	Repetition per set	Work relief ratio
Week 4									
1	Bench stepping	3	65%	6	35	3 x per week	3-4 mins	4	1.1
2	Running on the spot	3	65%	6	35	3 x per week	3-4 min	4	1.1
3	Hopping	3	65%	6	35	3 x per week	3-4 min	4	1.1
4	Rope skipping	4	65%	5	35	3 x per week	`3-4 min	4	1.1
5	Cycling in the air	4	65%	5	35	3 x per week	3-4 min	4	1.1
6	Brisk walking	4	65%	5	35	3 x per week	3-4 min	4	1.1

Work relief ratio minutes seconds
Source: MCAdle Protocol (1986)

Day	Mode of exercise	Set per work out	Intensity of exercise heart rate	Repetition per work out	Duration	Raining frequency	Training time	Repetition per set	Work relief ratio
Week 5									
1	Bench stepping	3	65%	6	35	3 x per week	3-4 mins	4	1.1
2	Running on the spot	3	65%	6	35	3 x per week	3-4 min	4	1.1
3	Hopping	3	65%	6	35	3 x per week	3-4 min	4	1.1
4	Rope skipping	4	65%	5	35	3 x per week	`3-4 min	4	1.1
5	Cycling in the air	4	65%	5	35	3 x per week	3-4 min	4	1.1
6	Brisk walking	4	65%	5	35	3 x per week	3-4 min	4	1.1

Work relief ratio minutes seconds
Source: MCAdle Protocol (1986)

Day	Mode of exercise	Set per work out	Intensity of exercise heart rate	Repetition per work out	Duration	Raining frequency	Training time	Repetition per set	Work relief ratio
Week 6									
1	Bench stepping	3	65%	6	35	3 x per week	3-4 mins	4	1.1
2	Running on the spot	3	65%	6	35	3 x per week	3-4 min	4	1.1
3	Hopping	3	65%	6	35	3 x per week	3-4 min	4	1.1
4	Rope skipping	4	65%	5	35	3 x per week	`3-4 min	4	1.1
5	Cycling in the air	4	65%	5	35	3 x per week	3-4 min	4	1.1
6	Brisk walking	4	65%	5	35	3 x per week	3-4 min	4	1.1

Work relief ratio minutes seconds
Source: MCAdle Protocol (1986)

Day	Mode of exercise	Set per work out	Intensity of exercise heart rate	Repetition per work out	Duration	Raining frequency	Training time	Repetition per set	Work relief ratio
Week 7									
1	Bench stepping	3	65%	6	35	3 x per week	3-4 mins	4	1.1
2	Running on the spot	3	65%	6	35	3 x per week	3-4 min	4	1.1
3	Hopping	3	65%	6	35	3 x per week	3-4 min	4	1.1
4	Rope skipping	4	65%	5	35	3 x per week	`3-4 min	4	1.1
5	Cycling in the air	4	65%	5	35	3 x per week	3-4 min	4	1.1
6	Brisk walking	4	65%	5	35	3 x per week	3-4 min	4	1.1

Work relief ratio minutes seconds
Source: MCAdle Protocol (1986)

Day	Mode of exercise	Set per work out	Intensity of exercise heart rate	Repetition per work out	Duration	Raining frequency	Training time	Repetition per set	Work relief ratio
Week 8									
1	Bench stepping	3	65%	6	35	3 x per week	3-4 mins	4	1.1
2	Running on the spot	3	65%	6	35	3 x per week	3-4 min	4	1.1
3	Hopping	3	65%	6	35	3 x per week	3-4 min	4	1.1
4	Rope skipping	4	65%	5	35	3 x per week	`3-4 min	4	1.1
5	Cycling in the air	4	65%	5	35	3 x per week	3-4 min	4	1.1
6	Brisk walking	4	65%	5	35	3 x per week	3-4 min	4	1.1

Work relief ratio minutes seconds
Source: MCAdle Protocol (1986)

The training frequency is given 3days per week with a gradual increase of duration of exercise between 15-35minutes per session.

Children should have repetition maximum of 2 sets per workout, with a gradual increase per set based on a work relief ratio of 1.1 and adequate recovery for children between ages 05-17years old. The first 2 weeks should be relatively easy in order to provide time for gradual adjustments towards full intensity, allowing for a Target Training Heart Rate of 60% - 65% per week. Each training session is preceeded by adequate warm up and followed by warm down period.

APPENDIX 7

Experimental Intervention Program

Week 1 and 2

- Frequency of training – 3 times a week
- Time allowed per aerobic exercises 1 min 45 sec.
- Rest between aerobic exercise – 15 sec.
- Time per session – 15 mins
- Number of cycles per session – 2
- Warm-up period – 5 mins
- Cool down period – 5 mins
- Total duration – 30 mins
- Desired heart rate – 65% of age predicted max H.R.
- **Week 3 and 4**
- Frequency of training – 3 times a week
- Time allowed for aerobic exercises 1 min, 45 sec.
- Rest between stations – 15 secs.
- Time per session – 30 min.
- Number of cycles per session – 3
- Warm up period – 5 mins
- Cool down period – 5 mins
- Total duration – 40 min.
- Desired heart rate – 65% of age predicted max H.R.
- **Week 5 and 6**
- Frequency of training – 3 times a week
- Time allowed per aerobic exercises 1 min, 45 sec.
- Rest between stations – 15 sec.
- Time per session – 40 min.
- Number of cycles per session – 4
- Warm up period – 5 mins
- Cool down period – 5 min
- Total duration – 50 min
- Desired heart rate – 70% of age predicted max H.R.

- **Week 7**
- Frequency of training – 3 times a week
- Time allowed per aerobic exercises 1 min, 45 sec.
- Rest between stations – 15 sec.
- Time per session – 50 min.
- Number of cycles per session – 6
- Warm up period – 5 mins
- Cool down period – 5 min
- Total duration – 70 min
- Desired heart rate – 75% of age predicted max H.R.
- **Week 8**
- Frequency of training – 3 times a week
- Time allowed per aerobic exercises 1 min, 45 sec.
- Rest between stations – 15 sec.
- Time per session – 70 min.
- Number of cycles per session – 7
- Warm up period – 5 mins
- Cool down period – 5 min
- Total duration – 80 min
- Desired heart rate – 75% of age predicted max H.R.

APPENDIX 8

LETTER OF PERMISSION TO COLLECT DATA/INFORMATION

IBADAN NORTH EAST LOCAL GOVERNMENT UNIVERSAL BASIC

P. O .Box 36336
Agodi Gate
Ibadan
Tel: 02-7514438

Your Ref:……………………………
Date:………………………………..
Our Ref……………………………..

The Zonal Co-ordinator,
Iwo Road Zone,
C/O Army Children School,
Iwo Road,
Ibadan

Yanda A. Emmanuel,
Dept. of Human Kinetics and Health Education,
University of Ibadan,
Ibadan.

RE: PERMISSION TO COLLECT DATA/INFORMATION
LETTER OF INTRODUCTION

Above subject matters refers please.
I wish to introduce Mr. Yanda A. Emmanuel from the Department of Human Kinetics and Health Education, University of Ibadan, Ibadan.
He is to collect data/information for his project course work.
Kindly give him necessary assistance and accommodate him accordingly.
Thank you.

W.O. Olaniyan,
For Education Secretary.

APPENDIX 9

UNIVERSITY OF IBADAN, IBADAN, NIGERIA

DEPARTMENT OF HUMAN KINETICS AND HEALTH EDUCATION

Head of Department

PROF. BENJAMIN O. OGUNDELE

B.Ed, M.Ed, Ph. D (Ibadan) MNSHA MNASSM

Our Ref: ______________________________

Your Ref: ______________________________ Date: JUNE 2011

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PERMISSION TO COLLECT DATA/INFORMATION/CARRY EXPERIMENT

The bearer Yanda .A. EMMANUEL with Matric No. 46579 is a M'PHIL**.** Student in the Department of Human Kinetics and Health Education, University of Ibadan, Ibadan. He/she needs to collect data/information/carry out experiment in your Department/Unit for his/her Project/Course work.

Kindly allow him/her all the necessary assistance required.

Thank you

Prof. B.O. Ogundele

Head of Department