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RELATIONSHIP BETWEEN CARDIORESPIRATORY FITNESS, MAXIMUM OXYGEN CONSUMPTION [VO2max] AND SOME HEMATOLOGICAL PARAMETERS IN ATHLETES IN PORT HARCOURT

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ABSTRACT

To determine the relationship between cardiorespiratory fitness (CRF), maximum oxygen consumption (VO_2max) and some haemorheological parameters: Plasma Concentration (PC) White Blood Cell (WBC) count, Red Blood Cell (RBC) count, Erythrocyte Sedimentation rate (ESR), Hematocrit (HCT) and haemoglobin Concentration (HB) in apparently healthy athletes in Port- Harcourt, Nigeria. A cross sectional prospective study involving thirty athletes (20 males and 10 females) and fifteen non-athletes (10 males and 5 females) aged between 17-32 years, selected from both the Port Harcourt Civic Center (athletes) and the undergraduates students population of the University of Port Harcourt. In the male athletes, there was a non-significant inverse correlation (r = -0.0408, -0.0392 and -0.3725 P>0.05) between VO_2max, ESR, FC and MAP, and a non-significant positive correlation between VO2max, PCV, RBC, WBC and HB. Similar results were observed for the females and analysis of the combined. The study shows clearly significantly higher values of maximum oxygen uptake (VO_2max) in athletes. A significantly lower values of systolic blood pressure and mean arterial pressure MAP) in athletes. It concludes that there is a positive relationship between VO_2max, PCV, RBC, WBC, and HB. A negative/inverse relation exists between VO_2max, ESR, and PFC as stipulated by Carrol & Cooke (2000), Culberson (2008).

Keywords: Cardiorespiratory Fitness; Maximum Oxygen; Consumption; Hematology; Parameters; Athletes

Introduction

Cardiorespiratory fitness also referred to as cardiopulmonary fitness, cardiorespiratory endurance (CRE), aerobic fitness or aerobic capacity encompasses the cardiovascular system in conjunction with the respiratory system, for the adjustments in response to various forms of activities to ascertain physical fitness. It suggests that, the heart, circulatory system and lungs function as an integral unit that takes in, delivers and exchanges oxygen and carbon dioxide, providing energy and permitting the individual to perform work (Onagbye, 2017). Physically active persons begin with a higher level of function and thus may experience less health impairment at a later age (David, 2017).

Maintaining a reasonable level of muscular fitness involves improvement of muscular strength, muscular power and muscular endurance through regular physical activity, which is important for normal hormonal, cardiovascular respiratory and substrate metabolism (Erica, 2022).

Years ago, exercise testing to determine cardiorespiratory fitness was relatively crude, such that in the 1920s, some of the earliest recording of ST-segment depressions were actually made by having the patients perform sit-ups. Exercise testing in the 1930s and 1940s usually meant stepping up and down on a bench for specified period, during and after which a one-channel recording of the electrocardiogram was obtained. In a survey on exercise testing published in 1971, 45% laboratories in the United State were using a step procedure for their standard exercise. By 1980, a survey of North American laboratories showed the numbers had dropped to 10-12%. ln 1995 however survey of methods of exercise testing in the United States and Europe showed step tests were virtually non-existent, having been replaced by microprocessor- controlled treadmills and cycle ergometers.

Not surprisingly, exercise testing today is even more sophisticated, is used more widely, and encompasses a wider range of subspecialties including Cardiology, Pulmonary and Nuclear Medicine (Chatterjee, 2006). Cardiopulmonary fitness plays an integral role in our understanding of nutrition, metabolism, diabetes, cardiac and pulmonary rehabilitation, recovery from injuries, over training, high altitude physiology, aging, disability, heat illness and many other areas. Active people today may simply want to know their "VO_2 max" but exercise testing actually has a variety of applications in sports medicine, including optimizing training and screening cardiac abnormalities. Whereas cardiac abnormalities in athletic individuals are quite common, serious events are extremely rare. It is no longer considered financially feasible or medically useful to screen apparently healthy, asymptomatic individuals of any age, however more often than not “abnormal" cardiac finding on the ECG, Electrocardiogram or, cardiac exam in such individuals are variants of normal.

Nevertheless, virtually every person who has a serious event (i.e, a heart attacks or death) during exercise has a serious disease- usually of the heart that adequately explains the events, such presentations as exercise induced syncope, exercise- induced asthma, and uncertain chest pain require a complete cardiac work up, and cardiopulmonary exercise testing is the cornerstone of such work up. Thus, physical performance is an outcome measure that pervades our lives, from the patient disabled by disease to the athlete striving to discover his genetic and physiological limits. Exercise greatly increases the rate at which oxygen is consumed and carbon dioxide is produced in the muscles. The capacity of the heart and lungs to respond to the stress of exercise is often a measure of their physiological health. Gas exchange response permits the user to study the cardiovascular and pulmonary

systems simultaneously and to observe directly the pathophysiology of disease states that affect them. Therefore, the cardiovascular and pulmonary systems work together and are inseparable. Risk of cardiovascular disease (CVD) is the commonest cause of death, in the middle aged and elderly in most Western societies. This is partly due to a decline in other previously important causes of death, such as infectious diseases (Jaspin, 2020).

Framingham Heart Study suggests that Hematocrit (PCV) per se is a cardiovascular diseases risk factor. Hematocrit was shown to a risk factor for coronary heart disease (CHD) in men in Puerto Rico and in men in the British Regional Heart Study. Also epidemiologic Suuales irom Japan and from the British Regional Heart study implicate hematocrit as a risk factor in stroke, especially thrombotic stroke. Normal values of men are typically about 40-50%, and normal values for women are about 36-45%. Increased hematocrit, and increased oxygen capacity can lead to performance gains, some racers have been caught using EPO and other drugs to boost their hematocrit red blood cell count. But there can be too much of a good thing. Hematocrit actually increases the viscosity of the blood. So if your hematocrit gets too high, your blood can get so thick that your heart has difficulty pumping it, and can actually lead to a heart attack (Bonchard, 1990).

Blood viscosity is determined from hematocrit and viscosity. (David, 2017). Hematocrit, white cell count, platelet count, fitness (CRP), Plasma viscosity, blood viscosity, haemostatic and inflammatory variables are significantly inversely associate to physical activity, physical fitness and athletic fitness (Wannamethee, 2002). Plasma viscosity was observed to be significantly lower, with higher levels of predicted maximum oxygen consumption VO2max). The odds ratio for hyperviscosity in subjects with metabolic syndrome as compared with those with no metabolic markers was attenuated following adjustment for age, sum of skinfolds and predicted maximum oxygen consumption (VO2 max), a cross-sectional result suggested that plasma viscosity, hematocrit are associated with increased clustering of metabolic markers. Obesity and poor cardiorespiratory fitness may be important in the development of haemorheological abnormalities associated with metabolic syndrome. (Carroll, et al 2000).

Prospective epidemiological studies agree that fibrinogen level is an independent risk factor for stroke or acute myocardial infarction (AMI). In Gothenburg, when a random sample of 729 middle aged men was followed for nearly 14 years, fibrinogen level was used to occurrence of stroke and AMI, a direct relationship that persisted for stroke even when blood pressure, cholesterol, and smoking were considered. In Framingham, 1315 people free of cardiovascular diseases (CVD) had Fibrinogen levels measured. During the next 12 years, for both sexes, the risk of cardiovascular diseases in general and of coronary heart disease in particular increased in proportion of baseline fibrinogen

level. The risk of stroke rose steadily with fibrinogen level in men but not women. lt was concluded that elevated fibrinogen level is cardiovascular diseases (CVD) risk factor. Elevated plasma fibrinogen may be observed in the presence of foreign bodies (Kwaan and Astry 2004) in physiological conditions such as diabetes mellitus.

Statement of Problem

There is obviously, an important need to establish the relationship between cardiorespiratory fitness and haematological parameters in athletes; unfortunately, minimal work (in research) has been done in this area, although it is greatly associated to physical fitness and health status.

With the increment in the incidence of disaster in sports, owing to collapse, heart failure, injuries and strokes, it is expected that thorough work be done to ascertain the health status of athletes and reduce the risk of cardiovascular disorders and hazards generally. Furthermore, with the increasing awareness in the area of sorts in Africa and the world as a whole, research and reports concerning the Africa populace is very discouraging.

Needless of the high levels of intensive work in the American, Asian, European populace, it their data and information are not established with the African populace in consideration. Various findings involving smokers, alcoholics, children, older adults, sedentary individuals, disease states, pubertal and pre-pubertal, have been adequately increasingly researched, but very little has been done as regards out athletes. Therefore, the essence of this research work is to create the necessary awareness on this subject topic and ultimately reduce the incidence of cardiorespiratory disorders and ensure knowledge is properly dispensed.

Materials and Methods

The study was carried out on thirty (30) apparently healthy and consenting subjects of Nigerian origin. The subjects of this research project were randomly selected irrespective of their varying ethnic groups. The thirty (30) well-informed athletes, twelve (12) footballers, three (3) track and field athletes, two (2) Karate, three (3) Kunfu, three(3) volleyballers, one (1) Taekwando, two (2) basketballers, two (2) cyclist, one (1) cricket and one (I) baseballer. The male athletes were twenty (20) while the female athletes were ten (10). The control subjects were fifteen (15), well informed and consenting non-athletes. They comprised of ten (l0) males and five (5) females. Both the athletes and non-athletes had age ranges between 17 to 32 years. All subjects were examined prior to acceptance incorporation in the test by a qualified, reliable and competent medical practitioner and confirmed healthy for the disqualified individuals were based on postoperative recovery handicapped, history of anaemia, asthma or other respiratory disorders, menstruating women and individuals under significant medication. The subjects were required to walk a given distance of one mile (1.5km) as fast as possible but at individual pace.

Parameters Measured

The parameters measured and used in this research and project were; Sex, Age, Height,

Weight, BMI (Body Mass Index), Blood pressure (systolic & diastolic), Mean arterial pressure, Pulse rate (post-walk), Time, VO2max (Maximum Oxygen Uptake), Hematocrit (Packed Cell Volume, PCV), RBC (Red Blood Cell Count), WBC (White Blood Cell Count), HBC (Hemoglobin Concentration), PFC (Plasma Fibrinogen Concentration), ESR, (Erythrocyte Sedimentation Rate) and CRE (Cardiorespiratory Fitness)

Height and Weight Measurement

The measurement of the height and weight were carried out using the standiometer scale, The height was measured to the nearest 0.5 meters, height measurement was carried out by extending the scale tape along the vertical length of the subject (with subject on bare-foot) while the weight was measured to the nearest 0.01 kilograms with the subject, still on bare foot. The subjects were relieved of any materials such as bag, shoes, books etc to ensure accuracy.

Blood Pressure

Blood pressure measurement was determined by the modern method clinically used, it is an indirect method called the AUSCUTATORY METHOD, which requires the use of sphygmomanometer and a stethoscope. The subject were seated upright at the edge of an examining table with the elbow of the arm (left or right) placed comfortably on the surface of the table. The portion of the sphygmanometer called the armlet or Recci cuff or plainly cuff was inflated around the upper arm. The diaphragm of the stethoscope was placed against the surface of the cubital fossa just below the armlet (particularly against the antecubital artery). The cuff of the sphygmanometer was inflated by repeated compression of the pump until the brachial pulse disappeared, the air pressure overcame the blood pressure and occluded the main artery of the arm (brachial artery). Then the air valve in the pump was gradually release to reduce the pressure in the cuff. As the pressure fell, blood was allowed to escape beneath the cuff and fill the artery below, faint tapping sounds synchronous with the heartbeat were heard with the stethoscope.

Blood pressure was recorded as a ratio of the systolic to the diastolic pressures (systolic/ diastolic). An electronic blood pressure monitor was also used in this research project for comparism and authentication.

Mean Arterial Pressure

Mean arterial pressure is the average pressure throughout the cardiac cycle. It is slightly lower or shorter than the value of halfway between systolic and diastolic pressures. It is determined only by integrating the area of the pressure curve.

However, arithmetically, it is approximately the summation of the diastolic pressure and one-third the pulse pressure (subtraction of the diastolic pressure from the systolic pressure).

Formula: Mean Arterial Pressure = Diastolic Pressure + (1/3 pulse pressure)

Pulse Rate (Post Walk)

Pulse Rate also called arterial pulse or heart rate is due to heartbeat. It is a pressure change transmitted as a wave through the arterial wall and the blood column to the periphery.

It is therefore measured by the palpitation of the radial, anti-brachial, temporal or carotid arteries. Though the commonest peripheral artery used is the radial artery in the wrist.
The pulse was felt by placing the palmary surfaces of the terminal phalanges of the three middle fingers (not the tips) of the right hand gently on the anatomical position of the artery. The intermittent tapping sensation felt is the arterial pulse.
The stopwatch was used to time the number of pulse beats per minute after the walk. The pulse rates were recorded as number of beats per minute.

Blood Samples
Collection and Preparation
Blood samples were collected from the subjects by peripheral venipuncture. The procedure was carried out on the blood vessels in the region of the cubital fossa of the arm. A 5ml syringe was used to extract between 2.5- 3ml of blood by a single puncture to prevent tissuing, to reduce the level of cellular activation of the platelets, and other clotting factor in the blood. A tourniquet was tied above the site of puncture, to increase the venous pressure, increase accessibility of the blood vessels. Also the fist of the subject was ensured tightened to further enhance pressure and accessibility. The skin at the site of puncture was sterilized with cotton wool and methylated spirit.

The sterilized disposable 5ml syringe, after extraction of blood was emptied immediately into a trisodium citrate collection tube. The tube was treated with 3.7g of sodium citrate per 100ml of water, at the ratio of 1:5 (Trisodium citrate was the anticoagulant. Platelet poor plasma was collected after centrifugation of anticoagulated blood at 2,500 rpms (revolution per minute) was pipetted and stored in plastic evacuation collection tubes, within which the fibrinogen test was carried out. The plasma sample was assessed at the Physiology Laboratory, College of Health Science, and University of Port Harcourt.

Hematocrit
(Packed Cell Volume Pcv)
Hematocrit was used to determine the percentage volume of blood occupied by the red cells. Blood rapidly move up to one end of the heparinized capillary tube (the other end was scaled with plastacine) by capillary attraction. After allowing about three quarters of the tube to be filled with blood, the tube was placed in a groove of the centrifuge with the sealed end outwards. Up to 20 tubes could be centrifuged at the same time. The cover plate and lid were tightly screwed and closed respectively, and then setting the time for 5 minutes, the tubes are centrifuged at 3,000rpm (revolution per min). The centrifuge was allowed to settle down completely before opening the lid. The capillary tube was then removed and placed in the groove of the hematocrit reader so that the lowest blood level (at the plastacine plug) was level with the lower line of micro-hamatocrit reader. The instrument of the reader was adjusted so that the upper level of the plasma was level with tthe slanting line at the top. The knob was adjusted since it is movable, so that the line running, from it

coincides with th the junction between the red cell mass and the plasma. The hematocrit was read off from the scale. At least two samples were read for each subject for accuracy. (PCV is measured in percentage).

Red Cell Count and White Cell Count
This determines the number of red blood and white blood capsules per cubic mm of blood.

Red Cell Count
Well-mixed capillary or venous blood is drawn exactly to the 0.5 mark on the pipette, using gentle suction on the mouth piece. This blood column was free of any bubbles, and excess blood from the outside of the pipette was wiped to avoid transfer of cells to the diluting fluid. The diluting fluid was sucked up to the 101 mark, at the same time rotating the pipette between the thumb and forefinger to mix the specimen and diluent. The diluting fluid used was Hayem's diluting fluid (consisting of 0.05>g MgCl2, 2.5g Na2SO4, and 0.5g, NaCl, all in 100mm water). The contents of the pipette is mixed for about 10 seconds by holding the pipette horizontally, between the thumb and forefinger of one hand and rotated. A clean haemocytometer cover glass was placed over the counting chamber. The specimen was mixed in the pipette for about 2 minutes to ensure even distribution of cells, the unmixed, relatively cell-free fluid from the capillary portion of the pipette - usually 2 to 3 drops was expelled, and allowed to flow under the cover glass until the chamber was completely charged, the opposite chamber of the haemocytometer was similarly filled. Then all the red cells within the squares were counted. The cells in 80 small squares (5 large squares) were multiply by 10,000 to get the red cell count per mm^3 blood. (RBC count is in millions per microliter).

White Blood Cell Count: Blood was drawn to exactly 0.5mark in the pipette by using gentle suction on the mouthpiece.
White cell diluting fluid consisting of 1% gentian violet in 0.5 to 1%- acetic acid was drawn to the '11' mark while rotating the pipette between the thumb and forefinger to mix. Counting chamber as described for red cell count (allow time for red cell lysis) is similar for white cell count.
The number of white cells counted, N are multiplied by the volume factor.
Volume factor = 1x 1 x 0.1 = 0.1 mm^3
Therefore WBC/mm^3 = N x 10 x 20.

Haemoglobin Estimation
Estimation of haemoglobin was done by the Sahli method to determine haemoglobin content of blood.
A known volume of blood was first converted to acid haematin using 0.1M HCI. The dilution tube was filled to the 10 mark with freshly prepared 0. 1M HCI. Blood was collected into the acid in the dilution tube, sucked up and down to allow all the red cells to haemolyse.
Distilled water drop-wise was added, stirring with a glass rod each time after allowing to stand for exactly 5 minutes.
Then the colour of the haemoysed blood against that of the standard in bright diffuse day light was compared with a sheet of white paper as background.

The dilution was continued until the colour was sighly similar to the standard. The reaching of the meniscus level, it was noted and the average (x %) taken.
Since 100% in the Sahli scale represents a haemoglobin concentration of 14g/100ml of blood, the average (x %) is converted to g/ 100ml by simple proportion.

Erythrocyte Sedimentation Rate (ESR)
ESR measures the rate of sedimentation of red blood cells, that is the distance red blood cells will fall along the length of a vertical tube over a given time period. A raised ESR is usually indicative of increased production of acute phase proteins. 1.6ml or venous blood was mixed properly with 0.4ml of 3.7% trisodium citrate solution in the proportion of one volume of citrate to five parts of blood. The anti-coagulated blood was drawn by suction up the calibrated Westergren tube to above the top calibration (zero). The tube (s) were placed properly into tube stands in the rack; taking care that their bases were firmly sealed by their seals so as to avoid leakages. The tubes were placed exactly in vertical position, and the blood levels were re-checked for confirmation. Finally, the tubes were placed in a cool dry place away from the sun to avoid accelerated sedimentation. Exactly one hour after, the red cell layer was read to attain the ESR values, which were recorded in millimeter per hour (mm/hr).

Plasma Fibrinogen Concentration
The procedure used for fibrinogen assay was based on the Von Claus clothing time principle. The principle uses the clotting time of plasma after the addition of thrombin (in excess) being proportional to the concentration of fibrinogen. The reagents used include, platelet- poor plasma, Bovine Thrombin (Dissolved thrombin to obtain a final concentration of C250 NIH units per ml. The solution was stored at -20^{o}C), Barbitone buffered saline and fibrinogen (freeze dried human fibrinogen powder dissolved in buffered 9g/1NaCl to give a master solution containing 40mg/dl).
Fibrinogen solution was diluted with buffered saline so as to obtain concentrations of 10, 20 and 30gm/dl. 0.1ml of each dilution was placed in a glass tube in a water-bath at 37^{o}C. 0.2ml of thrombin solution was added to each tube and rapidly mixed and clotting time recorded. The procedure was repeated once. The mean clotting time for each dilution was plotted against the fibrinogen concentration on double-log graph paper. A straight line was obtained. The subject's plasma and normal plasma was diluted 1in 10 with buffered saline. 0.2ml of thrombin was added to 0.2ml of the dilution and the clotting times recorded. Then the fibrinogen concentration was read off from the standard line.

The Walk Test
The Rockport Fitness Walking Test was used to determine the maximum oxygen consumption VO_2max. This was a one mile walk test (1.6km, 800m back and forth) on a flat surface, in which the subjects walked as fast as they could, and then the heart rate was recorded as well as the time it took to walk the one mile distance. The heart rate was

recorded immediately after the walk by taking the pulse for 1 minute. The information was plugged into a formula to predict the maximal oxygen consumption VO_2max oxygen consumption is the point at which oxygen intake cannot increase and it is expressed as VO_2max. VO_2max is one of the best indicators of cardiorespiratory fitness. After plugging the various information into the formula to get VO_2max expressed in milliliters of oxygen per kilogram of body weight per minute (ml/ kg/ min), the VO_2max is then compare to the chart to predict fitness level (cardiorespiratory fitness).

Formula: VO_2max (ml/ Kg/min) = 132.853-(0.0769 x BW) - (0.3877 x A) + (6.315 x G) - (3.2649 x T)-0.1565 x HR).
BW = Body weight in Pounds
A= Age in years
G = Gender Female - 0, Male - 1
T= Time for 1 mile walk in minutes and hundredths of a minutes
HR= Heart rate taken at the end of the 1 mile walk in beats per minute.
VO_2max = 1.72.853 -K- L + M- N-O
-L - M + N - O – P

Results and Analysis
Values of all parameters determined during the research are summarized as follows:
The mean age range of the subjects were athletes 24.10 ± 4.28 and 21.63 ± 2.22 non-athletes with ranges 14-42 and 18-25 respectively when combined (males and females) specifically, for the male: athletes, 24.64 ± 4.23 and non-athletes 21.75 ± 2.05 with ranges as 17-42 and 18-25 for the athletes and non-athletes respectively. For the females: athletes, 21.27 ± 3.44 and non-athletes, 21.43 ± 2.64 with ranges 14-27 and 17-25 for the athletes and non-athletes respectively. There was a significant difference between the ages of the male athletes and non-athletes with $P<0.05$ and no-significant difference between those of the female athletes and non-athletes with $P>0.05$ on comparison of their respective means using T-test (student T-test).

The weight and height for the males were: athletes 67.98 ± 8.18 and 1.73 ± 0.12, non-athletes 65 ± 5.83 and 1.71 ± 0.07, both showed no significance differences with $P>0.05$ for the athletes and non-athletes. For females: athletes, 59.55 ± 9.61 and 1.62 ± 0.07, non-athletes 57.14 ± 5.87 and 1.64 ± 0.05, both also showed no significance difference with $P>0.05$ for the athletes and non-athletes respectively. The mean weight and height of the subjects combined were: athletes 66.64 ± 8.91 and 1.71 ± 0.12, non-athletes 62.11 ± 6.89 and 1.68 ± 0.07 respectively.
Body Mass Index (BMI) for the males was; 22.75 ± 2.89, non-athletes 22.25 ± 2.59, there was no significant difference with $P>0.05$. For the females: athletes 22.64 ± 2.83, non-athletes 21.32 ± 1.54, there was no significant difference with P.0.05. Combined BMI was: athletes 22.73 ± 2.86 and non-athletes 21.90 ± 2.26 with no significant difference at $P>0.05$.

The systolic, diastolic and mean arterial pressure however were: males, athletes 119.14 ± 11.09, 74.78 ± 7.05 and 89.50 ± 7.15 respectively, non-athletes 111.25 ±

10.25, 72.92 ± 5.42 and 85.69 ± 5.00 respectively. Systolic blood pressure (SBP) showed a significant difference in means between athletes and non-athletes with P>0.05. Diastolic and mean arterial pressures showed no significance differences with P>0.05. The females: athletes 111.64 ± 6.52, 72.27 ± 5.78, 85.39 ± 5.05 respectively, non-athletes; 112.86 ± 3.93, 72.14 ± 2.67, 85.71 ± 1.89 respectively. They each showed no-significant differences with P<0.05 between athletes and non-athletes respectively. Combined however, athletes 117.94 ± 10.81, 73.38 ± 6.89, 85.70 ±7.00 while non-athletes 111.84 ± 8.37, 72.63 ± 4.52, 88.90 ± 4.06 respectively. Apart from diastolic which showed no significant difference with P>0.05, systolic and mean arterial pressure showed significant differences between athletes and non-athletes with P<0.05 each.

There was a significant difference in the post walking time between athletes and non-athletes for both males and the females and this also reflected in the analysis of the combined (athletes and non-athletes). The mean maximum oxygen consumption (VO_2max), males; athletes 86.96 ± 15.52, non-athletes 61.10 ± 11.60, there was a significance difference between those of the athletes and non-athletes on analysis, using the student t-test. For the females; athletes 72.95 ± 5.55; non-athletes 39.37 ± 16.04, there was also a significant difference between athletes and non-athletes. Analysis of the combined further confirmed the significant difference in VO_2max between athletes and non-athletes. The hematological parameters, males; athletes, PCV, RBC, WBC, HBC, ESR and PFC were: 34.60 ± 4.54, 5.09 ± 1.37, 5.58 ± 1.01, 11.57 ± 1.52, 13.37 ±5.95 and 1.99 ± 0.28 respectively. Non-athletes; 34.08 ± 2.57, 5.62 ± 1.08, 5.95 ± 0.70, 11.51 ± 0.82, 7.42 ± 5.25 and 2.05 ± 0.17 respectively. Apart from ESR which showed a significant difference with P<0.05, each of the other parameters showed a significant difference with P>0.05. For the females; athletes 28 ± 4.88, 3.85 ± 1.45, 4.71 ± 1.44, 9.36 ± 1.56, 19 ± 5.33 and 1.83 ± 0.31 respectively. Non-athletes 31.29 ± 4.86, 3.66 ± 0.76, 6.12± 0.81, 10.43 ± 1.65, 15.86 ± and 1.69 ± 0.23 respectively. WBC with P<0.05 showed a significant difference whereas each of the other parameters showed no significant difference with P> 0.05.

Correlation coefficient illustrating the degree of relationship between the maximum oxygen consumption (VO_2max) and the various parameters is summarized as follows: For the male athletes: a negative correlation exists as between VO_2max and the following parameters. Erythrocyte Sedimentation Rate (ESR), Fibrinogen Concentration (FC) and the Mean Arterial Pressure (MAP). The other parameters: PCV, RBC, WBC, HB all showed a positive correlation to VO_2max. For the male non-athletes (control): apart from only the Fibrinogen Concentration (FC) which showed a negative correlation, the various other parameters showed a positive correlation to VO_2max. The female athletes however showed a negative correlation between VO_2max and the following parameters PCV, HB the other parameters were of positive correlation to VO_2max. Female non-athletes (control) showed

negative correlation between VO_2max and the following parameters: WBC, ESR and MAP, whereas there was a positive correlation for PCV, RBC, HB and FC. Analysis of the combined (male and female) for the athletes and non-athletes showed, for the athletes: negative correlation between VO_2max and ESR and a significant positive correlation for the other parameters apart from FC. For the non-athletes: negative correlation between VO_2max and WBC, ESR and MAP, whereas there was a positive correlation for PCV, RBC, HB and FC. The various analysis to confirm these results were done using both the T-test and the test for correlation coefficient with T-test determining the relationship between the mean values and their level of significance. Test for correlation coefficient determining the degree of the relationship (positive or negative) between the parameters.

Table of Correlation Coefficient (R) Of Male Athletes

	PCV	**RBC**	**WBC**	**HB**	**ESR**	**FC**	**MAP**
VO_2max	0.18	0.09	0.27	0.17	-0.04	-0.04	-0.37
(r)	0.19	0.13	0.28	0.17	0.00	-0.00	-0.04
T	1.37	0.69	2.12	1.27	0.305	0.293	3.00
Sig. Diff	(0.27)* P>0.05 No Sig. Diff	(0.27)* P>0.05 No Sig. Diff	(0.27)* P=0.05 Sig. Diff	(0.27)* P>0.05 No Sig. Diff	(0.27)* P>0.05 No Sig. Diff	(0.27)* P>0.05 No Sig. Diff	(0.27)* P>0.05 No Sig. Diff

Table of Correlation Coefficient of Male Non-Athletes (Controls)

	PCV	**RBC**	**WBC**	**HB**	**ESR**	**FC**	**MAP**
VO_2max (r)	0.57	0.49	0.21	0.56	0.19	-0.14	0.04
T	2.20	1.82	0.66	2.16	0.60	0.31	0.13
Sig. Diff	(0.58)* P>0.05 No Sig. Diff	(0.58)* P>0.05 No Sig. Diff	(0.58)* P=0.05 Sig. Diff	(0.58)* P>0.05 No Sig. Diff	(0.58)* P>0.05 No Sig. Diff	(0.58)* P>0.05 No Sig. Diff	(0.58)* P>0.05 No Sig. Diff

Table of Correlation Coefficient of Female Athletes

	PCV	**RBC**	**WBC**	**HB**	**ESR**	**FC**	**MAP**
VO_2max (r)	-0.04	0.22	0.50	-0.06	0.42	0.19	0.03
T	0.12	0.69	1.74	0.19	1.40	0.56	0.10
Sig. Diff	(0.60)* P>0.05	(0.60)* P>0.05	(0.60)* P>0.05	(0.60)* P>0.05	(0.60)* P>0.05	(0.60)* P>0.05	(0.60)* P>0.05

	No Sig. Diff	No Sig. Diff	No Sig. Diff	No Sig. Diff	No Sig. Diff	No Sig. Diff	No Sig. Diff

Table of Correlation Coefficient of Female Non-Athletes (Controls)

	PCV	**RBC**	**WBC**	**HB**	**ESR**	**FC**	**MAP**
VO_2max (r)	0.29	0.77	-0.00	0.29	0.50	0.80	-0.57
T	0.80	2.66	0.01	0.70	1.285	2.936	1.5497
Sig. Diff	(0.75)* P>0.05 No Sig. Diff	(0.75)* P<0.05 Sig. Diff	(0.75)* P>0.05 Sig. Diff	(0.75)* P>0.05 No Sig. Diff	(0.75)* P>0.05 No Sig. Diff	(0.75)* P<0.05 Sig. Diff	(0.75)* P>0.05 No Sig. Diff

Table of Correlation of Combined Athletes

	PCV	**RBC**	**WBC**	**HB**	**ESR**	**FC**	**MAP**
VO_2max (r)	0.38	0.27	0.42	0.37	-0.123	0.12	0.16
T	3.31	2.27	3.77	3.24	1.02	1.02	1.30
Sig. Diff	(0.25)* P>0.05 No Sig. Diff	(0.25)* P>0.05 No Sig. Diff	(0.25)* P<0.05 Sig. Diff	(0.25)* P>0.05 No Sig. Diff	(0.25)* P>0.05 No Sig. Diff	(0.25)* P>0.05 No Sig. Diff	(0.25)* P>0.05 No Sig. Diff

Table of Correlation of Combined Non-Athletes (Controls)

	PCV	**RBC**	**WBC**	**HB**	**ESR**	**FC**	**MAP**
VO_2max (r)	0.53	0.759	-0.64	0.55	-0.45	0.64	-0.07
T	5.05	9.56	6.85	2.69	9.64	3.40	0.27
Sig. Diff	(0.46)* P<0.05 Sig. Diff	(0.46)* P<0.05 Sig. Diff	(0.46)* P<0.05 Sig. Diff	(0.46)* P>0.05 Sig. Diff	(0.46)* P>0.05 No. Diff	(0.46)* P<0.05 Sig. Diff	(0.46s)* P>0.05 No Sig. Df

Discussion and Conclusion

Regular exercise has been demonstrated to effectively reduce the nonfatal and fatal coronary artery disease (CAD). Exercise induced reduction in cholesterol and blood pressure contribute substantially to this cardioprotective effect. However, hypertension and hypercholesteremia are not the only factors of importance in the pathogenesis of CAD. Angiographic studies in acute myocardial infarction show 80-90% of the arterial occlusions are due to a thrombus.

Furthermore, recent success of antiplatelet and thrombolytic drug treatment supports the view that a myocardial infarction is usually caused by thrombus formation, Therefore CAD can thus be viewed in two-stages involving first, the development of atherosclerotic plaques, probably enhanced by hypertension and hypercholesteremia and second, thrombosis which causes myocardial infarction and sudden death. In addition, the development of atherosclerosis may be directly proportional my inadequate fibrinolysis. Furthermore, haemotological parameters are very vital and crucial in sports medicine for diagnosing, controlling and preventive aims.

Regular exercise is well known to reverse all adverse blood changes that may occur by inactivity such as low plasma volume, high hematocrit, high plasma fibrinogen, elevated blood viscosity, increased platelet aggregability and diminished fibrinolysis.

Regular exercise thereby helps prevent heart attack and stroke. Sudden death in competitive athletes is due to a variety of cardiovascular diseases, thus the need to test for diagnosing abnormalities in haemotological factors. Fibrinogen is negatively correlated with aerobic working capacity (as shown in this research work, there is a negative correlation between VO_2max, FC and ESR for the male athletes). It is established that blood viscosity is decreased in sportsmen and related to fitness. In fact a raised ESR is usually indicative of increased production of acute phase proteins which increases blood viscosity. A wide range of physiological concentration of fibrinogen in the human population is related to the fact that since it is an acute phase protein, it's concentration increases and decreases in response to a variety of stimuli. Such increases have been observed in cases of inflammatory states, infections, during pregnancies, after trauma as well as in cases of cigarettes smoking. Alternatively with the consumption of ethanol and in cases of intensive acute exercise, decreases in plasma fibrinogen concentrations have been observed, this decreases regulates fibrinogen concentrations and decreases blood viscosity, thus increasing cardiorespiratory fitness and decreasing the occurrence of myocardial infarction and strokes. It has been observed that increases in the rate and strength of exercise activates both the coagulation promoting factors as well as the fibrinolytic system thus creating the all usually indicative of increased production of acute phase proteins which increase blood viscosity. A wide range physiological concentration of fibrinogen in the human population is related to the fact that, since it is an acute phase protein, its concentration increases and decreases in response to a variety of stimuli. Such increases have been observed in cases of inflammatory states, infections, during pregnancies, after trauma as well as in cases of cigarettes smoking.

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increasing cardiorespiratory fitness and decreasing the occurrence of myocardial infarctions and strokes. lt has been observed that increases in the rate and strength of exercise activates both the coagulation promoting factors as well as the fibrinolytic system thus creating the all required balance (effect of coagulation surpasses in sedentary states). Hematocrit, though essentially the percentage of whole blood that is red blood cell from this research has been observed to have a positive correlation for male and negative correlation for the female athletes and the same has been observed in the haemoglobin concentration (Hb) between the male and female athletes. Increased hematocrit increases oxygen carrying and leads to performance gains, thus some athletes take drugs to boost hematocrit/red blood cell count, but hematocrit has been implicated as a risk factor for cardiovascular diseases since it increases blood viscosity by raising the cellular component of blood. (This is why the UCI will remove a rider from competition for "health reasons" if he or she has a hematocrit above 50%).

Interestingly, training can actually have an effect, lowering the percentage hematocrit. Responses to training can include RBC production but blood plasma levels also increases, if plasma levels increase more than RBC, then the percentage of hematocrit goes down, but oxygen carrying has actually increased. This is the HEMODILUTION phenomenon. Thus making hematocrit a smaller portion of the whole blood. Recently, there have been several reports on the influence of physical activity on immune function, from this research, there is a positive correlation (both male and female athletes) between VO2max and WBC and a significant difference in the mean values between the female athletes and non-athletes. This corresponds and confirms the several reports that there is a process of continuous exchange of leucocytes influenced by a proper stimulation such as exercise. The increased number of leucocytes can occur abnormally as a result of an infection, cancer or drug intake, but leukocytosis can also occur normally after eating a large meal or experiencing stress such as exercise.

Conclusion and Recommendation

The importance of fitness cannot be overestimated, in fact exercise and proper nutrition actually play vital roles in the prevention of cardiovascular heart diseases and other age related, debilitating diseases, even lack of physical activity can cause a phenomenon called atrophy, a condition where the body begins to deteriorate due to non-use.

That physical activity increases VO_2max which is directly related to RBC, WBC, PCV and Hb but inversely related to ESR and FC (thus decreasing blood viscosity) cannot be overemphasized. Therefore exercise is a physiotherapy to help reverse a variety of common medical problems.

Limitations

1. The non-athletes in this research work were students and therefore not exactly sedentary, though they were not professional athletes, they were however active individuals.

2. Convincing professional athletes and aspiring local athletes to donate blood for analysis was not exactly an easy task, due to the fear of the unknown, an incidence that might affect their elevating career.
3. The unfortunate decline in the participation of females in the area of sports as compared with their male counterparts, resulted in the inappropriateness of the numbers of subjects in each group. This work is therefore open to further studies and discoveries.

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