# A MEASUREMENT AND COMPARISON OF SELECTED PHYSICAL FITNESS COMPONENTS OF AMERICAN, MIDDLE EASTERN, AND EAST AND SOUTHEAST ASIAN MALE STUDENTS AT OKLAHOMA STATE UNIVERSITY

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# CHAPTER I

## INTRODUCTION

The study of racial and ethnic populations has always been the object of extensive attention of researchers, especially in the fields of medicine, physiology and exercise physiology. This particular interest has been on the rise in the last decade due to the increasing time and money devoted to research in the field. Although some individuals hope to find solutions to many unsolved problems that are complicated even more with racial and ethnic components, others simply try to find out the differences and similarities between the races to add new knowledge to the field or lead the way for extensive and advanced studies.

Race is a special component of heredity. There are tremendous similarities within a racial or ethnic group of people. These similarities, which can be physical, behavioral, and/or cultural, are affected by various environmental factors. The influence of cultural and environmental factors upon people should not be underestimated because people tend to behave and function differently under different conditions. It is also possible to see a certain degree of dissimilarities within the same race; however, this is not as distinct as between the races. The differences become even more obvious when the races grouped within geographical regions are compared with one another.

People behave and function dissimilarly because they believe in different religions, speak different languages, eat different types of foods, exhibit different lifestyles and have different cultural activities. In addition, people have different physical characteristics. Besides differing in their skin color and facial features, they also differ in body type and size. They live in various geographical environments such as cold and warm climate, high and low altitude, deserts, forests, mountains, etc. A comparison of the races of geographical regions as opposed to neighboring nations widens the gap even further. This also gives a broader look into the populations before breaking them into their components.

It appears important to determine how these groups of people originating from different parts of the world differ in aerobic work capacity, respiratory function, blood pressure and blood chemistry. It is believed these elements are influenced by racial, cultural, and environmental factors.

What human beings are may be caused by genetic factors or by environmental experiences, but the end product is formulated by the interaction of both. The problem is in determining the relative contributions each makes to one's level of attainment in a particular endeavor.

According to Singer (1), obviously dissimilar capacities for performing various tasks will be due to hereditary factors and/or previous experiences. He stated that genetics will usually determine body types. It is often witnessed that identical twins have similar body constitutions. Anatomically speaking, body structures may be greatly influenced by nonhereditary variables such as health, nutrition, and exercise. A good example of an environmental factor exerting influence over genetic tendencies is the fact that first generation Japanese immigrants exceed their former countrymen in height by two inches. Nutrition and diet evidently had much to do with this variation.

Physical fitness is defined by the World Health Organization (1968) as the ability to perform muscular work satisfactorily under specified conditions (2). It can be conceptualized in two ways: 1) the motor fitness concept in which the elements of performance are measured, and 2) the physical or aerobic working capacity concept in which capacity for oxygen transport is evaluated. The information provided by the assessment of maximal oxygen uptake is a measure of 1) the maximal energy output by aerobic processes, and 2) the functional capacity of the circulation, since there is a high correlation between the maximal cardiac output and the maximal aerobic power (3).

During prolonged, heavy physical work, the individual's performance capacity depends largely upon the ability to take up, transport, and deliver oxygen to the working muscle. In short, one's capacity depends upon efficient lungs, a powerful heart, and a good vascular system. Since it reflects the conditions of these vital organs, the aerobic capacity is the best index of overall physical fitness according to Cooper (4).

Hardly a day goes by without a newspaper reference to physical fitness or the lack of it (5). We hear frequently from the medical profession that obesity is our most common disease, that we suffer from a softness brought about by our highly mechanized lives, and that our complex civilization is producing ever increasing levels of nervous and mental disease.

Highly developed industrial societies present almost the end stage in the deterioration of physical condition. Daily work is highly mechanized and often requires little more energy expenditure than the resting metabolism. However, not all parts of the world and/or occupations are equally affected by this development. Some people have not had any physical deterioration yet, and they may not have it by the year 2000. In many primitive societies, according to Shephard (6), the strength and endurance of the individual still provide the principle energy resource for survival; for example, the cultivation of crops and/or the capture of game. Many of the observed differences in physical fitness, working capacity, and the prevalence of cardiovascular disease between and within populations could reflect differences of habitual activity rather than more fundamental differences of constitution or environmental challenge.

To a certain extent, people are a product of what they eat. Food is fuel for the biological machinery of the body. Therefore, it appears reasonable to expect that nutrition may well play a role in physical performance. Malnutrition definitely impairs performance. The study done by Buzina (7) showed a relationship between a low body weight and a poor physical working capacity in Yugoslavs. On the other hand in Canada and the United States (6), excess weight has become a sign of overnutrition. Heavy subjects do poorly on heavy work tasks, and there is a highly significant negative correlation between the estimated percentage of body fat and fitness test scores.

In terms of such measures of working capacity as aerobic power, there is a suggestion that populations from cold and/or mountainous regions perform better than those from pleasant, warm climates. Dua (8) reported that the native Indian residents of high altitude had much superior endurance capacity and produced 2.5 times more work than the acclimatized low landers even after 24 months at 4100 meters. The increased work capacity of high altitude native residents is attributed to their higher aerobic capacity, cardiovascular efficiency and respiratory efficiency, all of which may possibly be due to genetic adaptations at the tissue level.

An experiment was designed by Klissouras (9) to determine to what extent aerobic capacity is determined genetically. He tested twins and found that 93 percent of the aerobic capacity was determined by genetic factors. When the comparisons were made of a trained versus untrained twin, the trained twin was found to be superior in aerobic capacity; but, the absolute value after training was still only in the average category leading to the conclusion that while training can bring about substantial improvement, the ceiling is set by genetic factors.

Some physiologists have held that the usual performance of the top athlete is based largely on inherited traits. As Astrand (10, p. 730) put it, "I am convinced that any one interested in winning an Olympic gold medal must select his parents very carefully." Since regular training in previously trained persons, in most cases, increases the maximal oxygen uptake not more than 10 to 20 percent, it is evident that natural endowment is the most important factor determining the individuals maximum performance.

Although correlations can sometimes be established between lung volumes and athletic performance (11), most authors have held that the lungs play a minor role in determining either oxygen transport or physical fitness, except in special circumstances such as at high altitudes or when swimming underwater. Nevertheless, the symptom of breathlessness (12, 13) can induce a voluntary limitation of physical activity. Since unpleasant breathlessness of dyspnea usually develops when the tidal volume is 50 percent or more of vital capacity, it becomes of interest to consider racial differences of lung volumes and other indices of respiratory function. In some primitive communities, diseases such as tuberculosis have been rife until recently; thus, simple measurement of respiratory function also helps in deciding the health or physical fitness of the subjects tested.

The function of the lung reflects its structure and dimension, both of which are influenced by age, sex, and body size. Vital capacity, residual volume, and total lung capacity are related to body size and vary approximately as the cube of a linear dimension, such as body height, up to the age of 25 (3). The individual dimensions are, however, not exclusively decisive for the sizes of the lung volumes. Respiratory function is also influenced by other environmental factors including activities during childhood, altitude and the nature of habitual activity. These factors together may alter the average size of the lung by up to 20 percent (14). However, studies on people of different ethnic origin living in similar environments are now revealing systematic variations in lung volumes. In general, after the other factors have been taken into account, the vital capacities of European descent peoples appear to be larger than those of other ethnic groups. The ethnic difference in respiratory function is mainly confined to the vital capacity and forced expiratory volume.

One of the important factors in the physiology of athletic training is the increased efficiency of the breathing mechanics according to deVries (5). The ventilation equivalent is smaller in conditioned athletes, meaning that less breathing work is required to maintain a given oxygen supply. It is quite likely that high efficiency of breathing is a very important factor in such feats as the four-minute mile.

According to Finnerty (15) high blood pressure kills more Americans than any other single disease. In fact, it kills more people in the world than cars, cancer, fire, murder, or anything else one can name. Blood pressure is the pressure created against the arteries as blood flows through them. High blood pressure (hypertention) plays a major role in heart failure, heart attacks, kidney damage, strokes, rupture of major blood vessels, and hardening of the arteries.

Researchers are convinced that both heredity and environment have an influence on blood pressure. These scientists believe that people inherit a predisposition to high blood pressure, but depending on their environment and genetics, they may or may not develop it. Blood pressure has been reported lower among various "primitive" people than among Americans and Europeans. These "low blood pressure populations" represent many different races, climates, diets, habitats, and modes of life. Despite wide diversity, they share several common features: all adhere to traditional modes of life different from those of the dominant Western culture, and all are physically active people who show little or no tendency to gain weight as they age. When low blood pressure populations become accultured or modernized by adopting the ways of Western civilization, they will follow an age-related upward trend in blood pressure according to Page (16), thus demonstrating that they are not genetically protected from hypertention.

A modest but positive correlation appears for all blood pressure readings, with darker skin corresponding to higher blood pressure among Black Americans (17). The most obviously affected hypertensives are

Blacks. The average blood pressure for Black American men and women is significantly higher than for Whites. However, the linear relationship of means indicates that among Whites, the darker the skin, the lower the blood pressure. While respondents with parents from Mediterranean countries have the lowest pressures, those from Northern Europe have the highest. American Indians, on the other hand, have very low incidence of high blood pressure. Their blood pressures do not show increases with age as great as those seen among White and Black Americans (18).

High altitude and exercise affect the blood pressure in a positive manner. Studies show that people living in high altitudes have much lower blood pressures than the people living at sea level (15). Blood pressure levels are also lower in more active people than they are in sedentary people, and fitness programs do lower the blood pressure of hypertensive individuals according to Foyer and Kasch (19).

Obesity, smoking, high levels of cholesterol and other fats in the blood, and lack of physical exercise are all strongly implicated in the development of heart disease. But the major risk factor involved in almost every instance is high blood pressure.

Improper diet as a leading factor in the development of coronary heart disease is widely accepted by the medical community. The major culprits are fatty substances (lipids) called cholesterol and triglycerides. Cholesterol is manufactured in the liver and is also present in many foods that people eat. Its normal effects are beneficial because it helps the body use fats by moving them through the bloodstream. Cholesterol is actually an essential mechanism of good health, just as normal blood pressure is beneficial. Abnormally, it increases the risk of cardiovascular disease and premature death. When too much cholesterol circulates in the blood, the excess gradually deposits onto the inner walls of the arteries which contributes to artherosclerosis. Obviously, when people have high blood pressure and high cholesterol, they are going to be particularly susceptible to heart attack and stroke. But why some people have high cholesterol and others do not is still a mystery (20).

In the past ten years, scientists have discovered that total cholesterol can be further fractionated into high and low density lipoproteins which are composites of fat and protein that enable the lipids to be transported in the blood. A further finding was that high levels of high density lipoprotein (HDL) consistently correlated with lower incidence of heart disease (21). It appeared that high HDL levels had a protective effect against cardiovascular disease. Even more recently, research has been done which indicates that the ratio between total cholesterol (TC) and HDL-Cholesterol may be more important as a coronary heart disease risk indicator than TC alone. The higher the ratio, thus the lower the HDL, the greater the heart disease rate. The study done by Cooper (22) showed a direct correlation between fitness and the TC/HDL ratio. The TC/HDL ratios are inversely related to the levels of fitness.

High blood fat levels, physical inactivity, and sedentary lifestyle tend to increase the cholesterol levels, whereas exercise decreases the TC/HDL ratio by raising the HDL level. According to Cooper (22) running up to 11 miles per week is associated with a 35 percent increase in HDL cholesterol. Increasing HDL and decreasing LDL cholesterol levels helps to dissolve blood clots.

Serum cholesterol is a further simple quantitative index of nutritional status. In civilized communities, average values are much higher than among most primitive groups, and readings seem to rise even further with access to a particularly rich diet. This is supported by studies that showed the people who lived in London had higher cholesterol concentrations than people who lived in Nsukka, Nigeria; and the HDL cholesterol was higher in Nsukka than in London (23). Black and White Americans also show systematic differences in serum cholesterol and HDL cholesterol levels (24). Thus, the different cholesterol and HDL-C levels seem to be related to nutrition, environment, and racial factors.

Hemoglobin is the principle component of the red blood cells (erythrocytes) and accounts for most of the iron in the body. It acts as a carrier of oxygen from the lungs to the tissues and carbon dioxide from the tissues to the lungs. Measurements of hemoglobin has routinely been used in screening for anemia. Anemia is a condition in which there is a reduction in the total circulating hemoglobin.

High hemoglobin values as well as high red blood cell counts are associated with gross obesity as well as with chronic bronchitis or other lung diseases according to Roe (25). High altitude and training also increase the total body hemoglobin which results in better athletic performance because of increased capacity to carry oxygen into the muscle tissues.

It has been shown by Garn (26) that ethnic differences exist in hemoglobin values, such that Blacks have been found to have normal hemoglobin levels lower than Whites.

Glucose is a form of sugar found in the blood and is a source of energy for cellular metabolism. A glucose (blood sugar) concentration in excess of normal levels is known as hyperglycemia; this is characteristic of diabetes mellitus. A glucose concentration below normal levels is known as hypoglycemia and may occur in certain abnormalities of liver function, or when insulin is produced in excessive amounts by the pancreas (27).

Certain aspects of carbohydrate metabolism are altered at high altitudes. Residents at an elevation of 14,900 feet, for example, exhibit lower serum glucose concentration and reduced tolerance curves than people living at sea level (28). However, exposure to cold is apt to produce a modest increase in serum glucose levels since chilling may promote glycogenolysis. Besides environmental effects on glucose level the racial differences also affect the glucose level of the blood. It is reported (29) that there was a slight but statistically significant difference in blood glucose levels between White and Black men.

According to Cooper (30) there is a significant relationship between the level of cardiorespiratory fitness and selected risk factors and fitness variables (serum cholesterol, triglycerides, blood pressure, percent body fat and weight, glucose and uric acid, resting heart rate, and forced vital capacity), suggesting that those with high cardiorespiratory fitness levels are at a lower risk for the premature development of coronary heart disease

The author has been at Oklahoma State University for eight years and has met a number of foreign students from around the world. Having the opportunity to observe the diverse races within the University community aroused his interest in possible correlation of their aerobic capacity, respiratory function, blood pressure, and blood chemistry.

## Statement of the Problem

The problem was to compare physiological variables on three populations, two of which were foreign students at Oklahoma State University.

The purpose of this study was to measure and compare the aerobic work capacity, respiratory function, resting blood pressure, and blood chemistry of Oklahoma State University male students from Middle East and East and Southeast Asian countries with the United States population norms. The intent was to find the similarities and differences of physical fitness variables of students from different geographical regions of the world.

## Subproblems

The subproblem was to compare the selected fitness variables between the foreign students who have been in the United States: a) less than one year, and b) longer than three years. The purpose was to see if the length of time spent in the United States affected the fitness variables of the students. An attempt was made to analyze exercise and diet habits of the subjects and how they are related to these fitness components.

## Hypotheses

The null hypotheses was tested in comparing the following fitness variables of foreign students from Middle East, and East and Southeast Asia, and the United States population:

1. There is no significant difference of aerobic work capacity (maximum oxygen consumption) among the three groups.

2. There is no significant difference of respiratory function among the three groups.

a. Vital Capacity (VC)

b. Forced Vital Capacity (FVC)

c. Forced Expiratory Volume in One Second ($FEV_1$)

d. $FEV_1$/FVC Ratio

e. Maximum Voluntary Ventilation (MVV).

3. There is no significant difference of resting blood pressures among the three groups.

a. Systolic Blood Pressure

b. Diastolic Blood Pressure

4. There is no significant difference of blood chemistry among the three groups.

a. Total Cholesterol (TC)

b. High Density Lipoproteins (HDL)

c. TC/HDL Ratio

d. Glucose

e. Hemoglobin

5. There is no significant differences of the fitness variables between the two foreign student groups that have been in the United States: a) less than a year, and b) longer than three years.

a. Maximum Oxygen Consumption

b. Vital Capacity

c. Forced Vital Capacity

d. Forced Expiratory Volume in One Second

e. $FEV_1$/FVC Ratio

f. Maximum Voluntary Ventilation

g. Systolic Blood Pressure

h. Diastolic Blood Pressure

i. Total Cholesterol

j. High Density Lipoproteins

k. TC/HDL Ratio

l. Glucose

m. Hemoglobin

## Delimitations

The scope of this study was to investigate the effects of racial, cultural, and environmental factors on aerobic work capacity, respiratory function, blood pressure, and blood chemistry through male Oklahoma State University foreign students from Middle Eastern, and East and Southeast Asian countries and compare the results with the United States population norms. The subjects were in the 20-30 years of age group, and the selection of the subjects was done through stratified random sampling. The measurements took place in the Oklahoma State University Physiology of Exercise Laboratory.

## Limitations

1. There was no attempt to control diet, sleeping or physical activities of the subjects prior to measurement. They were advised not to eat two hours prior to measurements nor participate in any kind of physical activity prior to measurements on the test day.

2. The blood chemistry analysis was done on a voluntary basis, and not all subjects participated.

3. There was no assumption that the subjects represented all people from their respective country or region.

## Assumptions

1. The instruments used were accurate, and the researcher took accurate measurements.

2. The subjects followed all pre-test instructions with regard to diet and physical activity.

3. The subjects exerted a maximum effort while being tested on the treadmill and vitalograph spirometer.

4. The subjects represented the foreign student population from Middle East, and Far and Southeast Asia at Oklahoma State University.

## Significance of the Study

Physical educators and/or exercise physiologists play an important role in the fight against diseases, especially those that can be prevented, controlled or possibly cured through participation in physical exercise. The goal is to achieve the motto, "sound body, sound mind," throughout the world. Therefore, it is necessary to know the capacities and limitations of different peoples of the world. It is extremely important to find the effects of racial, cultural, and environmental factors on physical fitness and/or health variables to protect against or find solutions to health problems of human kind. This is what the researcher was trying to accomplish by measuring the aerobic work capacity, respiratory function, blood pressure, and blood chemistry variables of students from the various countries of the world.

Although all of these fitness variables are diagnostic in nature, the intent of this study was not to diagnose, but rather to contribute to basic physiologic knowledge of the determinants of physical fitness and health and to gain knowledge about the physiological characteristics of students from Middle East, and East and Southeast Asian countries. This study adds another perspective to the comparative population studies in terms of physical fitness and health variables. It is the first study presented from this angle since most of the studies have narrowed the problem down to focus on a certain point, such as comparison of two racial or ethnic groups, or a certain type of diet on performance, blood pressure, etc. However, the racial, cultural and environmental factors are so linked with each other that it is almost impossible to distinguish one from another. Besides preventing or finding solutions to the health problems, it is also important and interesting to know how the people from different parts of the world compare with one another.

## Definition of Terms

1. Physical Fitness: The ability to perform muscular work satisfactorily under specified conditions.

2. Cardiorespiratory Fitness: The efficiency of the heart, blood vessels, and lungs to supply and deliver oxygen to the organs and tissues.

3. Aerobic: A process by which work is accomplished in the presence of oxygen. The oxygen requirements for the work (activity) can be met during the work.

4. Aerobic Work Capacity (physical work capacity): The highest oxygen uptake the individual can attain during physical work while breathing air at sea level.

5. Maximum Oxygen Consumption (intake or uptake, $VO_2$ max.): The largest amount of oxygen that one can utilize under the most strenuous exercise. This is expressed in milliliters of oxygen per kilogram of body weight per minute (ml/kg/min).

6. Respiratory Function (pulmonary function): Physiologic measure-

ments (volumes, capacities), and performance of the lungs.

7. Vital Capacity (VC): The greatest voluntary expiration following the deepest inspiration.

8. Forced Vital Capacity (FVC): The volume of air that can be exhaled from a position of full inspiration, as rapidly and completely as possible.

9. Forced Expiratory Volume ($FEV_t$): The volume of air exhaled over a given time interval during a forced expiration.

10. Forced Expiratory Ratio ($FEV_t\%$): The forced expiratory volume expressed as a percentage of the vital capacity or forced vital capacity.

11. Maximum Voluntary Ventilation (MVV): The maximum volume of air that can be breathed per minute by voluntary effort.

12. Blood Pressure: It is a quantitative measurement of the pressure of the blood against the inner walls of the blood vessels.

13. Systolic Blood Pressure: Active phase of the heartbeat when the heart muscle contracts, forcing more blood into the arteries and raising pressure to its highest level.

14. Diastolic Blood Pressure: The resting phase of the heartbeat when the pressure within the arteries falls to the lowest level.

15. Hypertension: High blood pressure. Increased blood pressure above the normal range.

16. Hypotension: Low blood pressure. Blood pressure below the normal range.

17. Pulse Pressure: The systolic-diastolic difference is the pulse pressure. It represents the influence of the stroke output of the heart on blood pressure.

18. Cholesterol (C): One of the lipid (fat) substances of the body, a sterol. It is the key chemical involved in the development of atherosclerosis.

19. Atherosclerosis: Deposits of cholesterol of lipid materials in the arteries. Often called "hardening of the arteries."

20. High Density Lipoproteins (HDL): Lipoproteins that float in a solution of 1.0635 and 1.210 g/ml density in the ultraventrifugal field.

21. Glucose: Blood sugar.

22. Hemoglobin: It is a catalytic compound consisting of an iron porphyrin, heme, and a protein, globin, found within red blood cells which transports oxygen to and carbon dioxide away from living cells in support of metabolism.

## Description of Instruments

1. Quinton Motorized Treadmill: An instrument which consists of a motor driven conveyor belt that is large and strong enough for a person to walk and run upon at various speed and grade. (Model 24-72, Quinton Instruments, Seattle, Washington.)

2. Quinton 650 Heartrate Meter: An instrument that monitors heart rate per minute when the electrodes are placed on a person. (Quinton Instruments, Seattle, Washington.)

3. Sphygmomanometer: A device used to indirectly monitor blood pressure. It consists of a compression bladder enclosed in an unyielding cuff, an inflation bulb, a mercury manometer from which the applied pressure is read, and a control exhaust to deflate the system. (Trimline by PyMah Corporation, Sommerville, New Jersey.)

4. Stethoscope: A listening device to amplify sound. (Exercise Model, Quinton Instruments, Seattle, Washington.)

5. Vitalograph Spirometer: It is a lightweight compact and calibrated instrument that provides a permanent record of lung function by recording and tracing of the dynamic and static expiration of lung volume.

6. Spectrophotometer: Photoelectric colorimeter that transmits light which is used to analyze blood components.

# CHAPTER II

## REVIEW OF RELATED LITERATURE

This review of literature will be divided into five sections after a brief introduction and a definition of physical fitness. The sections are: 1) aerobic capacity, 2) respiratory function, 3) blood pressure, 4) cholesterol, high density lipoproteins, glucose, and hemoglobin, and 5) summary. Physical fitness variables will be reviewed in terms of racial, cultural, environmental, and other factors which may influence the state of these variables.

The American Dietetic Association (31) stated that with industrialization and mechanization many individuals in the United States have become more sedentary. A decrease in physical activity and an abundant food supply have contributed to wider prevalence of obesity and reduced physical fitness. In turn, the risk of chronic disease, such as cardiovascular disease and diabetes mellitus, is increased. The American Dietetic Association maintains that a nutritionally adequate diet and exercise are major contributing factors to physical fitness and health. In addition to appropriate diet and exercise, physical fitness and health are influenced by other interdependent factors: genetic variables, endocrine balances, psychologic and emotional status, sleep, and the use of alcohol, drugs, and tobacco.

According to deVries (5), the best possible definition of physical fitness encompasses the work that has been performed and accepted by the two professions most interested in this area: physical education and medicine. Thus, physical educators developed many fine test batteries which include such test items as running, jumping, throwing, pull ups and push ups. These test batteries, which are categorized as tests of motor fitness, attempt to measure the following elements of physical fitness: 1) strength, 2) speed, 3) agility, 4) endurance, 5) power, 6) coordination, 7) balance, 8) flexibility, and 9) body control. On the other hand, the concept of physical working capacity (PWC) has gained wide acceptance among physiologists, pediatricians, cardiologists, and other members of the medical profession. Physical working capacity may be defined as the maximum level of metabolism (work) of which an individual is capable.

An individual's PWC is ultimately dependent upon his capacity to supply oxygen to the working muscles. This in turn means that PWC probably evaluates, directly or indirectly, at least the following elements of physical fitness: 1) cardiovascular function, 2) respiratory function, 3) muscular efficiency, 4) strength, 5) muscular endurance, and 6) obesity. The last item, obesity, becomes a factor because the final score in maximal oxygen consumption is usually expressed in milliliter of oxygen per kilogram of body weight. Thus, physical fitness, according to Getchel (32), is the capability of the heart, blood vessels, lungs, and muscles to function at optimal efficiency.

## Aerobic Capacity

Getchel (32) writes that human beings need oxygen to live. The ability of the body to utilize oxygen depends on the functional efficiency of the cardiorespiratory system: the lungs, the heart, the blood vessels, and the associated tissues. During vigorous activity, the exercising muscles use increased amounts of oxygen and produce corresponding amounts of carbon dioxide. The largest amount of oxygen that one can consume per minute is called maximum oxygen consumption. This maximal value, often referred to as one's aerobic capacity, is a functional measure of physical fitness. The maximum effort one can exert over a prolonged period of time is limited by his/her ability to deliver oxygen to the active tissues. Theoretically, a higher oxygen consumption indicates an increased ability of the heart to pump blood, of the lungs to ventilate larger volumes of air, and of the muscle cells to take up oxygen and remove carbon dioxide.

It is obvious that the individual's maximal aerobic power plays a decisive role in his/her work capacity. According to Astrand and Rodahl (3) the individual's maximum oxygen uptake gives a measure of the "motor power" of the aerobic processes, i.e. of the person's maximal aerobic power. When related to body weight, the ability to move the body can be evaluated. In prolonged exercise, there is a high correlation between maximal oxygen uptake and total work output (maximal aerobic capacity). The actual oxygen uptake that can be tolerated is at a certain percentage of the maximum, this percentage being lower the longer the work time.

Differences between the United States and Austria in the number of deaths from heart attacks among men 35 to 44 years of age aroused considerable interest in Cooper and Zechner (33) with respect to the role of physical activity. As a result, a study was done for the purpose of evaluating the level of physical fitness in the United States Air Force and the Austrian Army.

This study revealed that the physical fitness of untrained military recruits 18 to 20 years of age, as measured by a 12-minute run, was considerably better in the Austrian Army than in the U.S. Air Force. Most of both groups entered the service on a voluntary basis shortly after leaving high school. Cooper and Zechner stated that to some extent the results of this study reflect either the amount or type of physical education in the secondary school systems for non-athletic students or, more likely, the type of daily activity of each group. For example, walking and cycling are popular among the youth of Austria, whereas mechanization has almost eliminated this type of activity among the youth of the United States.

Generally, after a few weeks of regular exercise, endurance performance improves considerably, but the improvement is not sustained unless the exercise is continued. Therefore, the performance of the U.S. airmen 18 to 20 years of age who had completed basic training and been assigned to permanent duty stations did not equal the performance of the incoming Austrian recruits.

Within the age span of 19 to 29 years, the Austrian soldiers had a minimal decrease in 12-minute performance, but the U.S. airmen had a more impressive decrease. This difference could be associated with a rapid gain in weight, but examination of the data revealed a 4.5 to 5 kilogram gain by both groups. Another consideration could be the consistency of the added weight, i.e., the airmen might have gained more fat. Further substantiation of this theory of a heavier, but leaner, Austrian soldier was seen in the overall statistics. The Austrian soldiers outweighed the U.S. airmen by nearly 3.2 kilograms, but almost twice as many Austrians could exceed the minimum fitness standard of 1.5 miles in 12 minutes.

Another interesting result of this study was the unusually large difference in the number of men 19 to 29 years of age in the excellent category of fitness, i.e., with the ability to run 1.75 miles or more in 12 minutes. Only 2.7 percent of the U.S. airmen could achieve this level of fitness in contrast to 37 percent of the Austrian soldiers. This difference could be explained partially by the fact that the Austrian soldiers were required to participate in regular physical activity for two hours of the day twice a week. Nevertheless, this observation did not explain the differences in the excellent category of fitness among the incoming recruits of the two countries (30.7% vs. 3.8%). As discussed previously, the active Austrian way of life appeared to be more conducive to the development of higher levels of fitness in young men than the way of life in the United States.

Ghesquiere (34) published data of physical fitness on the Bantu Negroes (Ntomba) and the Pygmoid people (Twa) living side by side in the same jungle community. Health conditions, nutrition, and way of living were said to be 'closely the same,' although the Pygmoids were hunters, while the Bantu Negroes made a living from primitive agriculture in addition to fishing and hunting. When aerobic powers were compared on a per kilogram basis, the Pygmoid (47.4 ml/kg/min) had a 15 percent advantage over the Bantu (42.6 ml/kg/min). Ghesquire wrote that this difference is believed to demonstrate a genetically determined difference in fitness for work.

Malhorta (35) reported the maximal oxygen consumption from 38.9 to 55.2 ml/kg/min. for 25 Indian athletes undergoing preselection training for different events for the Olympics. He remarked that Indian athletes have much lower aerobic capacity in comparison to world class athletes, the maximal oxygen consumption for the latter being 75.1 ml/kg/min.

Several studies (36, 37) have reported that Norwegian and Swedish women have a higher average maximal oxygen consumption than either Japanese or American women.

Glick and Schvartz (38) compared data on four groups of Israelis whose parents had migrated respectively from Europe (Germany, Austria, Poland, Russia, Romania, Hungary, and Czechoslovakia), North Africa (Morocco, Tunisia, and Algeria), Iraq and Yemen. Both in terms of predicted aerobic power (179 subjects) and direct measurement of maximal oxygen consumption (35 subjects), the Yemenites were significantly superior to the other three groups ($VO_2$ max of Europeans was 40/ml/kg/min., Iraqis was 43.8 ml/kg/min., North Africans was 41.3 ml/kg/min., and Yemenites was 49.2 ml/kg/min.). The authors ruled out differences of activity and diet among subjects and concluded "ethnic group differences in physical work capacity in this study were, therefore, largely a result of genetic differences between these groups."

The aerobic power of adolescent boys has been frequently measured. In Norwegian boys (39) the aerobic power per kilogram body weight was found to be 14.5 to 23.4 percent greater than for Japanese boys (40) at the age of 9-12 years, although other Norwegian boys had similar values as found at 14 years of age. Aerobic power per kilogram in 13 year old Norwegian and American Caucasian (41) boys was 40.9 and 20 percent greater than that of Japanese average students at the same age. However, these differences in aerobic power become less evident in older boys. At ages 16-17 the aerobic power of Norwegian and American boys was 4.8 percent greater than the Japanese.

Despite all the maximal oxygen consumption differences among the races and ethnic groups, the most recently published studies indicate that aerobic fitness levels in the Canadian Forces (42) are essentially the same as those in the armed forces of the United States (43) and Britain (44). There was also a clear and positive relationship between maximal oxygen uptake and the physical demands of the job in military populations.

Vichi and Souza (45) studied the physical performance of seven different professional groups living in the Brazilian Amazon and also found differences in physical capacity among the groups. The professional groups (ten persons each) consisted of military groups, rural workers, river workers, and primitive Kayapo Indians. The other groups consisting of five people each were professional soccer players, sedentary work persons and urban workers. The best physical capacity was obtained by the soccer players and military groups. In second place, having small differences, were the remaining groups, except the sedentaries.

Klissouras (9) performed an interesting study to determine the influence of heredity on an individual's aerobic capacity. Fifteen monozygous and ten dizygous male subjects, ages 7 to 13 were tested for variability of aerobic capacity. It was concluded that 93 percent of the subjects' aerobic capacity was determined by genetic factors. When the comparisons were made of a trained versus untrained twin, the trained twin was found to be superior in aerobic capacity by 37 percent; but, the absolute value after training was still only in the average category. This indicated that training can improve aerobic capacity, but the ceiling is determined by genetic factors.

There have been numbers of studies of working capacity in populations residing at high altitudes. Malhotra (46) described the primitive tribespeople of North Eastern India, many of whom were huntsmen, while some engaged in terrace cultivation, burning the native forests and planting seeds in the ashes. The population "spend their entire lives on the slopes of mountains, and so have grown very strong with well developed calf muscles." While the physical fitness of many high altitude peoples is partly an expression of the enforced activity of mountain climbing, the difference between sea level and altitude natives cannot be fully abolished even if sea level populations are allowed an extended period of acclimitization.

Anderson (47) compared two groups of Ethiopeans, living respectively at 1500 m and 3000 m. The people, Amharas, were a mixture of Mediterranean and Negro stocks, and the climate was dry heat at the lower altitude but somewhat cooler at the higher altitude. The state of nutrition was not specified, but populations were extremely light in relation to their height (56.2 kg for 168.3 cm, 53.5 kg for 169.9 cm). A 'hyper-maximal' bicycle ergometer or step test to exhaustion showed a relatively poor aerobic power at both altitudes; however, taking into account the respective altitudes of testing, those living at 3000 m were somewhat fitter and, again, had a somewhat slower apparent rate of aging than those living at 1500 m.

Bharadway (48) found that the Ladakhis native to 3960 m had a 12 percent higher aerobic power than the sea level Tamilians even after the latter group had spent ten months at the same altitude.

Donoso (49) examined 40 Aymara Indians living in the Chilean Andes (altitude 3680 m). All were working as farmers or shepherds. The maximum oxygen intake, measured directly on a bicycle ergometer, was a high normal value (49.1 ml/kg/min.). The apparent rate of aging of aerobic power was also less than in sea level populations.

Buskirk (50) summarized the results of IBP (International Biological Programme) experiments on the Peruvian Quechua living at sea level and at 3992 m. The high altitude residents (Nunoa) were not particularly active; three estimates of caloric intake for groups of adult men being 2115, 2719 and 2833 kilocalories per day. Nevertheless, their aerobic power was ten percent superior to that of sea level Quechua who were allowed to acclimitize at that altitude for four weeks.

Dua and Sen Gupta (8) studied the change in physical work capacity of 29 young healthy residents of sea level after a prolonged stay of 24 months at an altitude of 4100 m and compared it with 20 young native residents of high altitude having identical nutritional intake and physical training status. Maximum oxygen uptake capacity of 46.8 ml/kg per minute of sea level residents significantly reduced to 34.6 ml/kg/min. after 24 months at the higher altitude. The high native residents on the contrary had a significantly higher maximal oxygen intake of 41.1 ml/kg per minute which was not significantly different than the sea level residents value at sea level. Timings in outdoor running performance and hill climbing corroborated the findings of maximal oxygen intake. Similarly, endurance work output in the stepping exercise indicated that the native residents of high altitude had a superior capacity and produced 2.5 times more work than the acclimatized low landers even after 24 months at 4100 m. The increased work capacity of high altitude native residents is attributed to their higher aerobic capacity, cardiovascular efficiency, and respiratory efficiency, possibly due to genetic adaptations at the tissue level.

## Respiratory Function

Johnson (51, p. 1994) stated that the ability to blow up a balloon apparently is one of the best indicators of a person's general state of health. Forced vital capacity (FVC) measures the ability to take a deep breath and forcefully exhale into a spirometer. "According to Framingham, Massachusetts, investigators, newly analyzed data show that FVC is a measure of overall 'capacity for living.'" In addition, the investigators have discovered that hand grip strength is one of the best correlates of FVC, suggesting that grip may be an index of physical fitness.

Aging induces a decline in FVC, which cannot generally be improved even with training, although athletes have higher FVCs than others. Smoking cigarettes makes the FVC decline more rapidly than normal, but when smokers quit, their FVCs again begin to decline at the usual rate, although never returning to normal levels for their age and sex (51).

Although women have smaller FVCs than men, their FVCs are better indicators of health than are those of men. Johnson (51, p. 1994) reports that William B. Kannel, M.D., of the Framingham Heart Study, told a recent American Heart Association conference on cardiovascular disease epidemiology, "We have found that in women FVC is unequivocally the most powerful predictor of cardiovascular mortality. In men, it is rivaled by blood pressure." The inverse relationship between FVC and heart disease is striking in women, Kannel explained, This relationship is independent of age, stature, obesity, the cigarette habit, and evidence of pulmonary disease or chest deformity. It is strongest for cardiac failure and weakest for coronary heart disease. The same strong inverse relationship is found also for peripheral arterial disease and stroke.

O'Brien and Drizd (52) reported that of the factors found to influence spirometric test results in normal individuals, age, sex, and height are most important. Cigarette smoking and race also affect the results. Other factors, such as socioeconomic status, health status, and exposure to atmospheric pollutants may also play a role.

According to Cotes (14) the changes in lung function which constitute respiratory impairment reflect the underlying abnormality. This may arise primarily in the lung airways, the chest wall including the innervation of the respiratory muscles, the lung parenchyma or the regulation of respiration. Disturbances to any of these components of the respiratory system may give rise to characteristic syndromes of disordered lung function which are to some extent independent of the detailed etiology.

Shephard (6) stated that a low vital capacity in specific members of a given population may reflect advanced 'restrictive' chest disease. However, the interpretation of systematic differences of vital capacity between populations is a more complex question. Sir Joseph Barcroft first drew attention to the unusual shape of the chest in the indigenous population of the Andes. More recent radiographic studies of Rhodesians (Paul, Fletcher and Addison) (53) have shown that, even after allowance for differences of standing height, Europeans have wider and taller chests than Africans, the estimated volumetric discrepancy being 13.2 percent.

Damon (54) studied the pulmonary function among 392 White and 61 Black U.S. soldiers, aged 18-29. The Black soldiers had 13 percent smaller one second forced expiratory volume ($FEV_1$) and total vital capacities (TVC), as well as a ten percent slower mid-expiratory flow rate. Mean age, height, weight, and chest circumference were similar in the two groups, and the White soldiers smoked more than the Blacks. He concluded that the shorter trunk and reduced chest expansion of the Blacks could not account for much of the difference. Differences of this magnitude have been reported for almost 100 years, and prior pulmonary disease is unlikely to account for them.

Jain and Ramiah (55) reported that the pulmonary function capacity at rest, including maximal minute ventilation was 20 to 24 percent lower in Indians as compared to White races. According to the authors nutritional factors may have a role; however, the chief cereal being wheat in North and rice in South India does not make any difference, except insofar as any role it may play in developing the bigger body size of the Northerner.

Cotes (56) has also noted small vital capacities in Indians, Africans, and Chinese, and he has speculated that genetic differences among population may be demonstrated more readily in 'static' measurements such as vital capacity than in 'dynamic' data such as aerobic power.

The basic data on spirometry in U.S. adults between 1971 and 1975, analyzed by O'Brien and Drizd (52), showed significant differences of forced vital capacity and forced expiratory volume at one second between

White and Black populations which supports the findings of Damon. This data also showed significant differences between cigarette smokers and non-smokers.

After comparing lung volumes of average 20 year old and 170 cm tall Canadians, South Africans, Americans, Frenchmen and Britons Shephard (6) stated that such comparisons suggest the European may have a slight advantage of vital capacity over the United States populations, presumably because of greater muscular strength.

Hsu and co-workers (57) designed a study to investigate ventilatory function of Mexican-American, White, and Black children and adults. The study showed that Black children were well below White and Mexican-American children for each sex for forced vital capacity and forced expiratory volume at one second.

A comparison of lung function in Caucasian and East Indian woodworkers by Corey and co-workers (58) also revealed marked differences in forced vital capacity, forced expiratory volume in one second, and maximum mid-expiratory flow in relation to predicted age and height, but these findings were not attributed to differences in smoking habits, frequency of respiratory disease or employment characteristics. Rather, they suggested that the standard values employed were inappropriate for East Indians.

Cotes (14) stated that a high level of habitual activity is a feature of people living on the sides of mountains, many agriculturalists, nomads, and those who participate in gymnastics, ball games, athletics, and active outdoor recreations. The categories may be subdivided into those where the high level of activity is mandatory from an early age and where it is acquired during adolescence or in adult life. Among the former, in particular, the activity increases the size of the lung and its capability for gas exchange. Training of the muscles of the shoulder girdle leads to an increase in the vital capacity by reason of the increased strength of the accessory muscles of inspiration. This is a feature of oarsmen, weight lifters and participants in archery and other sports in which these muscles are employed. The change is not accompanied by a corresponding increase in the forced expiratory volume, so the proportion of the forced vital capacity which these subjects can expire in one second tends to be relatively low. In short and middle distance swimmers the increase in the vital capacity due to muscle training is supplemented by the possession of a big trunk length which probably also confers a competitive advantage.

Stuart and Collings (59) compared the vital capacity (VC), maximum breathing capacity (MBC) and MBC/VC measurements of 20 athletes on various varsity teams and 20 nonathletes. The mean VC score of the athletes was significantly higher than the mean nonathlete VC, but insignificant differences existed between the two groups in MBC and MBC/VC. It was suggested that the difference in VC is due to increased development of respiratory musculature incidental to regular physical training. This increase is not reflected in the MBC since this measurement would appear to be more concerned with the presence or absence of obstructive ventilatory defects that are unaffected by physical training.

Bachman and Horvath (60) found significant decreases in functional residual capacity, residual volume and the ratio of residual volume/ total lung capacity in swimmers after four months of training. Controls and a similar group 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 favor of improved athletic performance.

Onadeko and co-workers (61) studied the pulmonary function in Nigerian sportsmen (259 males and 151 females). The study showed that the mean observed FVC value of athletes was higher than the observed FVC value of nonathletes. Also, the mean FVC value of the sportsmen correlated with their sporting events which were determined by the extent of regular and strenuous physical training.

Smoking and air pollution also play significant roles in respiratory function, and highly industrialized societies are affected more than others. Nadel and Comroe (62), in a well controlled study, demonstrated that 15 puffs of cigarette smoke in five minutes caused an average decrease in airway conductance of 31 percent in 36 normal subjects. This finding was highly significant and was found both in smokers and nonsmokers. Changes occurred as early as one minute after smoking began and lasted from 10 to 80 minutes (mean was equal to 35 minutes).

Detels and co-workers (63) studied 3465 USA residents of an area historically exposed to photochemical/oxidant pollutants and 4509 residents of an area exposed to low levels of chemical pollutants. They found that lung function was better among residents of the low pollution area according to $FVE_1$, FVC, maximal expiratory flow rates, closing volume fraction, thoracic gas volume and airway resistance. The greatest differences between areas were in residents 18-59 years of age, suggesting that long term exposure may be required to cause measurable impairment.

## Blood Pressure

Hypertension, or high blood pressure, is a risk factor for coronary heart disease (CHD) as well as an important factor in other life-threatening diseases, such as renal (kidney) failure, stroke, and congestive heart failure. According to Shank (64) hypertension is among the most common physical abnormalities in adults and possibly in teenagers.

According to Page (16) population studies have disclosed a general tendency for blood pressure to rise with age in many parts of the world. The prevalence of hypertension varies among different racial and ethnic groups, but no race has been found to be genetically resistant to its development. Contrary to the general trend, over 20 isolated populations have been described that are virtually free of hypertension and show no age related upward trend in blood pressure. These "low blood pressure populations" represent many different races, climates, diets, habitats, and modes of life.

Feinmen (20) stated that high blood pressure is about four times more common in Black people than White. It also develops earlier in life, causing an extremely high incidence of premature death. In fact, diseases related to high blood pressure are the major cause of death among the Black population.

It was reported in Vital and Health Statistics (65) that the mean systolic and diastolic blood pressure levels for White and Negro children age 7-11 years were similar. The pattern of racial differences in mean blood pressure levels across the age range is not consistent among boys or girls. As in findings among those 7-11 years of age, mean systolic and diastolic blood pressure levels for White and Negro boys ages 12-17 years reflected no consistent significant pattern of racial differences.

Among White U.S. adults, both men and women, the increase with age in mean systolic blood pressure and the rates of increase over the 18-74 year age range were nearly identical to those reported for adults of all races. Mean systolic pressures of all White adults increased steadily and significantly with age from 119.3 mm.Hg in ages 15-24 years to 149.2 mm.Hg in ages 65-74 years.

Among Negro adults, the increase with age in both systolic and diastolic blood pressure means was more rapid than that reported for White adults. Systolic blood pressure means for Negro adults, both men and women, increased from 117.5 mm.Hg in ages 18-24 years to 159.3 mm.Hg in ages 65-74 years.

The mean systolic and diastolic blood pressures of White men 18-24 years were slightly higher than those of Negro men of comparable age, while in ages 25-34 years and older, the mean pressures of Negro men were higher than those of White men and remained so through 65-74 years.

Racial differences in systolic and diastolic blood pressure levels among White and Negro women followed a pattern generally similar to that for men. In ages 18-24 years, the mean systolic pressure for White women was slightly greater and the mean diastolic pressure slightly less than that for Negro women, while from 35 years on the mean levels for Negro women were significantly higher than those for White women.

In the sample design used for this survey, the United States was divided into four broad geographic regions--the Northeast, Midwest, South, and West, each approximately equal in population. Across the 7-74 year age span, the mean systolic blood pressures of persons living in the South were higher than those of persons in the other three regions. The mean systolic pressure levels were similar among persons living in the other three regions.

During 1973-1975, more than one million persons were screened in the nationwide Community Hypertension Evaluation Clinic (CHEC) program at 1,171 sites (66). The results showed that Blacks had higher systolic blood pressures than Whites in all but one age-sex group (20 to 29 year old men), as well as greater variability in blood pressure. Other nonwhites (American Indians and Asians) had average systolic blood pressures (SBP) somewhat lower than Whites, at least until age 60 for men and 50 for women.

Mean diastolic blood pressures (DBP) were higher for Blacks than for Whites in virtually all adult age-sex groups, with Blacks also displaying somewhat greater variability. Other nonwhites tended to have mean DPBs similar to Whites, particularly after the age of 40.

A Detroit study (17) showed that darker skin color, for Black males, especially, was related to higher blood pressure, independently of the control variables (e.g., age, weight, socioeconomic status). However, younger Black males (25-39 years of age) in high stress areas had higher blood pressure than counterparts in low stress areas, regardless of skin color and relative weight. For older Black males (40-59 years of age) darker skin color was correlated with higher blood pressure, regardless of relative weight or stress area. For 35 Blacks whose fathers were from the West Indies, blood pressures were higher than those with American born fathers. These findings suggest that varied gene mixtures may be related to blood pressure levels and that skin color, an indicator of possible metabolic significance, combines with socially induced stress to induce higher blood pressures in lower class American Blacks. The authors also pointed out that darker skin color, independently of other variables, was also related to residence in high stress areas, segregated by racial discrimination, and to lower education. One can speculate that darker skin color and lower education lead to residential segregation in high stressor areas, and "interact" to raise blood pressure levels for a subset of Blacks who are most sensitive to such stressors. Among Blacks, especially females, for example, they found lower income was independently related to higher blood pressure levels.

However, the Detroit study showed an opposite relationship among Whites, the darker the skin, the lower the blood pressure. The Whites were divided into four groups: 1) North Europe, 2) Central Europe, 3) French, and 4) Mediterranean. The rank order of these four category variables, White ethnicity, was related linearly to both systolic and diastolic blood pressure means. Respondents with parents from Mediterranean countries had the lowest blood pressures while those from Northern Europe had the highest. The relationship was even stronger for women than men.

In a medical survey of an urban population in Ghana, Ikeme and co-workers (67) found cardiovascular abnormalities in 25 percent of the population ages 16-64 years. This was largely due to hypertension and to cardiomegaly of obscure origin. Abnormal cardiovascular findings were most common in the lowest one-third of the socioeconomic stratum and next most frequent in the highest one-third. These abnormal findings were not related to smoking or drinking habits.

Vaughan and Miall (68) studied three typically rural communities in the Gambia, Jamaica and the United Republic of Tanzania. They found marked differences in blood pressure with higher values in Jamaicans than in Tanzanians who, in turn, had higher values than Gambians.

DeStefano and co-workers (18) conducted blood pressure screenings on the Navajo Indian reservation. Six hundred forty Navajos over 19 years of age were surveyed at various sites. The mean systolic and diastolic blood pressures in Navajo men and women did not show as great increases with age as those seen among white and black Americans. Navajos also had generally lower blood pressures and lower prevalence of hypertension than white and black Americans. The authors were unable to demonstrate any association between degree of acculturation and blood pressure, but they did find that obesity in both men and women and alcohol use in men were associated with a higher prevalence of elevated blood pressure in the Navajos.

DeStefano et al., also pointed out that blood pressures have been reported lower among various "primitive" peoples than among Americans and Europeans. An attractive hypothesis is that the Navajos had such a low prevalence of hypertension and lower mean pressures because of their traditional lifestyle, but since they have been adapting to a more modern lifestyle, blood pressure has been increasing. This hypothesis is supported by reports that hypertension occurs more frequently among off-reservation Indians with fewer traditional customs than Indians who have remained on the reservation.

According to Reed (69), although essential hypertension was more prevalent among black adults than white adults, results of an extensive high school blood pressure screening program revealed that this relationship did not exist among adolescents. In fact, the blood pressure levels of white youths equaled or exceeded that of black youths. This race effect still existed when age, sex, weight, and socioeconomic status were controlled.

The study done by Keil and co-workers (70) reported that education effects, but not skin color effects, were associated with blood pressure and the incidence of hypertension in a cohort of black females in Charleston, South Carolina, observed over the period 1960-1975. The authors suggested that skin color may be a secondary (non-causal) associate of blood pressure in Blacks.

Page and associates (71) studied the blood pressure of Qash'qai (Turkish origin) pastoral nomads in southern Iran in relation to culture, diet, and body form. Unlike traditional populations in several parts of the world, systolic, diastolic, and mean blood pressure increased significantly with age in both males and females in the Qash'qai. Blood pressure greater than 140/90 mm.Hg was found in 12 percent of males and 13 percent of females age 30 years or over. Body weight showed no tendency to increase with age in either sex. The data suggested that blood pressure trends in this population were related to habitual dietary electrolyte intake.

High altitude and exercise affect the blood pressure in a positive manner. According to Finnerty (15) there are some differences in susceptibility to high blood pressure according to where the people live. In Peru, investigators found that people living high in the

Andes have much lower blood pressures than their countrymen living at sea level, and when those who have high blood pressure living at sea level then move to higher altitude, their blood pressures gradually fall over several years.

Leaf (72) visited places where people lived a long life, and interestingly he found them all in mountain areas: Vilcabamba in the Andes, Hunza in the Karakoram Range, and Abkhasia in the Caucusus. He reported very low blood pressure levels for these people even at their great ages (100 years of age). He was convinced that the continuous and mandatory, if involuntary, exercise to which the mountain dwellers are subjected was a major factor in their longevity. He has studied the functions of the heart and lungs of these old people in detail and found that the conditioning effect of prolonged continuous exercise, made necessary by farming the steep hillsides, on the heart and lungs sustained the function of these vital organs into very old age.

A classic British study, conducted by Morris (73), compared the incidence of heart attacks and blood pressure among postal workers in London. Those who carried the mail bags and delivered the mail from door to door had a lower blood pressure and a lower incidence of heart disease than their sedentary colleagues working at desk jobs in the post office.

Another part of the same study compared the incidence of heart attacks among London bus drivers with that among an age matched group of conductors on the buses. The latter, who continually move up and down the double decker buses collecting the fares, suffered a lesser incidence and mortality from heart attacks than did the sedentary drivers. The conductors were also found to have higher blood pressure and serum cholesterol levels.

One of the better experiments in this area was performed by Boyer and Kasch (74) who found that six months of participation in their San Diego State fitness program resulted in decreases of systolic pressure of almost 12 mm.Hg and 13 mm.Hg in diastolic values in 23 hypertensive men.

Cooper (4) reported that many patients with high blood pressure have responded well to aerobic therapy. Among his patients at Wilford Hall, he pointed out a 45 year old Lieutenant Colonel. When he joined the Cooper's aerobic therapy program he had a blood pressure of 180/118 mm.Hg. In two years he lost 30 pounds on the aerobic program and his blood pressure dropped to 132/80 mm.Hg.

According to Pollock (75) the need to support an elevated blood pressure or a faster than optimal heart rate requires more heart power and therefore, greater fuel supplies for a specific task. Hence, in reducing heart rate and blood pressure, physical training insures that greater reserves are available in case of an accident or heart damage.

Obesity aggravates hypertension, but the exact relationship is unknown. According to Shank (64) as weight increases so do the prevalence and incidence of hypertension. The greater the weight gain, the greater the rise in blood pressure. Data also indicated that when people with high blood pressure lose weight blood pressure generally decreases, as was the case with Cooper's patient who lost 30 pounds during the aerobic exercise program.

According to Kaplan (76) even more impressive are the reports correlating body weight and increasing obesity with the presence and development of hypertension in children. Obesity appears to be the major marker for the susceptibility to hypertension in the young. The mechanism is unknown, with excessive sodium intake and expansion of body fluid volume being a possibility.

Dahl (77) found a positive correlation between salt and hypertension. The highest intake of salt was found in Northern Japan (38 grams per day) where about 38 percent of the population was hypertensive. In contrast, Alaskan Natives rarely add salt to food (4 grams per day), and they rarely have hypertension.

Shank (64) reviewed studies that ranked individuals according to reported salt intake or by the amount of sodium excreted in the urine. Findings from these studies indicate that elevated blood pressure levels are more prevalent among those who have high salt intakes. In addition, prolonged feeding of diets high in salt to experimental animals does induce hypertension. While Shank stated that no direct evidence indicates that moderate salt intake increases blood pressure in humans, he does support the theory proposed by Meneely and Battarbee (78). They postulated that the effects of excessive dietary sodium on blood pressure were determined by genetic predisposition and enhanced by low levels of potassium consumption, which was typical of the current American diet pattern.

People exposed to repeated psychogenic stresses may also develop hypertension more frequently than otherwise similar people not so stressed. According to Cobb and Rose (79) air traffic controllers, who work under tremendous psychological stress, annually develop hypertension at a rate 5.6 times greater than do nonprofessional pilots who were initially comparable in physical characteristics.

Cassel (80) reported that in at least 22 instances, populations living in small, cohesive, protected societies have been found to have low blood pressures which do not rise with aging. Those who abandon such an environment and migrate to more urbanized, modern, disorganized societies have high blood pressures which rise with aging. Obviously, other environmental factors may be responsible, but in some of these groups, the association between hypertension and social disorganization seems strong.

## Cholesterol, High Density Lipoproteins Glucose and Hemoglobin

Among the many variables thought to be associated with an increased incidence of degenerative conditions of the cardiovascular system are age, certain physical attributes (especially overweight), elevated serum cholesterol, and elevated blood glucose.

Total cholesterol is one of the important high risk factors associated with the development of coronary heart disease. However, according to Cooper (81) one cannot rely strictly upon the total cholesterol as the optimum indicator of one's susceptibility to coronary artery disease. Kannel (82) stated that in addition to the concentration of total cholesterol the manner in which the cholesterol is distributed or transported in the blood is associated with a high risk of development of coronary artery disease. Recent epidemiologic investigations indicated that high levels of high density lipoprotein (HDL) cholesterol act as a protective factor against coronary artery disease and, conversely, that persons with subnormal levels of HDL cholesterol have a significantly increased risk of having arteriosclerosis.

Recently, the inverse relation of HDL cholesterol to the development of coronary artery disease was emphasized by data from the Framingham study.

Even more recently, research has been done which indicated that the ratio between total cholesterol (TC) and HDL cholesterol may be more important as a coronary heart disease risk indicator than the TC alone according to Cooper (83). He indicated that a TC/HDL ratio above six is probably the best indicator of progressive and/or severe arteriosclerosis.

It was reported in Health, United States (84) that studies linking diet and coronary heart disease (CHD) include observations in populations, in small groups, and in individuals as well as animals. The link between diet, particularly fat, and CHD has been described by some scientists in the following way. Diets high in saturated fat and/or cholesterol raise an individual's blood lipid levels (hyperlipidemia), particularly the serum cholesterol level (hypercholesterolemia). Elevated blood lipids induce atherosclerosis, and individuals with atheroclerosis are highly susceptible to CHD.

In a review of studies on individuals eating controlled diets on a metabolic ward, Glueck and Connor (85) found substantial evidence to indicate that as the amount of dietary cholesterol increases, there is a consistent increase in the level of serum cholesterol.

According to Latner (86) racial differences in serum cholesterol concentration, which are considerable, have been attributed to differences in dietary fat. The values tend to be low in Orientals (100 to 140 mg/100 ml.) and in African Natives (140 to 180 mg.), whose diets contain relatively little animal fat (i.e., saturated) and relatively more vegetable fat.

Zohman (87) reported that the risk of heart attack is highest among middle aged and older men and is equally significant among post-menopausal women, although not younger women. Certainly, the atherosclerotic process begins in young people, possibly even in childhood. Many American soldiers in their early 20's who were killed during the Korean War were found to have had the disease. Interestingly, most of the young Koreans who were killed did not. Since the Korean people eat a diet which is low in saturated fats, they did not have atherosclerosis. The saturated fats tend to elevate blood lipids in contrast to polyunsaturated fats which actually tend to lower them.

Nelson (88) reported a study done on 129 vegetarian Buddhist monks and nuns. Their serum lipids were compared with those of U.S. Army personnel whose diets were certainly diverse. The Buddhist had 122 mg/100 ml of total cholesterol. The army officers had 231 mg/100 ml cholesterol. The incidence of coronary heart disease was reported to be very low in such a Buddhist population.

The data on total serum cholesterol of the U.S. population was reported in Vital and Health Statistics (89). The results showed that mean serum cholesterol levels for White men were consistently higher than those for Black men in age groups 18-24, 35-44, and 45-54 years. The same direction was not evident at ages 25-34 and 55 years and over, when Black men had higher mean serum cholesterol levels than the White men had. The differences in mean levels were not large enough to be significant.

Mean serum cholesterol levels for White and Black men generally increased with age. Mean levels for White men increased rapidly to age group 35-44 and then continued upward at a slower rate of increase, reaching a peak of 239.9 mg/100 ml at ages 45-64, thereafter they declined slightly. Mean levels for Black men also increased with age but at a slower rate. They were slightly higher at the older ages and peaked at a later age (55-64) than those for White men did. A slight decline in mean level occurred for ages 65-74 years.

The mean serum cholesterol levels showed no consistent pattern as income increased within each of the six age groups. Generally, the highest cholesterol levels were found at the highest income group for White males over age 35; however, the differences in these means at other income levels were not statistically significant. The mean serum cholesterol levels for Black males ages 18-74 years showed no significant change as income levels increased.

As educational level increased from less than 9 years to 13 years or more, the mean serum cholesterol level of White males aged 18-74 years decreased significantly from 219.9 to 208 mg/100 ml. Black males aged 18-74 years showed a significant decrease in mean level from 217.4 at less than nine years of education to 196.7 mg/100 ml at 12 years of education and increased to 210.6 mg/100 ml at 13 years or more of education.

A study done by Castelli and associates (90) showed that White men in Framingham and Albany and Japanese men in Honolulu all had about the same average serum cholesterol levels. For men 50-59 years of age serum cholesterol means ranged from 216.5 to 219.4 mg/100 ml. In all age groups, Japanese men in California had slightly but consistently higher average levels of serum cholesterol than their contemporaries at Framingham, Albany, and Honolulu; whereas, average cholesterol levels for men in Evans County were generally lower. The lowest cholesterol levels found were those for men in Puerto Rico, from an average of 191.4 mg/100 ml at age 50-59 to 180.8 mg/100 ml at age 70 and over. The reported HDL cholesterol levels were approximately the same for Framingham men as for Japanese men in Honolulu or San Francisco, Averaging 44-45 mg/100 ml at age 50-59, while HDL levels for men in Albany and Evans County reportedly were higher.

Serum cholesterol and triglyceride levels were evaluated by Ricci and associates (91) in males aged 20-59 in Northern, Central, and Southern Italy to relate dietary habits to the incidence of atherosclerosis. A statistically significant difference of mean serum cholesterol and triglyceride levels were observed for most age groups in the three different areas with lower values being found in the Southern population as compared to the Central and Northern ones. These findings supported the thought that large differences in blood lipid levels may still exist even within the same county and that they may be culturally determined in connection with different dietary habits.

Abdullah and Karimi (92) studied 150 normal, newly enrolled African army recruits aged between 18 and 24 years. They found a mean cholesterol level of 184 $\pm$ 18.7 mg/100 ml with a range of 100-250 mg/100 ml. According to the authors these figures were low compared with those obtained in industrialized countries in Europe and North America. This may be related to dietary and environmental factors.

Ononogbu (93) measured serum and high density lipoprotein cholesterol concentrations in 210 men and women in a London community and in a Nsukka community. Mean serum cholesterol concentrations were higher in London than in Nsukka. High density lipoprotein cholesterol was, however, higher in Nsukka than in London. The differences found were statistically significant in both serum cholesterol and high density lipoproteins.

Knuiman, Hermus and Hautvast (94) studied the serum cholesterol and HDL cholesterol concentration in boys from 16 countries. The results showed that the mean concentrations of total cholesterol (TC) in the three West African countries (Ghana, Ivory Coast and Nigeria) were low, the lowest being observed in the rural Nigerian boys. The values from Pakistan were also quite low. The TC concentrations in the rural groups were significantly lower than those in the corresponding urban groups in Ghana, Nigeria, and Pakistan. Intermediate values were observed in the Philippines, Greece, Portugal and Hungary. Higher TC concentrations were found in the boys in the remaining European countries and the United States. In this group of countries, a comparison of the values from countries where data from both rural and urban environments was available (Ireland, the Netherlands, Sweden and Finland) showed that the mean TC concentration in boys from the rural areas was significantly higher than the value found in boys from the urban areas.

HDL cholesterol concentrations also varied over a wide range. Generally, the mean serum HDL cholesterol concentrations showed a distribution similar to that observed for the TC concentrations with relatively low values in the developing and the less developed countries (in West Africa, Asia, Greece and Portugal), and higher values in the developed countries (U.S.A. and the remaining European countries). As with TC, in Ghana, Nigeria and Pakistan, the means of the HDL cholesterol concentrations were significantly lower in the boys from the rural areas compared with those from the urban areas. The HDL cholesterol concentrations in rural boys from the developed countries tended to be higher than those from the urban areas, but the differences were not significant. The HDL cholesterol/total cholesterol ratio in the Asian boys was found to be much lower than in all the other groups studied.

The authors concluded that lower total and HDL cholesterol levels in the rural regions of some developing countries (Ghana, Nigeria and Pakistan) possibly reflect a lower total food consumption in the rural boys from the countries concerned, or a lower intake of a specific food component such as saturated fats. It is interesting that in some European countries (Finland, Ireland, the Netherlands, and Sweden), the reverse could be observed: lower total and HDL cholesterol levels in the urban regions. The differences between urban and rural regions possibly result from differences in socioeconomic conditions leading to differences in food consumption. Thus, it would appear that when the total cholesterol concentration is high as a result of the diet consumed, the HDL cholesterol concentration also tends to be high. This effect of diet on HDL cholesterol is probably more clear between populations than within populations because the differences in diets are probably greater between populations than within populations. Other possible determinants of the HDL cholesterol concentration - e.g., the amount of alcohol consumed and physical activity - may further obscure the effect of diet on HDL cholesterol within populations.

Morrison and associates (95) studied 627 Black adults, aged 20 to 59 years, and compared them with 2,493 White adults, aged 20 to 59 years. The results showed that Black men had total cholesterol (TC) that was comparable with those in Whites, but TC levels were higher in Black than White women. Black men had lower levels of plasma triglycerides, higher HDL cholesterol levels, and lower LDL cholesterol levels than White men. Black women not taking exogenous sex steroid hormones had higher total cholesterol and HDL cholesterol levels, and lower triglyceride and LDL cholesterol levels than White women not taking exogenous sex steroid hormones. Black women taking exogenous sex steroid hormones had lower plasma cholesterol and triglyceride levels and slightly higher HDL cholesterol and lower LDL cholesterol levels than White women taking exogenous sex steroid hormones. These differences not only require the use of race specific lipoprotein distribution tables for characterization of individual subjects, but are consistent with putatively reduced risk for coronary heart disease in Blacks when compared with Whites.

Ueshima and associates (96) surveyed high density lipoprotein levels of six Japanese population groups with different lifestyles (1,804 men and 1,561 women). They found that the HDL cholesterol levels of Japanese men aged 40 to 69 years were approximately 55 mg/100 ml, or about 10 mg/100 ml higher than those of American men. The mean HDL cholesterol in U.S. men aged 40 to 59 years is about 45 mg/100 ml, but Japanese men had lower levels of total cholesterol. Also, the HDL cholesterol: TC ratio of .28 to .30 was higher for the Japanese men than for U. S. men.

These higher levels of HDL cholesterol and lower levels of TC in Japan were consistent with a lower mortality rate from coronary heart disease. Other, as yet unidentified, factors could also provide an explanation of the lower coronary heart disease mortality rate in Japan.

McMurry and associates (97) studied eight Tarahumara Indian men who participated in a metabolic study to measure the responsiveness of their plasma cholesterol levels to dietary cholesterol. They were fed isocaloric cholesterol free and high cholesterol diets containing 20 percent fat, 15 percent protein, and 65 percent carbohydrate calories. On admission to the study, the Tarahumaras had a low mean plasma cholesterol concentration (120 mg/100 ml), reflecting their habitual low cholesterol diet. After three weeks of a cholesterol free diet their cholesterol levels were 113 mg/100 ml. The men were then fed a high cholesterol diet (1000 mg/day) which increased the mean total plasma cholesterol to 147 mg/100 ml and also increased the low density lipoprotein cholesterol concentration. Tarahumaras, habituated to a low cholesterol diet after weaning, had the typical hypercholesterolemic response to a high cholesterol diet that has been previously observed in subjects whose lifelong diet was high in cholesterol content.

One of the most beneficial effects of exercise may be its effect on the concentration of lipids in the blood. According to Adner and Castelli (98) numerous reports of population studies from many countries strongly suggest that there is an inverse relationship between the amount of physical activity performed and the incidence of coronary artery disease. Their prospective long term study of 50 distance runners and 43 controls indicated that the runners had significantly lower pulse rates and relative weights and elevated high density lipoprotein (HDL) cholesterol levels. There was no difference in the systolic and diastolic blood pressures or triglyceride, total cholesterol, and low density lipoprotein cholesterol levels. Relative weight and triglyceride levels did not appear to be causal factors in producing HDL elevation. It is possible that in some way distance running results in HDL cholesterol elevation. If the inverse correlation between HDL cholesterol concentration and development of coronary artery disease is correct, then distance runners should have a lower risk of developing coronary artery disease than nonrunners.

Cooper (22) has published findings that claim a possible 35 percent increase in HDL levels as a result of running up to 11 miles per week. Cooper also compared fitness levels with TC/HDL ratios and found that there was a direct correlation between fitness and the TC/HDL ratio even though the relationship with TC was not consistent. The results showed that the greater the level of fitness, the higher the HDL cholesterol.

Hartung, Squires and Gotta (99) studied the effects of chronic exercise training on HDL cholesterol in 18 male coronary patients. Exercise consisted of aerobic activities utilizing approximately 70 percent of maximal oxygen uptake for 20 to 40 minutes, three times weekly for three months. Significant increase in maximal oxygen uptake, HDL cholesterol, HDL cholesterol/total cholesterol, and a decrease in a percent body fat were documented after training. No significant changes were found in total cholesterol, triglyceride, body weight, or low density lipoprotein cholesterol. They concluded that vigorous physical training can contribute to increases in HDL cholesterol in patients with coronary disease without changes in total cholesterol or body weight.

To assess the relationship between altitude, LDL, and HDL cholesterol levels, deMendoza and associates (100) studied Venezuelan Mestizos living at 1,000 and 3,500 meter elevations. The two groups did not differ in regard to height, weight, ethnic origin, social or economic status, nutritional patterns, age, or occupation. Both groups had a high level of daily physical exertion, an imperative in their subsistence rural agricultural economy. Due to the mountainous terrain, high altitude residents were thought to have increased levels of physical activity. The results showed that males and females at high altitude had significantly lower plasma total cholesterol and low density lipoprotein cholesterol levels, and slightly lower high density lipoprotein cholesterol levels than those at low altitudes. It was speculated that reduced coronary heart disease event rates at high altitude might be related to lower levels of the low density lipoproteins.

WHO study (101) reported that poor control of diabetes is a major factor in the development of vascular complications. More intriguing were the findings concerning coronary heart disease. Fasting plasma glucose levels were positively correlated with serum cholesterol levels and even more strongly with serum triglyceride levels. These two values, in turn, were positively correlated with coronary heart disease (the strongest association being observed in diabetics not using insulin). But surprisingly, fasting plasma glucose levels showed only a weak correlation with coronary heart disease.

However, coronary heart disease (CHD) mortality was approximately doubled for subjects with impaired glucose tolerance (IGT), defined as a blood sugar above the 95th centile ($\geqslant$96 mg/100 ml) in the Whitehall study (102). The study examined 18,403 male civil servants aged 40-64 years of age. Seven and one-half years' CHD mortality was examined in relation to blood sugar concentration two hours after a 50 gram oral glucose load. There was no trend of CHD mortality with blood sugar below the 95th centile.

In a review of studies of the relationship between nutrition and diabetes, West (103) stated that the degree and duration of adiposity (excess fat tissue) was the one factor most strongly and consistently associated with the prevalence of adult-onset diabetes. Some population studies have indicated that the rate of diabetes increases as the sugar intake in a population increases. However, increase in sugar intake is usually coupled with other factors such as decreased exercise and increased total calories and fat that lead to obesity. Thus, obesity may be the risk factor for diabetes rather than a specific diet component such as sugar. Evidence from animal studies also supports obesity as the major risk factor. West reviewed a number of studies in which different diet components (e.g., sugar, protein, or fat) were used to induce diabetes in susceptible laboratory animals. Based on these studies, he concluded that obesity rather than any specific diet component induced the diabetes.

According to Searcy (28) certain aspects of carbohydrate metabolism are altered at high altitudes. Residents at an elevation of 14,900 feet, for example, exhibit lower serum glucose concentrations and reduced tolerance curves than people living at sea level. Although the hypoglycemic tendency is poorly understood, it probably reflects an increase in glucose utilization. He also stated that exposure to cold is apt to produce a modest increase in serum glucose levels since chilling may promote glycogenolysis. Hyperglycemia has also been associated with torrid climates. When individuals living in such areas are moved to cooler zones, the hyperglycemia subsides.

Johansen and Munck (104) studied maximal oxygen uptake, glucose tolerance and insulin response in 17 young, nonobese, nondiabetic males. The study showed that the ratio between glucose tolerance and insulin response correlated significantly with maximal oxygen uptake. Subjects with a high maximal oxygen uptake thus maintained a given glucose tolerance with a lower insulin response than did subjects in whom maximal oxygen uptake was low.

According to Richter and Ruderman (105) physical training improves glucose tolerance in some noninsulin dependent diabetic subjects and in insulin dependent patients and may diminish insulin requirements. It may also have a role in retarding the development of cardiovascular complications. However, physical training is not totally innocuous and in many patients with diabetes special precautions are required.

The data reported in Vital and Health Statistics (106) showed that there was, apparently, a slight but statistically significant difference in blood glucose levels between White and Negro men in the United States. When looking at racial differences in the South, where the proportion of Negro to White persons is highest, there was a difference in the same direction for both men and women (higher in Negro), but it was not statistically significant.

Measurements of hemoglobin has routinely been used in screening for anemia. It has recently been shown by Garn and associates (26) that ethnic differences exist in hemoglobin values, such that Black Americans have been found to have normal hemoglobin levels lower than White Americans. Similar findings were also reported in Vital and Health Statistics (107). The data showed that for all ages, Black males had lower mean hemoglobin levels than White males, and mean hemoglobin levels for Black females were consistently lower than those for White females at all ages.

According to WHO (108) low hemoglobin readings may reflect parasitic infections rather than a deficiency of minerals, vitamins, and first quality protein, also an elevated rate of anemia has been observed in less developed countries and in lower social classes of developed countries.

Palgi (109) reported that hemoglobin levels of Asian Jewish women both while pregnant and nonpregnant were lower than in their European counterparts by about .23 g/100 ml to .3 g/100 ml. The groups had similar parity numbers, but the Asian women's socioeconomic status was lower.

According to Slonim (110) ascent to high altitude is associated with a prompt, slight rise of hematocrit, hemoglobin concentration, and erythrocyte count. Increased red blood cell production (erythropoiesis) in the bone marrow is stimulated by the hormone erythropoietin, which increases during hypoxia. The resulting polycythemia develops over a period of weeks to months. This polycythemia is marked in young people, is less pronounced among the middle aged, and may be completely absent in the aged. The erythropoiesis stimulating hormone, erythropoietin, is governed by partial pressure of oxygen ($PO_2$). The polycythemia of altitude acclimatization and the anemia of chronic hypoxia are illustrative examples of this fact.

There is considerable evidence to demonstrate that severe iron deficiency anemia impairs maximal work capacity in humans. According to Astrand (3) there is a high correlation not only between heart volume and maximal oxygen uptake in persons of a certain age, but also between blood volume or total hemoglobin and maximal oxygen uptake.

Vellar and Hermansen (111) found a significant correlation between hemoglobin concentration and maximal oxygen consumption. Donoso (49) also established a positive correlation between the hemoglobin level and the aerobic power of 96 poorly nourished foundry workers in Santiago, Chile. A recent study done by Gardner and associates (112) showed similar results that even a small reduction in hemoglobin level may result in a decreased performance during maximal or near maximal exercise.

## Summary

Physical fitness was defined as the capability of the heart, blood vessels, lungs, and muscles to function at optimal efficiency. Physical fitness has two components to it: 1) motor fitness, and 2) cardiovascular fitness. This study is more concerned with the components of cardiovascular fitness rather than motor fitness. The components are aerobic capacity, respiratory function, blood pressure, and blood chemistry.

Aerobic capacity was discussed in terms of maximal oxygen consumption which is the largest amount of oxygen one can consume per minute.

Studies reported that a nutritionally adequate diet and exercise were the major contributing factors to the level of aerobic capacity. In addition, it is also influenced by other factors such as genetic variables, race, and altitude.

It was shown that obese individuals and people who are nutritionally deprived have less aerobic capacity than the people who have nutritionally sound diets.

The aerobic capacity differences were reported between the races and nationalities, but most of these differences were found or thought to be the result of the more active way of life of the race or nation. However, some studies showed that different ethnic groups living side by side, sharing the same lifestyle and diet habits, also had different aerobic capacities. This was believed to be set by racial or genetic differences which was supported by twin studies. It was concluded that training can improve aerobic capacity, but the ceiling is determined by genetic factors.

People who lived at high altitudes had increased aerobic capacity over those who lived at sea level or lower altitudes. This is possibly because of the active lifestyle at the high altitude or the genetic adaptations at the tissue level.

The function of the lungs are influenced by age, sex, body size, and high level of physical activity during childhood or athletics. The other important factors are race, smoking, air pollution and altitude.

High level of activity during childhood, altitude and athletics increase the vital capacity and forced vital capacity. But smoking and exposure to air pollution cause a decrease in airway conductance and decrease in the respiratory function. Increased respiratory of athletes is usually the result of strength gain of respiratory muscles.

It was speculated that genetic differences between populations may be demonstrated more readily in static measurements such as vital capacity rather than in dynamic data such as aerobic capacity. Respiratory function differences in populations may reflect their body size, daily physical activity, or advanced restrictive lung disease.

Studies show that the Europeans have higher vital capacity than the Africans, Indians and Chinese, presumably because of a wider and taller chest, and greater muscular strength. However, it was found that Black soldiers have lower vital capacity and forced vital capacity than White soldiers in the United States. This is also applicable to the general population, and it is the result of racial differences rather than body size or strength.

High blood pressure is a risk factor for coronary heart diseases. Blood pressure varies among different races and ethnic groups, but no race has been found genetically resistant to its development. Researchers are convinced that both heredity and environment have an influence on blood pressure. Blood pressure is reported lower among various primitive people than among Americans and Europeans. They are physically active people who show little or no tendency to gain weight as they age.

Darker skin color corresponds to higher blood pressure among Black Americans; however, among White Americans, the darker the skin color, the lower the blood pressure. Blacks, in general, have higher blood pressure than Whites in the United States and blood pressure increases more rapidly among Blacks with age than among Whites. But, the studies showed that Black children and adults before 30 years of age had the same level of blood pressure as Whites. It was found that American Indians have lower blood pressure than both the Black and White Americans, and blood pressure did not show an increase with age among the Indians.

Other important factors that affect blood pressure are salt intake, stress, altitude and exercise. Salt intake and stress affect the blood pressure in a negative manner, but high altitude and exercise have a positive affect on blood pressure. Studies showed that people living in high altitudes have much lower blood pressures than the people living at sea level. Blood pressure levels were also lower in more active people than they were in sedentary people, and studies showed that exercise programs lower the blood pressure levels of hypertensive individuals.

High level of cholesterol is a risk factor for development of coronary heart diseases (CHD), however, high levels of high density lipoprotein (HDL) consistently correlated with a lower incidence of CHD. Studies indicated that the ratio between TC and HDL was more important as a CHD risk indicator than the TC or HDL alone.

High blood fat level, physical inactivity, and sedentary lifestyle tend to increase the TC levels, whereas, exercise decreases the TC/HDL ratio by raising the HDL level.

In civilized communities, average TC values are much higher than most primitive groups, and readings seem to rise even further with access to a particularly rich diet. Thus, the different TC and HDL levels seem to be related to nutrition, environment and racial factors.

Racial differences in TC concentration have been attributed to differences in dietary fat. The values tend to be low in Oriental and in African Natives, their diets containing relatively little animal fat and more vegetable fat. Black Americans also have a slightly lower TC level than White Americans, but the difference is not large enough to be statistically significant.

Recent studies have shown that runners possess a characteristic blood lipoprotein pattern that is now known to be strongly associated with lower risk of developing heart disease and heart attack.

Increased blood glucose level is associated with obesity meaning that nutrition and diabetes are closely related. Studies showed that there was high CHD risk with increased glucose level, and the glucose tolerance was found to be increased by exercise. There is a slight blood glucose difference between Black and White Americans, but the difference is not significant.

Ethnic differences also exist in hemoglobin values, such that Black Americans have been found to have slightly lower hemoglobin levels than the White Americans. An elevated rate of anemia has been observed in less developed countries and in lower social classes of developed countries. However, the high altitude residents show increased level of hemoglobin in their blood.

# CHAPTER III

# METHODS AND PROCEDURES

The purpose of this study was to measure and compare the aerobic work capacity, respiratory functions, blood pressure, and blood chemistry of Oklahoma State University male students from Middle Eastern, and East and Southeast Asian countries with the United States population norms. It was also intended to compare the above physical fitness components between the foreign students that have been in the United States: a) less than a year, and b) longer than three years. This chapter outlines the methodology and procedures used for assessing aerobic capacity, respiratory function, blood pressure, and blood chemistry.

## Selection of Subjects

Eighty subjects were selected from the male foreign students between 20 to 30 years of age who were attending Oklahoma State University or the English Language Institute during the academic year of 1981-1982. The list of names, countries, phone numbers, and addresses of foreign students was obtained from the Registrar's Office. Forty subjects from the Middle East and 40 subjects from East and Southeast Asia were selected through stratified random sampling. Each group was stratified into three subgroups, and the number of subjects from each subgroup was randomly selected according to its total number of students. The subgroups were the students who have been in the U.S.: 1) less than a year, 2) two and three years, and 3) longer than three years.

There were a total of 620 students from the Middle East, between 20 to 30 years of age, attending Oklahoma State University or the English Language Institute. The following countries and number of subjects from the respective countries represented the Middle East.

TABLE I

MIDDLE EAST REPRESENTATION

| Country | Group 1 | Group 2 | Group 3 | Total |
|---|---|---|---|---|
| Iran | 1 | 9 | 5 | 15 |
| Iraq | - | 1 | 1 | 2 |
| Jordan | 1 | 4 | 1 | 6 |
| Kuwait | 1 | 1 | 1 | 3 |
| Lebanon | 1 | 3 | 2 | 6 |
| Saudi Arabia | 1 | 1 | 2 | 4 |
| Syria | 1 | 1 | 1 | 3 |
| Turkey | 1 | - | - | 1 |
| TOTAL | 7 | 20 | 13 | 40 |

There were a total of 262 students from East and Southeast Asia between 20 to 30 years of age, attending Oklahoma State University or the English Language Institute. The following countries and number of subjects from the respective countries represented East and Southeast Asia.

TABLE II

EAST AND SOUTHEAST ASIA REPRESENTATION

| Country | Group 1 | Group 2 | Group 3 | Total |
|---|---|---|---|---|
| China | - | 1 | 1 | 2 |
| Indonesia | 1 | 1 | 1 | 3 |
| Japan | 2 | 2 | 1 | 5 |
| Korea | 1 | 1 | 1 | 3 |
| Malaysia | 3 | 4 | 1 | 8 |
| Singapore | 1 | 1 | 1 | 3 |
| Taiwan | - | 5 | 3 | 8 |
| Thailand | 2 | 4 | 2 | 8 |
| TOTAL | 10 | 19 | 11 | 40 |

The mean and standard deviation values of physical fitness components for the American population of 20 to 30 years of age group were taken from previous population studies.

## General Procedures

After the selection of the subjects, they were contacted by phone to let them know that they had been chosen for a research study. The researcher explained the study that was to take place, its purpose and significance, and asked the subjects to participate in the study.

The evaluation of the subjects took place in the Physiology of Exercise Laboratory in the Colvin Center at Oklahoma State University.

The subjects were notified at least 24 hours ahead of the testing date and were asked to: 1) dress in shorts and tennis shoes, 2) eat only light meals, and 3) avoid strenuous physical activity on the test day. They were also advised not to eat at all for at least two hours preceding the tests.

The evaluation of the subjects was done by the researcher and his colleague who was also doing a study using the same subjects. The sequence of the evaluation was: 1) resting blood pressure, 2) respiratory function, and 3) measurement of aerobic work capacity (stress test on a treadmill). The blood chemistry analysis was done at another time in the morning since it requires subjects to fast about 12 hours preceding the collection of blood samples. This blood chemistry test was done by the physical fitness laboratory technician at Oklahoma State University.

## Personal Data

Upon arrival at the Physiology of Exercise Laboratory, each subject was interviewed personally and a pre-evaluation form was filled out (see Appendix B), including the following information: name, age, smoking habit, drinking and exercise habits, personal and family medical history in terms of heart disease and diabetes, and present medication or medical conditions. In addition to the pre-evaluation form, the information about diet habits and socioeconomic classes of the subjects were also recorded.

## Measurement of Blood Pressure

Blood pressure was measured in millimeters of mercury (mm.Hg) with either a mercury or anaeroid sphygmomanometer. The technique used in this research is called indirect since it involved wrapping a pressure cuff around the arm rather than measuring the pressure directly, which would involve the insertion of a pressure tranducer into the artery.

Equipment

1. Sphygmomanometer
2. Stethoscope

Testing Procedure

Resting blood pressure was measured while the subject was in a sitting position. The subject was seated comfortably with the left arm slightly flexed and the forearm supported at the heart level.

1. The deflated cuff was wrapped around the left arm with its lower edge about one inch above the elbow. The mercury manometer was placed in front of the researcher at the eye level.

2. Stethoscope diaphram was placed just below the crease of the elbow over the brachial artery (at the center of the forearm when held with the palm up).

3. With the stethoscope in place (bulb was in a closed, screwed down position), the cuff was inflated quickly by squeezing the rubber bulb rapidly and tightly. The pressure was raised approximately 30 mm.Hg above the point at which the radial pulse disappeared.

4. Then, the pressure was released by barely opening the screw at the base of the rubber bulb at a rate of two to three mm.Hg per second.

5. As the pressure fell, the researcher listened for the first thumping sound through the stethoscope. When the first sound appeared, the manometer was read and this reading was recorded as a systolic pressure.

6. Researcher continued to deflate the cuff slowly. When the thudding sounds became sharply muffled or completely disappeared he took another reading, and this reading was recorded as a diastolic pressure.

When all the sounds disappeared, the cuff was deflated rapidly and completely. The second reading was taken after a two minute wait. The researcher took two readings. If the readings were not the same, he took a third reading. If the third reading was fairly close to one of the first two, the average of the two closer readings was recorded.

## Respiratory Function Test

A Vitalograph Spirometer was used to test the respiratory function of the subjects. The instrument was turned on and calibrated at 5.45 for the BTPS (body temperature, air pressure, and saturation with water).

### Testing Procedure

A simple explanation of the procedure was given to the subject with the emphasis placed on the maximum effort. The researcher then demonstrated the breathing maneuver of the test.

The subject was told to stand in front of the instrument and take the breathing tube in one hand. After placing a nose clip on the subject's nose, he was asked to take a maximal inhalation while being continually exhorted, persisting almost until he felt he could burst. He was then told to close his lips around the mouthpiece ensuring that no leak of air occurred, and exhale into the machine. When a static vital capacity was being measured, time was of no importance, and the subject was urged to breathe out and out and out, until he could no longer go on. When a forced vital capacity or forced expiratory volume measurement was being made, the record/return button on the machine was depressed before the start of the expiration. The latter triggered the carrier to move. In this instance, the subject was asked to breathe out as quickly as possible and as much as possible. By unlatching the record/return button, the chart carrier automatically returned to its start position and was ready for the next test. The researcher then pushed the print button to obtain the computer printout of respiratory function test results.

The test was repeated three times, and the best of the three was accepted as the results.

## Measurement of Aerobic Work Capacity

The aerobic work capacity was evaluated in terms of maximal oxygen consumption ($VO_2$max.), which is the most important measure of physical fitness. $VO_2$max. was predicted from a treadmill test.

The Balke treadmill test (protocol) was used in this study. It is probably the most widely accepted test being used today in medical and physiology laboratories as a test of functional work capacity and is highly valid in predicting maximal oxygen consumption.

The number of minutes that the subject walked on the treadmill before reaching the cut off point was an indication of his aerobic work capacity or maximal oxygen consumption capacity. The predicted maximal oxygen consumption in ml/kg/min was determined from the Balke's regression chart which is shown on the treadmill results form (See Appendix B). Then, the physical fitness level of the subject was determined from the Cooper's fitness classification table for men (See Appendix B) according to the subject's predicted maximal oxygen consumption.

## Equipment

1. Treadmill
2. Heart Rate Meter
3. Sphygmomanometer and a stethoscope
4. Clock with a second hand

## Termination of Treadmill Test

The following factors were considered as the end point criteria for the treadmill stress test.

1. The subject would not be tested if he had 160/120 mmHg or higher resting blood pressure readings.

2. The subject would not be tested if he had any type of resting EKG (electrocardiogram) abnormalities, such as ST segment depression, or any type of arrythmias of the heart.

3. Heart rate of 180 beats per minute was chosen as an end point criterion. The test was stopped when the heart rate reached 180 beats per minute.

4. The subject could stop the test at any time he felt that he had reached his maximal work load or exhaustion point.

5. The test would be stopped if any of the following signs and symptoms occurred:

    a. Dizziness and/or unsteady gate
    b. Angina (chest pain)
    c. Nausea
    d. Unusual or severe fatigue

e. Lack of rapid erythematous return of skin color after brief firm compression

f. Loss of sustained vigor of palpable pulse.

6. The test would be stopped if the blood pressure responded in the following manner during exercise:

a. Systolic blood pressure failed to rise with increasing exercise intensities. Leveling off in three readings.

b. Systolic blood pressure showed a drop of 5 mmHg or more.

c. Systolic blood pressure increased up to or above 240 mmHg.

d. Diastolic blood pressure increased more than 22 mmHg, or above 120 mmHg.

7. The test would be stopped if the respiratory system responded with marked dyspnea, or heavy breathing. When subject starts puffing, he is approaching the end point.

8. The test would be stopped if the equipment malfunctioned.

## Testing Procedure

Resting blood pressure, heart rate, and EKG were recorded before the test. The heart rate electrodes were placed on the subject's body, and the cable was attached to the heart rate meter to monitor the heart rate during the exercise. Three electrodes were placed on the subject, one three to four inches below and to the left of the left nipple, one two to three inches below the sternum, and the other one three to four inches below and to the right of the right nipple. The exercise blood pressure cuff and stethoscope were also placed on the subject's arm at respective places.

The subject was given instructions about the whole test including how to get on and off the treadmill. The subject got on the treadmill at about two miles per hour (mph) speed and zero percent grade. He walked at this two mph speed until he felt comfortable, and then he warmed up to about five minutes at three mph speed and zero percent grade.

The testing started at 3.4 mph speed and zero percent grade. The speed of the treadmill remained constant throughout the test. The incline of the treadmill was elevated two percent at the end of the first minute and an additional one percent each minute thereafter until the end of the test.

Heart rate was recorded at the end of each minute, and blood pressure was recorded every three to five minutes throughout the test. Each subject walked to voluntary maximum or until other symptoms indicated stopping the test. During the last minute of the walk, heart rate and blood pressure were recorded.

After the completion of the test, the speed of the treadmill was decreased to two mph, and the elevation was decreased to zero percent grade. The subject walked at this speed and percent grade for two minutes, and then sat on a chair for three minutes which added up to a total of five minutes recovery period. Heart rate and blood pressure were recorded at the end of the third and fifth minutes.

## Measurement of Blood Chemistry

Blood chemistry of the subjects were analyzed by an instrument called a Spectrophotometer. Blood was drawn from each subject in the morning from a vein following a 12 to 14 hour fast. Blood was analyzed for total cholesterol, high density lipoprotein, glucose and hemoglobin according to the methods distributed by Sigma Chemical Company.

## Statistical Analysis of Data

Multiple t-tests were used by the Oklahoma State University Computer Center to determine the differences on each physical fitness variable between the United States population, Middle Eastern, and East and Southeast Asian students.

An Analysis of Variance (ANOVA) was used to test for significance of differences on each physical fitness variable between the foreign students according to their length of stay in the United States, specifically those students who have been in the United States for less than one year, and those students who have been in the United States for more than three years. A t-test was also used to determine the differences on each fitness variable of foreign students in terms of smoking, drinking, exercise and various diet habits.

A .05 confidence level was selected to determine the significance of the differences.

The following selected physical fitness variables were analyzed at the Oklahoma State University Computer Center:

1. Maximum Oxygen Consumption ($VO_2max$)
2. Vital Capacity (VC)
3. Forced Vital Capacity (FVC)
4. Forced Expiratory Volume in One Second ($FEV_1$)
5. $FEV_1$/FVC
6. Maximum Voluntary Ventilation (MVV)

7. Systolic Blood Pressure
8. Diastolic Blood Pressure
9. Total Cholesterol (TC)
10. High Density Lipoproteins(HDL)
11. TC/HDL Ratio
12. Glucose
13. Hemoglobin

# CHAPTER IV

## RESULTS AND DISCUSSION

Forty foreign students participated in the aerobic work capacity, respiratory function and blood pressure measurements, and 31 of them participated in blood analysis from each area, Middle East, and East and Southeast Asia. A total of 13 physical fitness variables were recorded for the purpose of this study. Table III represents the means, standard deviations, and standard errors of the mean of the physical fitness variables of foreign students from Middle East and East and Southeast Asia, and the United States population.

Subjects from each area, Middle East and East and Southeast Asia, were divided into three groups according to how long they had been in the United States. Those students who had been in the United States less than one year were compared with those students who had been in the United States longer than three years. Tables IV and V show the means of the variables for the groups from each area.

The mean age of the participants from Middle East was 23.57 years; the mean values were 171.4 cm for height, 72.8 kg for weight and 13.2% for body fat. On the other hand, the participants from East and Southeast Asia had a mean age of 24.5 years. They were 2.6 cm shorter (mean was 168.8 cm); they weighed 10.3 kg less (mean was 62.5 kg); and they had 1.3 percent less body fat (mean was 11.9%) than the Middle Eastern participants (Table VI).

TABLE III

VALUES OF PHYSICAL FITNESS COMPONENTS OF MIDDLE EAST, EAST AND SOUTHEAST ASIA AND THE UNITED STATES

| Variables | Age | N | Mean | Standard Deviation | Std. Error of the Mean |
|---|---|---|---|---|---|
| | MIDDLE EAST | | | | |
| $VO_2$Max (ml·kg·min) | | 40 | 43.60 | 5.21 | .82 |
| VC (Liters | | 40 | 4.94 | .73 | .11 |
| FVC (Liters) | | 40 | 5.10 | .68 | .11 |
| $FEV_1$ (Liters) | | 40 | 4.33 | .62 | .10 |
| $FEV_1$/FVC (%) | | 40 | 85.00 | 6.59 | 1.04 |
| MVV (Liters/min) | | 40 | 162.40 | 23.50 | 3.70 |
| Systolic B.P. (mmHg) | | 40 | 120.40 | 6.03 | .95 |
| Diastolic B.P. (mmHg) | | 40 | 80.90 | 4.57 | .72 |
| TC (mg/100 ml) | | 31 | 173.70 | 39.70 | 7.13 |
| HDL (mg/100 ml) | | 31 | 43.20 | 10.70 | 1.93 |
| TC/HDL Ratio | | 31 | 4.18 | 1.05 | .19 |
| Glucose (mg/100 ml) | | 31 | 71.10 | 9.70 | 1.75 |
| Hemoglobin (g/100 ml) | | 31 | 16.30 | .92 | .17 |
| Age (years) | | 40 | 23.57 | | |
| Height (centimeters) | | 40 | 171.40 | | |
| Weight (kilograms) | | 40 | 72.80 | | |
| % Body Fat | | 40 | 13.20 | | |
| | EAST AND SOUTHEAST ASIA | | | | |
| $VO_2$Max (ml·kg·min) | | 40 | 41.80 | 4.28 | .68 |
| VC (Liters) | | 40 | 4.28 | 1.00 | .16 |
| FVC (Liters) | | 40 | 4.34 | 1.07 | .17 |
| $FEV_1$ (Liters) | | 40 | 3.74 | .90 | .14 |
| $FEV_1$/FVC (%) | | 40 | 87.00 | 9.20 | 1.46 |
| MVV (Liters/min) | | 40 | 140.40 | 33.70 | 5.33 |
| Systolic B.P. (mmHg) | | 40 | 118.70 | 7.46 | 1.18 |
| Diastolic B.P. (mmHg) | | 40 | 79.80 | 5.70 | .90 |
| TC (mg/100 ml) | | 31 | 160.20 | 37.50 | 6.73 |
| HDL (mg/100 ml) | | 31 | 41.80 | 10.40 | 1.86 |
| TC/HDL Ratio | | 31 | 3.99 | 1.12 | .20 |
| Glucose (mg/100 ml) | | 31 | 74.60 | 17.00 | 3.05 |
| Hemoglobin (g/100 ml) | | 31 | 16.30 | 1.13 | .20 |
| Age (years | | 40 | 24.25 | | |
| Height (centimeters) | | 40 | 168.80 | | |
| Weight (kilograms) | | 40 | 62.50 | | |
| % Body Fat | | 40 | 11.90 | | |

TABLE III (Continued)

| Variables | Age | N | Mean | Standard Deviation | Std. Error of the Mean |
|---|---|---|---|---|---|
| | | UNITED STATES | | | |
| $VO_2$Max (ml·kg·min)[1] | 20-29 | 371 | 40.00 | 6.40 | |
| VC (Liters)[2] | 20-29 | 115 | 4.82 | .62 | |
| FVC (Liters)[3] | 25-34 | 2,633 | 5.48 | .77 | |
| $FEV_1$ (Liters)[3] | 25-34 | 2,633 | 4.40 | .58 | |
| $FEV_1$/FVC (%)[3] | 25-34 | 2,633 | 80.70 | 5.90 | |
| MVV (Liters/min)[2] | 20-29 | 115 | 184.00 | 29.00 | |
| Systolic B.P. (mmHg)[4] | 20-29 | 63,030 | 128.50 | 14.50 | |
| Diastolic B.P. (mmHg)[4] | 20-29 | 63,030 | 77.90 | 10.00 | |
| TC (mg/100 ml)[5] | 20-24 | 118 | 162.20 | | 2.50 |
| HDL (mg/100 ml)[5] | 20-24 | 118 | 45.40 | | 1.00 |
| TC/HDL Ratio[5] | 20-24 | 118 | 3.57 | | |
| Glucose (mg/100 ml)[1] | 20-29 | 371 | 101.00 | 14.50 | |
| Hemoglobin (g/100 ml)[6] | 20-24 | 486 | 15.80 | 1.10 | |

[1]Cooper Clinic, Reported in Health and Fitness Through Physical Activity, Ed. Michael L. Pollock, J. H. Wilmore, and S.M. Fox. New York: John Wiles and Sons, 1978, pp. 266-7.

[2]Boren, Hollis G., R. C. Kory, and J. C. Syner. "The Veterans Administration-Army Cooperative Study of Pulmonary Function." American Journal of Medicine, July, (1966), 41:96-114.

[3] ________. "Basic Data on Spirometry in Adults 25-74 Years of Age" (Non-smoker, White males). Vital Health Statistics, Series 11, No. 222. United States 1971-75.

[4] Stamler, Jerimiah, R. Stamler, F. Riedlinger, G. Algera, and R. H. Roberts. "Hypertension Screening of One Million Americans - Community Hypertension Evaluation Clinic Program, 1973 Through 1975." JAMA, (May 24, 1976), 235:2299-2306.

[5] Heiss, Gerardo, I. Tamir, C. E. Davis, and H. A. Tyroler. "Lipoprotein Cholesterol Distribution in Selected North American Populations: The Lipid Research Clinics Program Prevalence Study." Circulation, (1980), 61(2):302-314.

[6] ________. "Hemoglobin and Selected Iron Related Findings of Persons 1-74 Years of Age: United States, 1971-1974." Vital and Health Statistics, (January 26, 1979), No. 46.

TABLE IV

MEANS OF THE PHYSICAL FITNESS VARIABLES OF FOREIGN STUDENTS FROM MIDDLE EAST

| Variables | Group 1 N | Group 1 Mean | Group 3 N | Group 3 Mean |
|---|---|---|---|---|
| $VO_2$Max (ml·kg·min) | 7 | 43.60 | 13 | 43.70 |
| VC (Liters) | 7 | 5.20 | 13 | 4.80 |
| FVC (Liters) | 7 | 5.40 | 13 | 4.94 |
| $FEV_1$ (Liters) | 7 | 4.71 | 13 | 4.15 |
| $FEV_1$/FVC (%) | 7 | 87.00 | 13 | 84.00 |
| MVV (Liters/min) | 7 | 176.90 | 13 | 155.50 |
| Systolic B.P. (mmHg) | 7 | 117.10 | 13 | 119.70 |
| Diastolic B.P. (mmHg) | 7 | 81.40 | 13 | 78.60 |
| TC (mg/100 ml) | 7 | 161.80 | 11 | 158.50 |
| HDL (mg/100 ml) | 7 | 37.30 | 11 | 44.20 |
| TC/HDL Ratio | 7 | 4.58 | 11 | 3.64 |
| Glucose (mg/100 ml) | 7 | 68.30 | 11 | 73.60 |
| Hemoglobin (g/100 ml) | 7 | 15.70 | 11 | 16.20 |

GROUP 1: Students who have been in the United States less than one year.

GROUP 3: Students who have been in the United States longer than three years.

TABLE V

MEANS OF THE PHYSICAL FITNESS VARIABLES OF FOREIGN STUDENTS FROM EAST AND SOUTHEAST ASIA

| Variables | Group 1 N | Group 1 Mean | Group 3 N | Group 3 Mean |
|---|---|---|---|---|
| $VO_2$Max (ml·kg·min) | 10 | 41.40 | 11 | 42.70 |
| VC (Liters) | 10 | 4.44 | 11 | 4.78 |
| FVC (Liters) | 10 | 4.57 | 11 | 4.83 |
| $FEV_1$ (Liters) | 10 | 3.98 | 11 | 3.99 |
| $FEV_1$/FVC (%) | 10 | 88.00 | 11 | 83.00 |
| MVV (Liters/min) | 10 | 149.40 | 11 | 149.80 |
| Systolic B.P. (mmHg) | 10 | 116.40 | 11 | 122.40 |
| Diastolic B.P. (mmHg) | 10 | 80.00 | 11 | 82.00 |
| TC (mg/100 ml) | 8 | 175.90 | 11 | 160.90 |
| HDL (mg/100 ml) | 8 | 42.30 | 11 | 41.10 |
| TC/HDL Ratio | 8 | 4.39 | 11 | 4.03 |
| Glucose (mg/100 ml) | 8 | 74.50 | 11 | 75.00 |
| Hemoglobin (g/100 ml) | 8 | 16.60 | 11 | 16.10 |

GROUP 1: Students who have been in the United States less than one year.

GROUP 3: Students who have been in the United States longer than three years.

TABLE VI

MEAN VALUES OF AGE, HEIGHT, WEIGHT, AND PERCENT BODY FAT FOR MIDDLE EASTERN, AND EAST AND SOUTHEAST ASIAN SUBJECTS

| Area | N | Age | Height (cm) | Weight (kg) | % Fat |
|---|---|---|---|---|---|
| Middle East | 40 | 23.57 | 171.4 | 72.8 | 13.2 |
| East and Southeast Asia | 40 | 24.25 | 168.8 | 62.5 | 11.9 |

## Aerobic Work Capacity

The maximum oxygen consumption ($VO_2max$) was measured on the treadmill and used as the aerobic work capacity of the individual or the group. The students from the Middle East had the highest mean of $VO_2max$ of the three areas with 43.6 ($\pm$ 5.21) ml·kg·min. The East and Southeast Asian students had the second highest $VO_2max$ mean of 41.8 ($\pm$ 4.28) ml·kg·min. The United States population had the lowest $VO_2max$ of the three groups with the mean score of 40 ($\pm$ 6.4) ml·kg·min. There were no significant differences between Middle East and East and Southeast Asia, or between East and Southeast Asia and the United States at the .05 confidence level. However, there was a significant difference between the Middle East and the United States at the .05 confidence level.

The $VO_2max$ difference between the students from the Middle East and East and Southeast Asia could be the result of the time spent for exercise. It was reported that the Middle Eastern students exercised more than the East and Southeast Asian students. Five percent of the

Middle Eastern students exercised five or more times per week as compared to 2.5 percent of the East and Southeast Asian students. Also, 12.5 percent of the Middle Eastern students exercised 3-4 times a week compared to 2.5 percent of the East and Southeast Asian students.

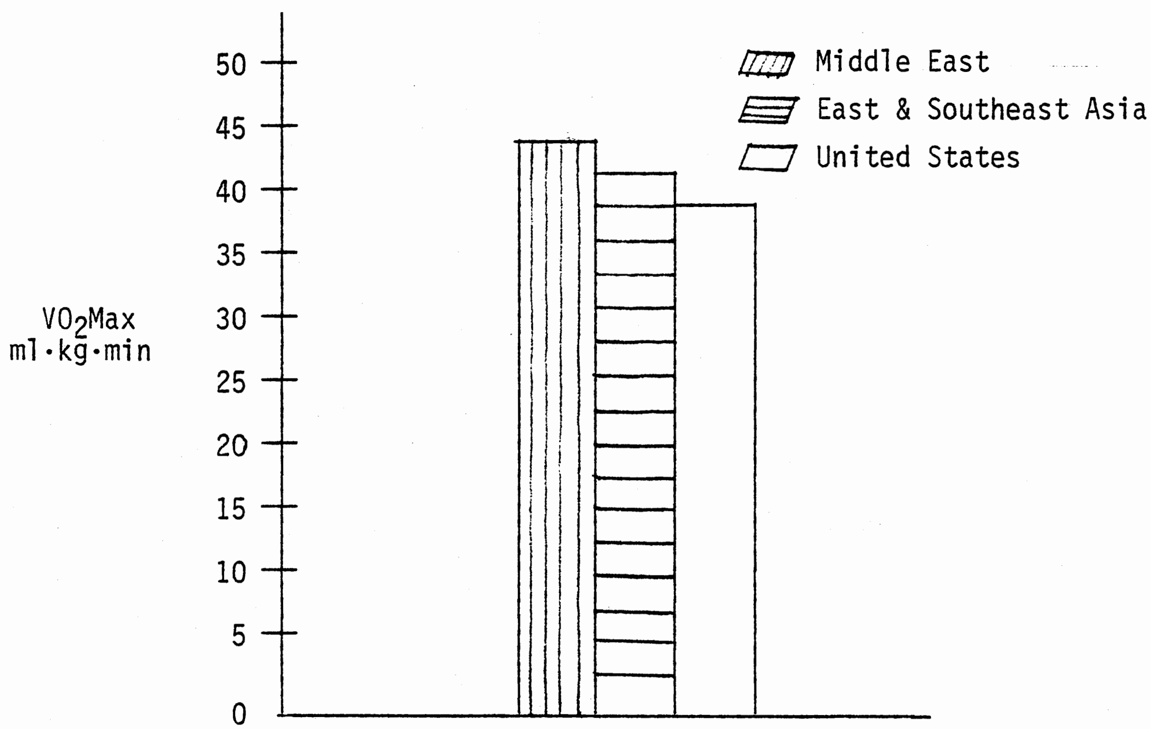


Figure 1. The Mean $VO_2$max of the Middle East, East and Southeast Asia and the United States

The higher $VO_2$max of foreign students compared with the American population could be because of the way of life in their respective countries. The daily activities of the people living in the Middle East and

East and Southeast Asia are more physically demanding, whereas mechanization has almost eliminated physical activity among the people of the United States.

Duration of stay in the United States did not have a significant affect on $VO_2$max of foreign students. Middle Eastern students, those who have been in the United States less than one year, had a mean $VO_2$max value of 43.6 ml·kg·min compared with 43.7 ml·kg·min for those students who have been in the United States longer than three years. East and Southeast Asian students showed a little more difference than the Middle Eastern students. Those students from East and Southeast Asia, who have been in the United States less than one year, had a little less $VO_2$max (41.4 ml·kg·min) than those who have been in the United States longer than three years (42.7 ml·kg·min). However, none of the groups showed a significant difference at the .05 confidence level.

The mean $VO_2$max values of foreign students showed that the amount of exercise done in the home country and/or in the United States had a positive linear relationship with $VO_2$max. Those foreign students who did not exercise at home (16.25%) had the lowest mean $VO_2$max value of 40.8 ml·kg·min. The students who had exercised 1-2 times a week (45%) had a mean $VO_2$max value of 42.2 ml·kg·min. The students who had exercised 3-4 times a week (28.75%) had a mean $VO_2$max value of 43.5 ml·kg·min. The students who had exercised five or more times a week (10%) had the highest mean $VO_2$max value as expected, which was 45.9 ml·kg·min.

The above relationship was also found between the amount of exercise done in the United States and $VO_2$max; however, the percentages of the students at each category are different, and the $VO_2$max values are higher for the exercising groups in the United States. The mean $VO_2$max value for the students who have not been exercising at all (47.5%) was 40.7 ml·kg·min. The students who have been exercising 1-2 times a week (41.25%) had a mean $VO_2max$ value of 43.9 ml·kg·min. The students who have been exercising 3-4 times a week (7.5%) had a mean $VO_2max$ value of 44.8 ml·kg·min. The highest mean $VO_2max$ value 52.2 ml·kg·min was scored by the students who have been exercising five or more times a week (see Table VII). These results indicate that $VO_2max$ is very much dependent upon or affected the most by the amount of physical activity which is still the way of life in underdeveloped or less developed countries. Table VII shows that the foreign students have become less active after they have come to the United States.

TABLE VII

MEAN $VO_2MAX$ VALUES AND THE AMOUNT OF PHYSICAL ACTIVITY PER WEEK

| | N | None (N) | 1-2 Times (N) | 3-4 Times (N) | 5 or More Times (N) |
|---|---|---|---|---|---|
| Home Country | (80) | 40.8 (13) | 42.2 (36) | 43.5 (23) | 45.9 (8) |
| United States | (80) | 40.7 (38) | 43.9 (33) | 44.8 ( 6) | 52.2 (3) |

Smoking cigarettes had a negative affect on the mean $VO_2max$ values. The study showed that cigarette smokers (22.5%) had a lower mean $VO_2max$ value (41.2 $\pm$ 5.4 ml·kg·min) than the nonsmokers (77.5%) which was 43.2 $\pm$ 4.6 ml·kg·min. However, the difference was not large enough to be significant at the .05 confidence level.

The $VO_2$max was also analyzed in terms of the socioeconomic class of the foreign students. The students reported that 1.25 percent belonged to the low, 86.25 percent belonged to the middle, and 12.5 percent belonged to the high socioeconomic classes in their home countries. It appeared everybody wanted to belong to the middle class. Because of observations and personal communication, it was hard for the researcher to believe that they were almost all middle class instead of high class, even though the middle class in one country can easily be high class in another and vice versa. It is hard for one to draw a sharp line between the socioeconomic classes no matter where the individual is. For these reasons the researcher believes that the results may not reflect the real values. However, it is important that the results are reported. The middle class students had higher mean values of $VO_2$max, 43 ml·kg·min, compared with that of the higher class students, which was 41.1 ml·kg·min. The lower class mean values of $VO_2$max were not reported because there were not enough students to represent it. There was only one out of 80 students in the lower class. The difference in mean values of $VO_2$max between the middle and high socioeconomic classes was not significant at the .05 confidence level. This difference might reflect, even though it was not significant, the more sedentary lifestyle of the high class people because of having a better chance to be exposed to the highly mechanized lifestyle.

## Respiratory Function

The respiratory function results are summarized in Table VIII. The

Middle Eastern students had a higher mean value for VC (4.94 Liters) than the United States population (4.82 Liters), and the East and Southeast Asian students had the lowest mean value of VC (4.28 Liters). While there was not a significant difference between the VC of the Middle Eastern students and the United States population at the .05 confidence level, there were significant differences between the VC of Middle Eastern students and East and Southeast Asian students, and also between the United States population and East and Southeast Asian students at the .05 confidence level.

TABLE VIII

MEANS AND STANDARD DEVIATIONS OF RESPIRATORY FUNCTION MEASUREMENTS

| Variables | Middle East | East and SE Asia | United States |
|---|---|---|---|
| VC | 4.94 (± .73) | 4.28 (± 1.00) | 4.82 (± .62) |
| FVC | 5.10 (± .68) | 4.34 (± 1.07) | 5.48 (± .77) |
| $FEV_1$ | 4.33 (± .62) | 3.74 (± .90) | 4.40 (± .58) |
| $FEV_1$/FVC | 85% (± 7.00) | 87% (± 9.00) | 80.7% (± 5.90) |
| MVV | 162.40 (±23.50) | 140.40 (±33.70) | 184.00 (±29.00) |

The United States population had the highest mean values for FVC (5.48 Liters), $FEV_1$ (4.4 Liters), and MVV (184 Liters/min), then the

Middle Eastern students followed with the mean values for FVC (5.1 Liters), $FEV_1$ (4.33 Liters), and MVV (162.4 Liters/min), while the East and Southeast Asian students achieved the lowest mean values for these parameters (FVC = 4.34 Liters, $FEV_1$ = 3.74 Liters, and MVV = 140.4 Liters/min). There were significant differences at the .05 confidence level for FVC, $FEV_1$, and MVV between the United States population and the East and Southeast Asian students and also between the Middle East and East and Southeast Asian students. There were also significant differences at the .05 confidence level for FVC and MVV between the United States population and the Middle Eastern students, but there was no significant difference in $FEV_1$ between the two groups.

The East and Southeast Asian students achieved the highest mean value for $FEV_1$/FVC (87%), then the Middle Eastern students followed with the mean value of 85 percent, while the United States population had the lowest mean value for $FEV_1$/FVC (80.7%). There was no significant difference between the East and Southeast Asian and Middle Eastern students, but there were significant differences between the East and Southeast Asian students and the United States population and also between the Middle Eastern students and the United States population.

Respiratory function differences between the three groups might be the result of the differences in body size and height. However, the results between the Middle East and East and Southeast Asia were greater than the results between Middle East and the United States. But, the body sizes and heights seem to differ equally if not greater between the United States and Middle Eastern students compared with the difference between the Middle East and East and Southeast Asia. This suggests that the respiratory function was also influenced by other factors besides body size and height. Those factors can be simply racial or environmental including activities during childhood or adolescence and dietal habits of the populations.

Duration of stay in the United States did not make any significant difference in respiratory function of Middle Eastern students at the .05 confidence level. Table IX lists the mean values of respiratory function measurements for Middle Eastern students. The students who have been in the United States less than one year had higher mean values of VC (5.2 Liters), FVC (5.4 Liters), $FEV_1$ (4.71 Liters), $FEV_1/FVC$ (87%) and MVV (176.9 Liters/min) than those students who have been in the United States longer than three years for these variables (VC = 4.8 Liters, FVC = 4.94 Liters, $FEV_1$ = 4.15 Liters, $FEV_1/FVC$ = 84% and MVV = 155.5 Liters/min). However, those new students also had less mean age value (21.85 vs. 24.77 years) and higher mean height value (174.6 cm vs. 170.3 cm) which were more favorable for the new students to have higher respiratory function. Therefore, the differences were not the result of the length of stay in the United States, but the differences in age and height values.

The two East and Southeast Asian student groups, students who have been in the United States less than one year and the students who have been in the United States longer than three years, did not show as great a difference in respiratory function as the Middle Eastern groups. The differences were very small and not significant between the two groups at the .05 confidence level. However, the East and Southeast Asian groups did not have as much age and height differences as the Middle Eastern groups either. The mean age and height values for the East and Southeast Asian groups were 23.4 years vs. 24.5 years and 169.9 cm vs.

171.2 cm respectively. The new students had lower mean values for VC (4.44 vs. 4.78 Liters), FVC (4.57 vs. 4.83 Liters), $FEV_1$ (3.98 vs. 3.99 Liters), and MVV (149.8 vs. 149.4 Liters/min), but higher mean value for $FEV_1$/FVC (88% vs. 83%) than the students who have been in the United States longer than three years.

TABLE IX

MEAN RESPIRATORY FUNCTION OF THE MIDDLE EASTERN AND EAST AND SOUTHEAST ASIAN STUDENTS

| Middle East | N | VC | FVC | $FEV_1$ | $FEV_1$/FVC | MVV |
|---|---|---|---|---|---|---|
| Group 1 | 7 | 5.20 | 5.40 | 4.71 | 87% | 176.9 |
| Group 3 | 13 | 4.80 | 4.94 | 4.15 | 84% | 155.5 |
| East and SE Asia | | | | | | |
| Group 1 | 10 | 4.44 | 4.57 | 3.98 | 88% | 149.4 |
| Group 3 | 11 | 4.78 | 4.83 | 3.99 | 83% | 149.8 |

GROUP 1: Students who have been in the United States less than one year.

GROUP 3: Students who have been in the United States longer than three years.

Table X shows the mean values for respiratory function of foreign students increased as the amount of exercise per week was increased with the exception of $FEV_1$/FVC, which showed a negative relationship. The difference between the nonexercisers and the students who exercised

1-2 times a week was not great at all. Even with the exception of VC, the nonexercisers had higher respiratory function values. As the amount of exercise per week was increased up to five or more times a week, so did the VC, FVC, $FEV_1$, and MVV increase. This shows the importance of exercise on the respiratory function of the individuals.

TABLE X

MEAN VALUES FOR RESPIRATORY FUNCTION OF FOREIGN STUDENTS ACCORDING TO THE AMOUNT OF EXERCISE DONE PER WEEK AT THE HOME COUNTRY

| Exercise | N | VC | FVC | $FEV_1$ | $FEV_1$/FVC | MVV |
|---|---|---|---|---|---|---|
| None | 13 | 4.54 | 4.70 | 4.10 | 87% | 153.8 |
| 1 - 2 times | 36 | 4.57 | 4.65 | 3.99 | 86% | 149.7 |
| 3 - 4 times | 23 | 4.60 | 4.72 | 4.00 | 85% | 150.0 |
| 5 or more times | 8 | 5.05 | 5.11 | 4.29 | 84% | 161.1 |

This study showed that the effect of smoking can best be seen on the $FEV_1$/FVC, where the cigarette smokers had mean value for $FEV_1$/FVC of 82% compared with 87% for nonsmokers. This difference was significant at the .05 confidence level. However, cigarette smokers had higher mean values for VC (4.65 Liters) and FVC (4.8 Liters), but lower mean values for $FEV_1$ (3.99 Liters) and MVV (149.8 Liters/min). The mean respiratory function values for nonsmokers were 4.65 Liters for VC, 4.7 Liters for FVC, 4.05 Liters for $FEV_1$ and 151.9 Liters/min for MVV. These respiratory function differences between the smokers and nonsmokers were not significant with the exception of $FEV_1/FVC$ at the .05 confidence level.

TABLE XI

RESPIRATORY FUNCTION OF CIGARETTE SMOKERS AND NONSMOKERS

| | N | VC | FVC | $FEV_1$ | $FEV_1/FVC$ | MVV |
|---|---|---|---|---|---|---|
| Smokers | 18 | 4.65(± 1.06) | 4.8(±.97) | 3.99(±.99) | 82(±10) | 149.8(±37.49) |
| Nonsmokers | 62 | 4.65(± .89) | 4.7(±.97) | 4.05(±.77) | 87(± 7) | 151.9(±29.07) |

**Mean and Standard Deviation Values

Interestingly, the high socioeconomic class students had higher mean respiratory function values than the middle class students. This was reversed when the $VO_2max$ was concerned. But, the differences of respiratory function values were not significant at the .05 confidence level between the high and middle socioeconomic class students. Table XII summarizes the mean values of respiratory function measurements for the middle and high class students.

## Blood Pressure

Significant differences in systolic and diastolic blood pressures were found between the U.S. population and Middle Eastern students, and between the U.S. population and East and Southeast Asian students at the .05 confidence level. No significant differences in systolic and diastolic blood pressures were found between the Middle Eastern and East and Southeast Asian students.

TABLE XII

MEAN VALUES OF RESPIRATORY FUNCTION MEASUREMENTS ACCORDING TO SOCIOECONOMIC CLASS

| | N | VC | FVC | $FEV_1$ | $FEV_1/FVC$ | MVV |
|---|---|---|---|---|---|---|
| Middle | 69 | 4.60 | 4.70 | 4.00 | 85% | 150.1 |
| High | 10 | 4.75 | 4.90 | 4.32 | 89% | 162.0 |

The mean systolic blood pressure of East and Southeast Asian students was (118.7 mmHg) slightly lower than that for the Middle Eastern students (120.4 mmHg). The U.S. population had the highest systolic blood pressure mean of the three groups with 128.5 mmHg, which was significantly different from the other two groups, but the racial differences in diastolic blood pressures did not follow a pattern similar to that of systolic blood pressure. The lowest diastolic blood pressure was found among the U. S. population (77.8 mmHg). This was also significantly different from the other two groups. Middle Eastern students had the highest diastolic blood pressure mean (80.9 mmHg), and the East and Southeast Asian students had a slightly lower diastolic blood pressure mean (79.8 mmHg) than the Middle Eastern students. However, this difference was not significant. Means and standard deviations of systolic and diastolic blood pressures for each area are shown on Table XIII, and comparisons are made in Figure 2.

TABLE XIII

MEANS AND STANDARD DEVIATIONS OF BLOOD PRESSURE MEASUREMENTS

| | N | B.P. Systolic | B.P. Diastolic |
|---|---|---|---|
| Middle East | 40 | 120.4 (± 6.03) | 80.9 (± 4.57) |
| East and SE Asia | 40 | 118.7 (± 7.46 | 79.8 (± 5.70) |
| United States | 63,030 | 128.5 (±14.5) | 77.9 (±10.00) |

Although there were some differences in systolic and diastolic blood pressures of foreign students between those who have been in the United States less than one year and those who have been in the United States longer than three years, the differences were not significant at the .05 confidence level. The new students from both areas, Middle East and East and Southeast Asia, had lower systolic blood pressure than the groups that have been in the United States longer than three years. These differences were 117.1 mmHg compared with 119.7 mmHg for the Middle Eastern students, and 116.4 mmHg compared with 122.4 mmHg for the

East and Southeast Asian students. These increases in systolic blood pressures might be the result of the environmental change, presumably the change in diet and physical activity of the students.

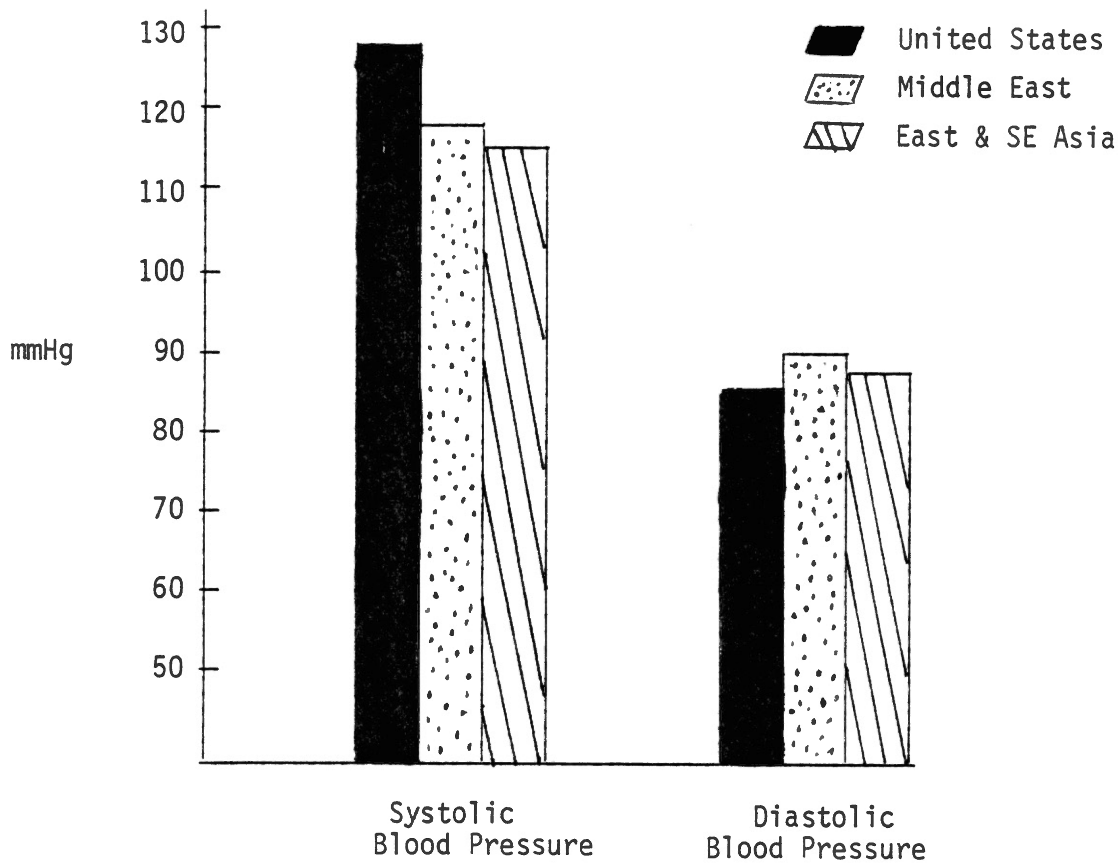


Figure 2. Comparison of Blood Pressure Measurements

Again, the diastolic blood pressure behaved differently than the systolic blood pressure. One area showed an increase in diastolic blood pressure, while the other area showed a decrease with the length of time spent in the U.S. The new students from East and Southeast Asia had mean diastolic blood pressure of 80 mmHg compared with 82 mmHg for those students who have been in the United States longer than three years. But, the new students from the Middle East had higher mean diastolic blood pressure compared with those students who have been in the United States longer than three years, 81.4 mmHg and 78.6 mmHg respectively (see Table XIV).

TABLE XIV

MEAN BLOOD PRESSURES OF MIDDLE EASTERN AND EAST AND SOUTHEAST ASIAN STUDENTS

| Middle East | N | Systolic B.P. | Diastolic B.P. |
|---|---|---|---|
| Group 1 | 7 | 117.1 | 81.4 |
| Group 3 | 13 | 119.7 | 78.6 |
| East and SE Asia | | | |
| Group 1 | 10 | 116.4 | 80.0 |
| Group 3 | 11 | 122.4 | 82.0 |

GROUP 1: Students who have been in the United States less than one year.

GROUP 3: Students who have been in the United States longer than three years.

When the systolic and diastolic blood pressures of three vegetarians were compared with the meat eaters (the rest of the foreign students), the vegetarians had lower means of systolic and diastolic blood pressures. However, the number of vegetarians was small compared with the meat eaters. A significant difference in systolic blood pressure was found between the vegetarians and the meat eaters at the .05 confidence level. The vegetarians had a mean systolic blood pressure of 114 mmHg compared with the mean values of 119.7 mmHg for the meat eaters. The diastolic blood pressure mean of the vegetarians was 78 mmHg while the meat eaters was 80.5 mmHg. There was no significant difference in diastolic blood pressures of the two groups (see Table XV).

TABLE XV

BLOOD PRESSURE MEANS AND STANDARD DEVIATIONS OF VEGETARIANS AND MEAT EATERS

| | N | Systolic B.P. | Diastolic B.P. |
|---|---|---|---|
| Vegetarians | 3 | 114.0 (±2.00) | 78.0 (±2.00) |
| Meat Eaters | 77 | 119.7 (±6.83) | 80.5 (±5.23) |

All three of the vegetarians were from the Middle East. One of them did not eat meat, but ate eggs and dairy products. The other two did not eat meat or dairy products, but ate eggs.

The comparison was also made between the students who ate rice and those who ate both rice and potatoes. The students who ate only potatoes and not rice were dropped because there were only two out of 80 students. The results showed that those students who ate rice but not potatoes had slightly higher systolic and diastolic blood pressures than did those students who ate both rice and potatoes. But, the differences were not significant at the .05 confidence level. The mean systolic and diastolic blood pressure values for those students who ate rice, but not potatoes, were 120.2 mmHg and 82.7 mmHg respectively. The students who ate both rice and potatoes had a mean systolic blood pressure of 119.4 mmHg and a mean diastolic blood pressure of 80.3 mmHg.

The students who belonged to the middle socioeconomic class had lower systolic and diastolic blood pressures than those students who belonged to the high socioeconomic class (see Table XVI). Middle class students had a mean systolic blood pressure of 118.9 mmHg and a mean diastolic blood pressure of 80.1 mmHg. The mean systolic and diastolic blood pressure values for upper class students were 123 mmHg and 81.4 mmHg respectively. The results showed no significant difference at the .05 confidence level between middle and high socioeconomic class students.

TABLE XVI

MEAN BLOOD PRESSURE VALUES OF MIDDLE AND HIGH SOCIOECONOMIC CLASS STUDENTS

| | N | Systolic B.P. | Diastolic B.P. |
|---|---|---|---|
| Middle Class | 66 | 118.9 | 80.1 |
| High Class | 10 | 123.0 | 81.4 |

## Blood Chemistry

The mean and standard deviation of total cholesterol (TC), high density lipoproteins (HDL), TC/HDL Ratio, glucose and hemoglobin concentrations are presented in Table XVII. These results were drawn from 62 students from the Middle East and East and Southeast Asia between 20 - 30 years of age. The results for the United States were collected from a different source which represents different numbers of subjects and the age groups. Results of the United States population for TC, HDL, and TC/HDL represent 118 subjects and a 20-24 years of age group, which is a narrower range than the other two groups. The results for glucose were drawn from 271 subjects between 20-24 years of age, and the results for hemoglobin were drawn from 486 subjects between 20-24 years of age.

Based on these results, the mean concentration of TC was highest in the Middle Eastern students with the score of 173.7 mg/100 ml. The United States population had the second highest TC mean value with the score of 162.2 mg/100 ml for the age group of 20-24 years. But, the mean TC values for the age group of 25-29 years for the United States population was 178.7 mg/100 ml, which is even higher than the Middle East values. The lowest mean TC concentration values scored by the East and Southeast Asian students was 160.2 mg/100 ml. East and Southeast Asian students also had the lowest HDL mean concentration of the three groups with the score of 41.8 mg/100 ml. The mean HDL values for the Middle Eastern students was 43.2 mg/100 ml and the United States population had the highest HDL mean concentration with the score of 45.4 mg/100 ml. Despite all the TC and HDL differences of the groups, these differences were not statistically significant at the .05 confidence level.

TABLE XVII

MEANS, STANDARD DEVIATIONS AND STANDARD ERROR OF THE MEANS OF BLOOD CHEMISTRY RESULTS

| | Middle East | East and SE Asia | United States |
|---|---|---|---|
| TC | 173.70 (±39.70)(±7.13) | 160.20 (±37.50)(±6.73) | 162.20 ( --- )(±2.5) |
| HDL | 43.20 (±10.70)(±1.93) | 41.80 (±10.40)(±1.86) | 45.40 ( --- )(±1.0) |
| TC/HDL | 4.18 (± 1.05)(± .19) | 3.99 (± 1.12)(± .20) | 3.57 ( --- )( -- ) |
| Glucose | 71.10 (± 9.70)(±1.75) | 74.60 (±17.00)(±3.05) | 101.00 (±14.5)( -- ) |
| Hemoglobin | 16.30 (± .92)(± .17) | 16.30 (± 1.13)(± .20) | 15.80 (± 1.1)( -- ) |

The mean TC/HDL ratio in the U.S. population was found to be significantly lower at the .05 confidence level than the other two groups studied. The mean TC/HDL ratios were 3.57 for the U.S. population, 3.99 for the East and Southeast Asian and 4.18 for the Middle Eastern students. The difference between East and Southeast Asian and Middle Eastern students was not statistically significant. This low TC/HDL value for the United States population suggested that they are much better off in terms of not developing cardiovascular diseases than the other two groups, especially the Middle Eastern students.

The highest TC score for the Middle Eastern students was 285.7 mg/100 ml, which belonged to an obese individual, and the lowest TC score was 105.5 mg/100 ml which belonged to a vegetarian individual. The Middle Eastern students had wide ranges of scores for HDL and TC/HDL ratio, 20.8 - 72.9 mg/100 ml and 2.24 - 6.46 respectively. The East and Southeast Asian students also had wide ranges of scores that were comparable to the Middle Eastern students. The range for TC was 110 - 256.7 mg/100 ml. The highest number belonged to an obese person while the lowest number belonged to a very light and slim person. The range for HDL was 24 - 71.8 mg/100 ml, and the range for TC/HDL ratio was 2.12 - 6.46. Because of these high TC/HDL ratios, there were a few students from the Middle East and East and Southeast Asian countries who have a high risk factor for the development of cardiovascular diseases.

The mean glucose level of the United States population was found to be significantly higher at the .05 confidence level than both the Middle Eastern and East and Southeast Asian students. The mean glucose values were 101 mg/100 ml for the U.S. population, 74.6 mg/100 ml for the East and Southeast Asian students, and 71.1 mg/100 ml for the

Middle Eastern students. The difference between the East and Southeast Asian and Middle Eastern students was not statistically significant. The glucose scores ranged from 48.1 to 121.7 mg/100 ml among the East and Southeast Asian students and from 39 to 91.3 mg/100 ml among the Middle Eastern students.

The students from the Middle East and East and Southeast Asia both had the same mean hemoglobin level, which was 16.3 g/100 ml. However, the United States population had a lower mean hemoglobin level (15.8 g/100 ml), which was statistically significant at the .05 confidence level.

There were some differences of TC, HDL, TC/HDL ratio, glucose and hemoglobin levels of Middle Eastern students between those who have been in the United States less than one year and those who have been in the United States longer than three years. However, none of these differences was statistically significant at the .05 confidence level. New students had a higher mean TC level (161.8 mg/100 ml) but a lower mean HDL level (37.3 mg/100 ml) than those students who have been in the United States longer than three years. They had 158.5 mg/100 ml of mean TC, and 44.2 mg/100 ml of mean HDL levels. The new students also had a higher mean TC/HDL ratio (4.58) compared with those who have been in the United States longer than three years with a mean TC/HDL of 3.64. The higher HDL level of those students who have been in the United States might be the result of their more active lifestyle than the new students from the Middle East. The reports showed that the students who have been in the U.S. longer than three years exercised much more than the new students.

The glucose and hemoglobin results showed that the new students from the Middle East had lower mean values than their counterparts who have been in the United States longer than three years. These mean glucose and hemoglobin values were 63.3 mg/100 ml and 15.7 g/100 ml for new students compared with 73.6 mg/100 ml and 16.2 g/100 ml respectively for those students who have been in the United States longer than three years.

The length of stay in the United States also showed differences of TC/HDL, TC/HDL ratio, glucose and hemoglobin levels of East and Southeast Asian students between those who have been in the United States less than one year and those who have been in the United States longer than three years. Again, none of these differences was statistically significant at the .05 confidence level, which suggests that the change in environment and diet up to a certain point did not have significant effects on these variables.

Somehow the mean TC level for new students was considerably higher (175.9 mg/100 ml) than for the students who have been in the United States longer than three years (160.9 mg/100 ml). However, the mean HDL levels of new students and those students who have been in the United States longer than three years was slightly different, being 42.3 mg/100 ml and 41.1 mg/100 ml respectively. Because of the large difference of mean TC levels and slight difference of mean HDL levels between the groups, the TC/HDL ratio was also considerably different. The new students had a mean TC/HDL ratio of 4.39, which was higher than those students who have been in the United States longer than three years who had mean TC/HDL ratio of 4.03.

The new students had a slightly lower mean glucose level, but a slightly higher mean hemoglobin level, than their counterparts who have been in the United States longer than three years. The mean glucose and hemoglobin levels of new students were 74.5 mg/100 ml and 16.6 g/100 ml compared with 75 mg/100 ml and 16.1 g/100 ml respectively for those students who have been in the United States longer than three years.

Table XVIII lists the results of TC, HDL, TC/HDL ratio, glucose and hemoglobin values among the students from Middle East and East and Southeast Asia.

TABLE XVIII

MEAN BLOOD CHEMISTRY LEVELS
OF FOREIGN STUDENTS

| Middle East | N | TC | HDL | TC/HDL | Glucose | Hemo-globin |
|---|---|---|---|---|---|---|
| Group 1 | 7 | 161.8 | 37.3 | 4.58 | 68.3 | 15.7 |
| Group 3 | 11 | 158.5 | 44.2 | 3.64 | 73.6 | 16.2 |
| East and SE Asia | | | | | | |
| Group 1 | 8 | 175.9 | 42.3 | 4.39 | 74.5 | 16.6 |
| Group 3 | 11 | 160.9 | 41.1 | 4.03 | 75.0 | 16.1 |

GROUP 1: Students who have been in the United States less than one year.

GROUP 3: Students who have been in the United States longer than three years.

Vegetarian students had a lower mean TC (148.8 mg/100 ml) than the meat eaters (167.9 mg/100 ml), but the difference was not statistically significant. However, the mean HDL level of the vegetarians was significantly higher (48.4 mg/100 ml) than the meat eaters (42.2 mg/100 ml).

Because of the low TC and high HDL levels of the vegetarians, the TC/HDL ratio (3.08) was also lower among vegetarians than the meat eaters (4.13). The difference in TC/HDL ratio was not statistically significant. These findings indicate that the vegetarians are less susceptible to develop coronary heart disease.

Another comparison was made between the students who ate other animal sources with the students who did not eat those animal sources. The results showed that those students who ate dairy products had a higher mean TC level (171.4 vs. 155.2 mg/100 ml), about an equal mean HDL level (42.5 vs. 42.6 mg/100 ml), and a higher TC/HDL ratio (4.17 vs. 3.84) than those students who did not eat dairy products. None of these differences were statistically significant. When the comparison was made between those students who ate eggs and those who did not eat eggs, the students who ate eggs had a significantly higher mean TC (175.9 vs. 148.2 mg/100 ml) than the students who did not eat eggs. They also had a higher mean HDL level (43.9 vs. 39.8 mg/100 ml) and a higher mean TC/HDL ratio (4.19 vs. 3.87) than those students who did not eat eggs.

Table XIX summarizes the results of TC, HDL, and TC/HDL ratio for those students who eat animal products and those who do not. These results showed that those people who avoid animal products have advantages over the others in terms of not having some of the factors which are related to cardiovascular diseases. It was interesting to see (Table XIX) that those students who did not eat eggs had a comparable mean TC level with the vegetarians, but all the vegetarians reported in this study said that they ate eggs.

Table XX lists the blood chemistry results of the students who smoked and who did not smoke. The two groups had very close mean TC

TABLE XIX

MEANS AND STANDARD DEVIATIONS OF TC, HDL AND TC/HDL RATIO OF STUDENTS WHO EAT ANIMAL PRODUCTS AND WHO DO NOT

| | | N | TC | HDL | TC/HDL |
|---|---|---|---|---|---|
| Vegetarians | | 3 | 148.8 (±50.20) | 48.4 (± 2.08) | 3.08 (±1.09) |
| Meat Eaters | | 59 | 167.9 (±38.55) | 42.2 (±10.66) | 4.13 (±1.07) |
| Dairy Products | Yes | 45 | 171.4 (±38.10) | 42.5 (± 9.70) | 4.17 (±1.08) |
| | No | 17 | 155.2 (±39.60) | 42.6 (±12.70) | 3.84 (±1.08) |
| Eggs | Yes | 42 | 175.9 (±42.60) | 43.9 (±11.10) | 4.19 (±1.17) |
| | No | 20 | 148.2 (±20.10) | 39.8 (± 8.80) | 3.87 (± .87) |

levels, nonsmokers scored 167.5 mg/100 ml and the smokers scored 165 mg/100 ml. However, nonsmokers had a significantly higher mean HDL (44.5 vs. 35.8 mg/100 ml) and a significantly lower mean TC/HDL ratio (3.89 vs. 4.73) at the .05 confidence level than those students who smoked. This finding indicates that cigarette smokers are also more susceptible to the development of cardiovascular diseases than the nonsmokers.

TABLE XX

BLOOD CHEMISTRY MEANS AND STANDARD DEVIATIONS
OF CIGARETTE SMOKERS AND NONSMOKERS

| | N | Smokers | N | Nonsmokers |
|---|---|---|---|---|
| TC | 14 | 165.00 (±45.60) | 48 | 167.50 (±37.20) |
| HDL | 14 | 35.80 (± 8.40) | 48 | 44.50 (±10.30) |
| TC/HDL Ratio | 14 | 4.73 (± 1.24) | 48 | 3.89 (± .96) |
| Glucose | 14 | 75.60 (±17.90) | 48 | 72.00 (±12.56) |
| Hemoglobin | 14 | 16.00 (± .77) | 48 | 16.30 (± 1.08) |

The mean values for glucose and hemoglobin showed slight differences between the cigarette smokers and the nonsmokers. These differences were not statistically significant at the .05 confidence level. The cigarette smokers had a higher mean glucose level (75.6 vs. 72 mg/100 ml) and a lower mean hemoglobin level (16 vs. 16.3 g/100 ml).

When the fitness levels of the students were compared with their blood chemistry results (Table XXI), no relationship could be seen between the TC, HDL, TC/HDL Ratio, and hemoglobin and fitness levels of the students. These results did not support Cooper's (83) findings which stated that HDL levels increased and the TC/HDL ratio decreased as the fitness levels of the people increased. However, this study showed a negative relationship between the fitness levels of the students and the mean glucose levels with the exception of the very poor fitness category. This exception could be because of the few students (only two) in this category. The mean glucose level decreased as the fitness levels increased, which supports that exercise might be a good way to control glucose level in blood. High levels of blood glucose among the United States population might be the result of lack of exercise.

TABLE XXI

PHYSICAL FITNESS AND MEAN BLOOD CHEMISTRY LEVELS

| Fitness Level | N | TC | HDL | TC/HDL | Glucose | Hemo-globin |
|---|---|---|---|---|---|---|
| Very Poor | 2 | 166.1 | 37.4 | 4.56 | 71.8 | 16.2 |
| Poor | 8 | 194.9 | 41.2 | 5.09 | 80.0 | 15.3 |
| Fair | 21 | 172.1 | 46.3 | 3.88 | 76.9 | 16.5 |
| Good | 36 | 156.7 | 41.3 | 3.93 | 71.7 | 16.2 |
| Excellent | 10 | 175.7 | 42.5 | 4.24 | 68.2 | 16.5 |
| Superior | 3 | 171.1 | 41.4 | 4.12 | 64.6 | 16.7 |

The mean values of TC, HDL, TC/HDL, glucose and hemoglobin showed slight differences between the middle and high socioeconomic class students, but these differences were not statistically significant at the .05 confidence level. These differences could be due to the smaller sample of the high socioeconomic class students (4 compared to 57 middle class students). Table XXII summarizes the mean blood chemistry of middle and high socioeconomic class students.

TABLE XXII

MEAN BLOOD CHEMISTRY LEVELS OF MIDDLE AND HIGH SOCIOECONOMIC CLASS STUDENTS

| | N | TC | HDL | TC/HDL | Glucose | Hemo-globin |
|---|---|---|---|---|---|---|
| Middle Class | 57 | 168.7 | 42.3 | 4.14 | 72.1 | 16.3 |
| High Class | 4 | 147.8 | 45.8 | 3.41 | 81.5 | 16.2 |

The results of this study showed that none of the three groups had the best or the worst values of all the tested physical fitness variables. Each group had better scores on some, and intermediate or worse scores on other physical fitness variables when compared with one another. The physical fitness index was developed by selecting the most important physical fitness variables. Each group was given a value of 1, 2, or 3 for each physical fitness variable depending on its value. The best result for the physical fitness variable was given a value of

1, the second best result was given a value of 2, and the worst result was given a value of 3 (see Table XXIII). The lowest total score indicates the best overall physical fitness level of the group, and the highest total score indicates the worst overall physical fitness level of the group for this study. This study showed that the United States population had the lowest total physical fitness index score with the value of 18. The Middle Eastern and the East and Southeast Asian students had higher, but the same, physical fitness index scores with values of 21. According to these index scores the United States population was found to be in a better overall physical fitness level than the Middle Eastern and the East and Southeast Asian students.

TABLE XXIII

OVERALL PHYSICAL FITNESS INDEX SCORES

| Variables | Middle East | East and SE Asia | United States |
|---|---|---|---|
| $VO_2max$ | 1 | 2 | 3 |
| VC | 1 | 3 | 2 |
| FVC | 2 | 3 | 1 |
| $FEV_1/FVC$ | 2 | 1 | 3 |
| MVV | 2 | 3 | 1 |
| Systolic B.P. | 2 | 1 | 3 |
| Diastolic B.P. | 3 | 2 | 1 |
| TC | 3 | 1 | 2 |
| HDL | 2 | 3 | 1 |
| TC/HDL | 3 | 2 | 1 |
| TOTAL | 21 | 21 | 18 |

## Summary of Results

The purpose of this study was to compare the aerobic work capacity, respiratory function, blood pressure and blood chemistry of Middle Eastern students, East and Southeast Asian students, and the United States population. A secondary purpose was to compare these physical fitness variables of those foreign students who have been in the United States less than one year with those who have been in the United States longer than three years. Besides these two problems, an attempt was also made to analyze these variables in terms of exercise, smoking and diet habits, and socioeconomic classes of the foreign students.

Eighty subjects from the Middle East and East and Southeast Asian countries were used for the aerobic work capacity, respiratory function and blood pressure measurements. The subject number decreased to 62 for the blood chemistry analysis because some subjects did not want to have their blood drawn.

The primary determinant of aerobic work capacity was maximal oxygen consumption. The Middle Eastern students had the highest mean $VO_2max$, and the United States population had the lowest mean $VO_2max$. There was a significant difference between the Middle Eastern students and the United States population, but the differences between the Middle Eastern and East and Southeast Asian students, and between the United States population and East and Southeast Asian students were not significant at the .05 confidence level.

The mean VC was highest in Middle Eastern students, followed by the United States population. The East and Southeast Asian students had the lowest mean VC. There were significant differences between the

United States population and the East and Southeast Asian students, and between the Middle Eastern students and East and Southeast Asian students. The mean VC between the Middle Eastern students and the United States population did not differ significantly. The United States population had the highest mean values of FVC, $FEV_1$ and MVV, and the East and Southeast Asian students had the lowest mean values of these parameters. There were statistically significant differences of FVC, $FEV_1$ and MVV between the United States population and East and Southeast Asian students, and between the Middle Eastern and East and Southeast Asian students, and also between the United States population and the Middle Eastern students with the exception of $FEV_1$. It was concluded that these differences might be the result of the body size and height differences between the respective areas. Despite all these differences, East and Southeast Asian and Middle Eastern students had significantly higher $FEV_1$/FVC mean values than the United States population. Although the East and Southeast Asian students had a higher mean value of $FEV_1$/FVC than the Middle Eastern students, the difference was not statistically significant.

The United States population had the highest mean systolic and the lowest diastolic blood pressures of the three groups, and they were significantly different at the .05 confidence level than both the Middle Eastern and East and Southeast Asian students. East and Southeast Asian students had the highest mean diastolic blood pressures, but there were no significant differences in mean systolic or diastolic blood pressures between the Middle Eastern and East and Southeast Asian students.

Middle Eastern students had the highest mean TC, and it was followed by the United States population and then the East and Southeast

Asian students. However, the mean HDL was higher in the United States population, followed by the Middle Eastern students and then the East and Southeast Asian students. The mean TC and HDL values were not statistically significant between any of the three groups. The mean TC/HDL ratio was lowest among the United States population, second highest among the East and Southeast Asian students, and highest among the Middle Eastern students. The differences in TC/HDL ratio were statistically significant between the United States population and the other two groups, but it was not significant between the Middle Eastern and East and Southeast Asian students.

The United States population had significantly higher mean glucose values than both the Middle Eastern and East and Southeast Asian students, but the difference in mean glucose values between the Middle Eastern and East and Southeast Asian students was not significant. The East and Southeast Asian students had slightly higher mean glucose values than the Middle Eastern students. The United States population also had higher statistically significant mean hemoglobin values than the Middle Eastern and East and Southeast Asian students. The mean hemoglobin values were the same for the Middle Eastern and East and Southeast Asian students; however, the United States population had a lower mean hemoglobin level.

The results showed some slight differences in almost all the tested fitness variables between the foreign students, those who have been in the United States less than one year and those students who have been in the United States longer than three years. None of the differences, however, were statistically significant at the .05 confidence level.

Exercise habits both at home and in the United States had positive effects on the $VO_2$max and the respiratory function variables. Results showed that $VO_2$max and respiratory function variables increased as the amount of exercise per week increased.

Although cigarette smoking had negative effects on the $VO_2$max and respiratory function variables, the differences between smokers and nonsmokers were not statistically significant with the exception of $FEV_1$/FVC percentage.

Vegetarian students had lower systolic and diastolic blood pressures, lower TC, higher HDL, and lower TC/HDL values than the students who ate meats, but the significant differences were found only in systolic blood pressure and HDL levels; the rest of the differences were not statistically significant at the .05 confidence level.

The students who ate dairy products had higher TC and higher TC/HDL ratio than the students who did not eat dairy products. The differences were not large enough to be statistically significant. Those students who ate eggs compared with ones who did not also had higher TC and TC/HDL ratio; however, their HDL level was also higher. The students who ate eggs had statistically significant high TC levels when compared with the students who did not. These results showed that foods from animal sources increased the TC levels and the TC/HDL ratios of the students which are the risk factors for developing cardiovascular diseases.

Interestingly, the cigarette smokers also had a significantly lower HDL level and significantly higher TC/HDL ratio than the nonsmokers.

When the physical fitness levels of the students were compared with their blood chemistry components, there was no relationship found between the two; however, the glucose level was decreased as the fitness level increased with the exception of the very poor fitness category.

There were also very slight differences in the physical fitness components of students between the middle and high socioeconomic classes, but none of the differences was statistically significant at the .05 confidence level.

## CHAPTER V

## CONCLUSIONS AND RECOMMENDATIONS

It is an interest of physical educators or of exercise physiologists to find the physical capacities and limitations of different peoples of the world. It is extremely important to know the effects of racial, cultural, and environmental factors on physical fitness and/or health variables in terms of athletics or to find solutions to the health problems of human kind.

With the current interest in racial and ethnic population studies, the purpose of this study was to measure and compare the aerobic work capacity, respiratory function, blood pressure and blood chemistry of Middle Eastern students, East and Southeast Asian students, and the United States population. A secondary purpose was to compare these physical fitness variables of those foreign students who have been in the United States less than one year with those who have been in the United States longer than three years. An attempt was also made to analyze those tested variables in terms of exercise, smoking and diet habits, and socioeconomic classes of the foreign students.

A total of 80 subjects were tested from the Middle East, and East and Southeast Asian countries for the aerobic work capacity, respiratory function and blood pressure measurements. The subject number decreased to 62 for the blood chemistry analysis because of those subjects who did not want to have their blood drawn for various reasons.

These foreign students at Oklahoma State University may not represent the whole people in their respective countries or regions, they only represent the Middle Eastern and East and Southeast Asian students at Oklahoma State University. The United States population norms were selected from various studies and these norms do not necessarily represent the whole United States population.

Multiple t-tests were used by the Oklahoma State University Computer Center to determine the differences on each physical fitness variable between Middle East, East and Southeast Asia, and the United States. An Analysis of Variance (ANOVA) was used to test for significance of differences in each variable among the foreign students according to their length of stay in the United States. A t-test was also used to analyze the effects of exercise, smoking and diet habits, and the socioeconomic classes of students on these physical fitness variables.

Differences in physical fitness variables were tested for statistical significance at the .05 confidence level.

## Conclusions

Within the limits of this study and based on the null-hypotheses stated, the following conclusions were made:

1. The differences in the means of $VO_2max$ were not statistically significant between the Middle Eastern students and the East and Southeast Asian students at the .05 confidence level. The null-hypothesis was accepted.

2. The Middle Eastern students had a significantly higher mean $VO_2max$ than the United States population at the .05 confidence level.

The null-hypothesis was rejected.

3. The differences in the means of $VO_2$max were not statistically significant between the East and Southeast Asian students and the United States population at the .05 confidence level. The null-hypothesis was accepted.

4. The Middle Eastern students had significantly higher means of vital capacity (VC), forced vital capacity (FVC), forced expiratory volume in one second ($FEV_1$), and maximum voluntary ventilation (MVV) than the East and Southeast Asian students at the .05 confidence level. The null-hypotheses were rejected.

5. The United States population had significantly higher means of VC, FVC, $FEV_1$, and MVV than the East and Southeast Asian students at the .05 confidence level. The null-hypotheses were rejected.

6. The differences in the means of VC and $FEV_1$ were not statistically significant between the Middle Eastern students and the United States population at the .05 confidence level. The null-hypotheses were accepted.

7. The United States population had significantly higher means of FVC and MVV than the Middle Eastern students at the .05 confidence level. The null-hypotheses were rejected.

8. The difference in the means of $FEV_1$/FVC was not statistically significant between the Middle Eastern students and the East and Southeast Asian students at the .05 confidence level. The null-hypothesis was accepted.

9. The Middle Eastern students had a significantly higher mean of $FEV_1$/FVC than the United States population at the .05 confidence level. The null-hypothesis was rejected.

10. The East and Southeast Asian students had a significantly higher mean of $FEV_1/FVC$ than the United States population at the .05 confidence level. The null-hypothesis was rejected.

11. The differences in the means of systolic and diastolic blood pressures were not statistically significant between the Middle Eastern students and the East and Southeast Asian students at the .05 confidence level. The null-hypotheses were accepted.

12. The Middle Eastern students had a significantly lower mean of systolic blood pressure, but a significantly higher mean of diastolic blood pressure than the United States population at the .05 confidence level. The null-hypotheses were rejected.

13. The East and Southeast Asian students had a significantly lower mean of systolic blood pressure, but a significantly higher mean of diastolic blood pressure, than the United States population at the .05 confidence level. The null-hypotheses were rejected.

14. The differences in the means of TC, HDL and TC/HDL were not statistically significant between the Middle Eastern and East and Southeast Asian students at the .05 confidence level. The null-hypotheses were accepted.

15. The differences in the means of TC and HDL were not statistically significant between the Middle Eastern students and the United States population at the .05 confidence level. The null-hypotheses were accepted.

16. The differences in the means of TC and HDL were not statistically significant between the East and Southeast Asian students and the United States population at the .05 confidence level. The null-hypotheses were accepted.

17. The United States population had a significantly lower mean of TC/HDL ratio than the Middle Eastern and also the East and Southeast Asian students at the .05 confidence level. The null-hypotheses were rejected.

18. The difference in the mean of blood glucose was not statistically significant between the Middle Eastern and the East and Southeast Asian students at the .05 confidence level. The null-hypothesis was accepted.

19. The United States population had a significantly higher mean blood glucose than the Middle Eastern and the East and Southeast Asian students at the .05 confidence level. The null-hypotheses were rejected.

20. The difference in the means of hemoglobin was not statistically significant between the Middle Eastern and the East and Southeast Asian students at the .05 confidence level. The null-hypothesis was accepted.

21. The United States population had a significantly lower mean of hemoglobin than the Middle Eastern and the East and Southeast Asian students at the .05 confidence level. The null-hypotheses were rejected.

22. The differences in the means of the following physical fitness variables were not statistically significant between those foreign students who have been in the United States less than one year and those students who have been in the United States longer than three years at the .05 confidence level. The null-hypotheses were accepted. The fitness variables were:

a) $VO_2$max.

b) VC

c) FVC

d) $FEV_1$

e) $FEV_1$/FVC %

f) MVV

g) Systolic Blood Pressure

h) Diastolic Blood Pressure

i) TC

j) HDL

k) TC/HDL Ratio

l) Glucose

m) Hemoglobin

## Recommendations

There is no question concerning the importance of studying more about the other nationalities or the geographical regions of the world. Therefore, it seems logical to conduct further study of these or other races possibly in their home countries using large numbers of subjects to represent the whole population.

In order to make final conclusions in physical fitness variables of certain races or ethnic groups, more work needs to be done with larger samples using standardized test procedures. It is important to use the same test procedures under the same conditions to obtain valid results from different laboratories around the world. This procedure will enable researchers to make comparisons and/or correlations between the populations or variables.

It is also recommended that diverse population groups should be included in the study rather than limiting the study to just students or another homogenous group.

Finally, longitudinal studies should be used to determine the effects of environmental change on the physical fitness variables of students or populations.

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# APPENDIX A

# RAW DATA

## TABLE XXIV

## PHYSICAL FITNESS COMPONENTS OF MIDDLE EASTERN STUDENTS

| NO. | AGE | GROUP | $VO_2$MAX ml·kg·min | VC Liters | FVC Liters | $FEV_1$ Liters | $FEV_1$/FVC (%) | MVV Liters | BLOOD PRESSURE SYS. mmHg | BLOOD PRESSURE DIAS. mmHg | TC mg/100ml | HDL mg/100ml | TC/HDL | GLUCOSE mg/100ml | HEMOGLOBIN g/100ml |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 28 | 1 | 39 | 5.96 | 5.93 | 4.63 | 78.1 | 174 | 118 | 84 | 189.5 | 58.9 | 3.22 | 83.9 | 14.8 |
| 2 | 22 | 1 | 46 | 5.32 | 5.17 | 4.49 | 86.9 | 168 | 114 | 84 | 125.7 | 20.8 | 6.04 | 60.9 | 16.2 |
| 3 | 21 | 1 | 44.5 | 4.56 | 4.79 | 4.34 | 90.8 | 163 | 120 | 80 | 151.3 | 36 | 4.20 | 39 | 16.2 |
| 4 | 20 | 1 | 44.5 | 5.04 | 5.15 | 4.60 | 89.3 | 173 | 116 | 78 | 167.6 | 32 | 5.24 | 73.9 | 14.8 |
| 5 | 22 | 1 | 44.5 | 4.43 | 4.70 | 4.25 | 90.5 | 159 | 116 | 78 | 203.8 | 47.3 | 4.3 | 72.2 | 15.5 |
| 6 | 20 | 1 | 41 | 6.30 | 6.59 | 5.78 | 87.6 | 217 | 126 | 86 | 140.5 | 29.3 | 4.8 | 65.4 | 16.6 |
| 7 | 20 | 1 | 46 | 4.82 | 5.48 | 4.90 | 89.3 | 184 | 110 | 80 | 154.3 | 36.5 | 4.23 | 82.6 | 15.7 |
| 8 | 23 | 2 | 36 | 4.47 | 4.58 | 3.96 | 86.5 | 149 | 110 | 80 | x | x | x | x | x |
| 9 | 24 | 2 | 44.5 | 5.30 | 5.19 | 4.53 | 87.2 | 170 | 126 | 84 | 194.7 | 57.5 | 3.39 | 64.3 | 17.6 |
| 10 | 25 | 2 | 49 | 6.07 | 5.89 | 4.37 | 74.2 | 164 | 128 | 78 | 219.3 | 43 | 5.1 | 61.1 | 16.7 |
| 11 | 20 | 2 | 41 | 5.37 | 5.48 | 4.60 | 83.9 | 173 | 126 | 80 | 213.8 | 36.4 | 5.87 | 84.6 | 16.2 |
| 12 | 26 | 2 | 39 | 6.18 | 6.18 | 5.28 | 85.4 | 198 | 124 | 90 | 285.7 | 72.9 | 3.92 | 82.6 | 17.8 |
| 13 | 22 | 2 | 41 | 5.12 | 5.16 | 4.24 | 82.3 | 159 | 126 | 84 | x | x | x | x | x |
| 14 | 25 | 2 | 47 | 4.79 | 5.45 | 4.68 | 85.9 | 176 | 124 | 80 | 200 | 45.3 | 4.42 | 65.4 | 16.9 |
| 15 | 30 | 2 | 37.5 | 5.52 | 5.60 | 4.56 | 81.6 | 171 | 126 | 84 | x | x | x | x | x |
| 16 | 26 | 2 | 46 | 4.60 | 5.01 | 3.53 | 70.6 | 133 | 120 | 80 | x | x | x | x | x |
| 17 | 21 | 2 | 46 | 3.72 | 3.72 | 3.31 | 89.1 | 124 | 124 | 84 | 183.8 | 36.7 | 5 | 71.7 | 16.9 |
| 18 | 21 | 2 | 43 | 4.58 | 4.92 | 4.14 | 84.1 | 155 | 110 | 80 | 162.2 | 45.3 | 3.58 | 71.7 | 14.4 |
| 19 | 29 | 2 | 51.9 | 4.84 | 4.98 | 4.25 | 85.4 | 160 | 122 | 80 | 243.2 | 39.3 | 6.19 | 65.2 | 17.5 |
| 20 | 23 | 2 | 47 | 5.93 | 5.93 | 5.06 | 85.4 | 190 | 128 | 84 | x | x | x | x | x |
| 21 | 23 | 2 | 31.5 | 4.82 | 4.97 | 4.31 | 86.7 | 162 | 120 | 90 | 154.3 | 29.9 | 5.16 | 69.5 | 16.6 |
| 22 | 22 | 2 | 43 | 4.67 | 4.96 | 3.96 | 79.9 | 149 | 116 | 76 | 211.1 | 38.3 | 5.51 | 64.6 | 16.6 |
| 23 | 24 | 2 | 36 | 3.62 | 3.77 | 3.55 | 94.2 | 133 | 124 | 88 | x | x | x | x | x |
| 24 | 21 | 2 | 46 | 5.05 | 5.34 | 4.43 | 82.9 | 166 | 132 | 90 | 148.6 | 54.7 | 2.72 | 76.1 | 18.2 |
| 25 | 20 | 2 | 41 | 4.89 | 5.48 | 4.48 | 81.8 | 168 | 110 | 80 | x | x | x | x | x |
| 26 | 23 | 2 | 49 | 4.65 | 4.36 | 4.36 | 100 | 164 | 126 | 78 | 137.5 | 56 | 2.46 | 76.9 | 14.6 |
| 27 | 20 | 2 | 56.9 | 4.65 | 4.95 | 4.58 | 92.7 | 172 | 118 | 76 | 154.8 | 37.8 | 4.1 | 62.9 | 16 |
| 28 | 24 | 3 | 41 | 5.33 | 5.59 | 4.85 | 86.8 | 182 | 128 | 80 | x | x | x | x | x |
| 29 | 24 | 3 | 46 | 2.61 | 3.24 | 2.12 | 65.4 | 79 | 114 | 76 | 113.5 | 30 | 3.78 | 91.3 | 14.8 |
| 30 | 24 | 3 | 47 | 4.53 | 4.75 | 3.83 | 80.6 | 144 | 122 | 84 | 156.7 | 32 | 4.9 | 71.7 | 16.6 |
| 31 | 22 | 3 | 43 | 4.93 | 5.07 | 4.37 | 86.1 | 164 | 116 | 72 | 136.8 | 47.1 | 2.9 | 73.2 | 16.2 |
| 32 | 27 | 3 | 31.5 | 4.00 | 4.22 | 3.26 | 77.2 | 122 | 116 | 78 | 177.8 | 44.9 | 3.96 | 74 | 15.8 |
| 33 | 26 | 3 | 43 | 4.54 | 4.57 | 3.84 | 84 | 144 | 124 | 80 | 131.4 | 41.7 | 3.15 | 69.5 | 16.6 |
| 34 | 24 | 3 | 47 | 4.39 | 4.35 | 3.84 | 88.7 | 144 | 130 | 80 | x | x | x | x | x |
| 35 | 20 | 3 | 46 | 5.60 | 5.82 | 4.82 | 82.9 | 181 | 124 | 84 | 190.5 | 45.6 | 4.18 | 72 | 16.8 |
| 36 | 27 | 3 | 46 | 5.12 | 5.34 | 4.35 | 81.5 | 163 | 120 | 80 | 203.8 | 54.8 | 3.72 | 66.7 | 16.2 |
| 37 | 24 | 3 | 43 | 4.98 | 5.01 | 4.87 | 97.1 | 183 | 114 | 80 | 105.5 | 47.1 | 2.24 | 79.2 | 16.9 |
| 38 | 27 | 3 | 53.6 | 5.89 | 5.93 | 4.64 | 78.3 | 174 | 118 | 84 | 203 | 47 | 4.32 | 81 | 16 |
| 39 | 29 | 3 | 43 | 5.12 | 4.94 | 4.17 | 84.4 | 156 | 118 | 68 | 187.5 | 45.3 | 4.14 | 65.4 | 16.4 |
| 40 | 24 | 3 | 37.5 | 5.34 | 5.34 | 4.97 | 93.1 | 186 | 112 | 76 | 137 | 50.8 | 2.7 | 65.2 | 16.2 |

# TABLE XXV

## PHYSICAL FITNESS COMPONENTS OF EAST AND SOUTHEAST ASIAN STUDENTS

| NO. | AGE | GROUP | $VO_2MAX$ ml·kg·min | VC Liters | FVC Liters | $FEV_1$ Liters | $FEV_1/FVC$ (%) | MVV Liters | BLOOD PRESSURE SYS. | DIAS. mmHg | TC mg/100ml | HDL mg/100ml | TC/HDL | GLUCOSE mg/100ml | HEMOGLOBIN g/100ml |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 24 | 1 | 36 | 3.04 | 3.59 | 3.26 | 90.7 | 122 | 110 | 84 | 167.6 | 26.7 | 6.28 | 80.8 | 15.5 |
| 2 | 25 | 1 | 39 | 4.74 | 4.82 | 4.22 | 87.4 | 158 | 110 | 76 | 238.7 | 37.8 | 6.31 | 96.3 | 17.1 |
| 3 | 20 | 1 | 46 | 5.41 | 6.00 | 4.52 | 75.3 | 169 | 118 | 80 | x | x | x | x | x |
| 4 | 29 | 1 | 44.5 | 3.80 | 3.84 | 3.15 | 81.9 | 118 | 116 | 90 | x | x | x | x | x |
| 5 | 20 | 1 | 47 | 5.56 | 5.60 | 4.79 | 85.5 | 179 | 116 | 76 | 121.6 | 36 | 3.38 | 71.7 | 16.9 |
| 6 | 20 | 1 | 39 | 4.19 | 4.47 | 3.99 | 89.2 | 150 | 114 | 80 | 193.5 | 38.4 | 5.04 | 66.7 | 16.4 |
| 7 | 22 | 1 | 44.5 | 3.96 | 3.31 | 3.31 | 100 | 124 | 118 | 80 | 165.7 | 37.8 | 4.38 | 75.9 | 17.6 |
| 8 | 22 | 1 | 41 | 3.91 | 4.03 | 3.91 | 97 | 147 | 128 | 80 | 200 | 58.9 | 3.4 | 65 | 16 |
| 9 | 29 | 1 | 39 | 4.98 | 5.05 | 4.50 | 89.1 | 169 | 114 | 74 | 113.2 | 53.4 | 2.12 | 70.4 | 16.6 |
| 10 | 23 | 1 | 37.5 | 4.83 | 4.98 | 4.21 | 84.6 | 158 | 120 | 80 | 206.9 | 49 | 4.22 | 69.2 | 16.9 |
| 11 | 30 | 2 | 43 | 4.93 | 5.15 | 4.22 | 82 | 158 | 114 | 76 | 123 | 39.7 | 3.1 | 48.1 | 15.8 |
| 12 | 22 | 2 | 44.5 | 2.09 | 2.26 | 1.93 | 85.4 | 72 | 114 | 80 | x | x | x | x | x |
| 13 | 26 | 2 | 39 | 3.99 | 4.13 | 3.70 | 89.4 | 139 | 126 | 76 | x | x | x | x | x |
| 14 | 22 | 2 | 43 | 5.16 | 5.16 | 4.24 | 82.3 | 159 | 136 | 84 | x | x | x | x | x |
| 15 | 30 | 2 | 44.5 | 4.72 | 4.72 | 3.88 | 82.2 | 146 | 126 | 90 | x | x | x | x | x |
| 16 | 20 | 2 | 43 | 3.02 | 3.07 | 3.02 | 98.6 | 113 | 118 | 78 | 117.1 | 44.3 | 2.64 | 84.8 | 16.9 |
| 17 | 20 | 2 | 47 | 4.19 | 4.44 | 3.85 | 86.7 | 144 | 116 | 76 | 187 | 41.7 | 4.48 | 55.5 | 16.9 |
| 18 | 20 | 2 | 44.5 | 4.05 | 4.23 | 3.64 | 86.1 | 137 | 130 | 90 | 142.8 | 40.4 | 3.53 | 82.6 | 15.8 |
| 19 | 20 | 2 | 43 | 4.28 | 4.23 | 4.13 | 97.7 | 155 | 124 | 86 | 145.9 | 24 | 5.2 | 78.3 | 14.8 |
| 20 | 22 | 2 | 47 | 4.57 | 4.57 | 4.10 | 89.6 | 154 | 116 | 70 | 140.5 | 46.7 | 3.0 | 78.3 | 15.5 |
| 21 | 29 | 2 | 36 | 4.13 | 4.17 | 3.62 | 86.8 | 136 | 114 | 74 | x | x | x | x | x |
| 22 | 26 | 2 | 41 | 3.29 | 2.17 | 1.70 | 78.6 | 64 | 110 | 76 | 138.9 | 45.8 | 3.03 | 79.2 | 19.1 |
| 23 | 22 | 2 | 37.5 | 3.55 | 3.42 | 2.91 | 85.1 | 109 | 114 | 80 | 150 | 53.4 | 2.8 | 56.2 | 17 |
| 24 | 27 | 2 | 39 | 4.20 | 4.20 | 3.72 | 88.6 | 139 | 116 | 70 | x | x | x | x | x |
| 25 | 20 | 2 | 43 | 2.75 | 2.94 | 2.66 | 90.4 | 100 | 114 | 74 | x | x | x | x | x |
| 26 | 22 | 2 | 44.5 | 3.15 | 3.33 | 3.19 | 95.6 | 119 | 110 | 78 | 173.6 | 49 | 3.54 | 77.8 | 18 |
| 27 | 25 | 2 | 36 | 4.42 | 5.04 | 4.50 | 89.3 | 169 | 116 | 80 | 196.2 | 45.5 | 4.31 | 66.7 | 15.1 |
| 28 | 20 | 2 | 39 | 4.88 | 5.03 | 4.47 | 88.9 | 168 | 118 | 80 | 139.6 | 49 | 2.85 | 105.9 | 15.5 |
| 29 | 24 | 2 | 36 | 2.87 | 2.50 | 2.50 | 100 | 94 | 104 | 72 | 135.1 | 28 | 4.82 | 78.3 | 14 |
| 30 | 22 | 3 | 41 | 4.86 | 4.97 | 4.82 | 97 | 181 | 120 | 80 | 110 | 33.9 | 3.24 | 86.4 | 16.6 |
| 31 | 23 | 3 | 56.9 | 5.52 | 5.52 | 4.53 | 82 | 170 | 124 | 86 | 155.5 | 39.4 | 3.95 | 50 | 18 |
| 32 | 28 | 3 | 41 | 4.23 | 4.56 | 2.21 | 48.4 | 83 | 114 | 78 | 124.3 | 26.7 | 4.65 | 76.9 | 15.1 |
| 33 | 30 | 3 | 44.5 | 5.15 | 5.19 | 4.11 | 79.3 | 154 | 116 | 78 | 147.4 | 38.3 | 3.85 | 53.6 | 17.1 |
| 34 | 24 | 3 | 43 | 5.34 | 4.86 | 4.86 | 100 | 182 | 126 | 74 | 116.2 | 30.7 | 3.78 | 69.2 | 16.9 |
| 35 | 25 | 3 | 43 | 4.98 | 4.84 | 3.67 | 75.9 | 138 | 122 | 82 | 162.8 | 47.5 | 3.43 | 121.7 | 14.4 |
| 36 | 25 | 3 | 43 | 5.74 | 5.78 | 4.96 | 85.9 | 186 | 136 | 90 | 180.6 | 51.4 | 3.51 | 59.2 | 16.6 |
| 37 | 28 | 3 | 33.9 | 6.89 | 7.08 | 5.80 | 81.9 | 218 | 128 | 90 | 219 | 33.9 | 6.46 | 111.1 | 16.4 |
| 38 | 30 | 3 | 44.5 | 3.51 | 3.80 | 3.70 | 97.1 | 139 | 132 | 90 | 145.9 | 32 | 4.56 | 69.5 | 15.1 |
| 39 | 28 | 3 | 36 | 3.99 | 3.99 | 3.17 | 79.4 | 119 | 120 | 80 | 256.7 | 71.8 | 3.58 | 63 | 15.5 |
| 40 | 26 | 3 | 43 | 2.38 | 2.54 | 2.07 | 81.5 | 78 | 108 | 74 | 151.3 | 46 | 3.36 | 64.5 | 15.5 |

TABLE XXVI

SMOKING, ALCOHOL, EXERCISE AND DIET HABITS, SOCIOECONOMIC CLASS OF MIDDLE EASTERN STUDENTS

| Subj No. | Smok | Alco | Exer | Vege | Meat Eater | Beef | Lamb | Pork | Poul | Fish | Rice | Pota | Bean | Lett Toma etc. | Dairy | Eggs | Trop Fruits | Fruit | Cake and Sweets | Class |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | H-US | H-US | H-US | H-US | H-US | H-US | H-US | H-US | H-US | H-US | H-US | H-US | H-US | H-US | H-US | H-US | H-US | |
| 1 | N | N | H-N | N-N | Y-Y | Y-Y | Y-N | N-N | N-N | N-N | Y-Y | Y-Y | Y-N | Y-Y | N-N | Y-Y | N-N | Y-Y | N-Y | M |
| 2 | Y | N | L-N | N-N | Y-Y | Y-Y | Y-N | N-N | Y-N | N-N | N-N | Y-N | Y-N | Y-Y | N-N | Y-Y | N-N | Y-Y | N-N | M |
| 3 | N | Y | N-N | N-N | Y-Y | Y-Y | Y-N | N-N | N-N | N-N | Y-N | N-N | Y-N | Y-Y | N-N | N-N | N-N | Y-Y | Y-Y | M |
| 4 | N | N | L-L | N-N | Y-Y | Y-Y | Y-N | N-N | N-N | N-N | Y-N | Y-Y | N-N | Y-Y | Y-Y | Y-Y | N-N | Y-Y | Y-Y | M |
| 5 | N | N | L-N | Y-Y | N-N | N-N | N-N | N-N | N-N | N-N | Y-Y | Y-Y | Y-Y | Y-Y | Y-Y | Y-Y | N-N | Y-Y | Y-Y | M |
| 6 | Y | Y | N-N | N-N | Y-Y | N-Y | Y-N | Y-Y | Y-N | Y-Y | Y-N | N-Y | N-N | Y-Y | N-N | Y-Y | N-N | Y-Y | Y-Y | H |
| 7 | N | N | L-L | N-N | Y-Y | Y-Y | Y-N | N-N | Y-Y | Y-N | Y-N | Y-N | Y-N | Y-Y | Y-Y | N-N | N-N | Y-Y | N-Y | M |
| 8 | N | N | L-N | N-N | Y-Y | Y-Y | Y-N | N-N | N-N | Y-Y | N-N | Y-Y | Y-Y | Y-Y | N-N | Y-Y | N-N | Y-Y | Y-Y | M |
| 9 | N | N | L-L | N-N | Y-Y | Y-Y | Y-N | N-N | N-Y | N-N | Y-N | Y-Y | Y-N | Y-Y | N-Y | N-N | N-N | Y-Y | N-N | M |
| 10 | Y | Y | L-L | N-N | Y-Y | Y-Y | Y-N | N-N | Y-Y | N-N | Y-N | Y-Y | Y-N | Y-Y | Y-Y | Y-Y | N-N | Y-Y | N-N | M |
| 11 | N | Y | N-N | N-N | Y-Y | Y-Y | Y-N | N-N | Y-Y | N-N | Y-Y | Y-Y | Y-N | Y-Y | Y-Y | Y-Y | N-N | Y-Y | N-Y | M |
| 12 | N | N | L-L | N-N | Y-Y | N-Y | Y-N | N-Y | N-Y | Y-Y | Y-Y | Y-N | Y-N | Y-Y | Y-Y | Y-Y | N-N | Y-Y | Y-Y | M |
| 13 | N | N | L-L | N-N | Y-Y | Y-Y | Y-N | N-N | N-Y | N-N | Y-N | Y-N | Y-N | Y-Y | N-N | N-N | N-N | Y-Y | Y-Y | M |
| 14 | N | N | L-L | N-N | Y-Y | N-Y | Y-N | N-N | N-N | N-N | Y-N | Y-Y | Y-N | Y-Y | Y-Y | Y-Y | N-N | Y-Y | N-N | M |
| 15 | N | Y | M-L | N-N | Y-Y | Y-Y | Y-Y | N-N | Y-Y | N-N | Y-Y | Y-Y | Y-Y | Y-Y | Y-Y | Y-Y | N-N | Y-Y | Y-Y | H |
| 16 | N | N | H-L | N-N | Y-Y | Y-Y | Y-Y | N-N | N-N | N-N | Y-Y | Y-Y | Y-Y | Y-Y | Y-Y | Y-Y | N-N | Y-Y | Y-Y | M |
| 17 | N | Y | L-L | N-N | Y-Y | Y-Y | Y-N | N-N | Y-Y | N-N | Y-Y | Y-Y | Y-N | Y-Y | Y-Y | Y-Y | N-N | Y-Y | N-N | M |
| 18 | N | N | M-M | N-N | Y-Y | Y-Y | Y-N | N-N | N-Y | N-N | Y-Y | Y-Y | Y-N | Y-Y | Y-Y | N-Y | N-N | Y-Y | Y-Y | M |
| 19 | Y | Y | H-L | N-N | Y-Y | Y-Y | Y-N | N-N | N-Y | N-N | Y-Y | Y-Y | Y-N | Y-Y | Y-Y | N-Y | N-N | Y-Y | Y-Y | M |
| 20 | N | N | M-N | N-N | Y-Y | Y-Y | Y-Y | N-N | Y-Y | N-N | N-N | Y-Y | N-N | Y-Y | N-N | Y-Y | N-N | Y-Y | N-N | M |
| 21 | N | N | N-N | N-N | Y-Y | Y-Y | Y-Y | N-N | N-N | N-N | Y-Y | Y-Y | Y-Y | Y-Y | N-N | N-N | N-N | Y-Y | Y-Y | M |
| 22 | Y | N | L-L | N-N | Y-Y | N-Y | Y-N | N-N | Y-Y | N-N | Y-N | Y-Y | Y-N | Y-Y | N-N | Y-Y | N-N | Y-Y | N-N | M |
| 23 | N | N | L-N | N-N | Y-Y | N-Y | Y-Y | N-N | N-N | Y-N | Y-Y | Y-Y | Y-N | Y-N | N-N | N-N | N-N | Y-Y | N-Y | H |
| 24 | N | N | M-N | N-N | Y-Y | Y-Y | Y-N | N-N | N-N | Y-Y | Y-Y | N-N | Y-Y | Y-Y | Y-Y | N-N | N-N | Y-Y | N-N | M |
| 25 | N | N | N-N | N-N | Y-Y | N-Y | Y-N | N-N | Y-Y | Y-N | Y-N | N-N | Y-N | N-N | Y-Y | Y-Y | N-N | Y-Y | Y-Y | H |
| 26 | N | Y | H-M | N-N | Y-Y | N-Y | Y-N | N-N | Y-Y | N-N | Y-Y | N-Y | Y-N | Y-Y | Y-Y | N-Y | N-N | Y-Y | Y-N | H |
| 27 | N | N | N-L | N-N | Y-Y | Y-Y | Y-N | N-N | N-N | N-N | Y-N | Y-Y | Y-N | Y-Y | N-Y | N-N | N-N | Y-Y | N-N | M |
| 28 | N | N | L-N | N-N | Y-Y | Y-Y | Y-Y | N-N | Y-Y | N-N | Y-Y | N-N | Y-Y | Y-Y | N-N | N-N | N-N | Y-Y | Y-Y | H |
| 29 | Y | N | L-L | N-N | Y-Y | N-Y | Y-N | N-N | Y-Y | N-N | Y-Y | Y-Y | Y-Y | Y-Y | Y-Y | Y-Y | N-N | Y-Y | N-N | M |
| 30 | N | Y | N-N | N-N | Y-Y | N-Y | Y-Y | N-N | N-N | N-N | Y-Y | Y-Y | Y-Y | Y-Y | Y-Y | Y-Y | N-N | Y-Y | N-N | M |
| 31 | N | N | M-M | N-N | Y-Y | N-Y | Y-N | N-N | N-N | N-N | Y-Y | Y-Y | Y-N | Y-Y | N-N | N-N | N-N | Y-Y | N-Y | M |
| 32 | Y | N | N-N | N-N | Y-Y | Y-Y | Y-Y | N-N | Y-Y | N-N | Y-Y | Y-Y | Y-Y | Y-Y | Y-Y | Y-Y | N-N | Y-Y | N-N | M |
| 33 | N | N | L-N | N-N | Y-Y | N-N | Y-Y | N-N | N-Y | N-N | Y-Y | Y-Y | Y-Y | Y-Y | Y-Y | N-N | N-N | Y-Y | N-N | M |
| 34 | N | N | M-L | N-N | Y-Y | Y-Y | Y-N | N-N | Y-Y | N-N | Y-Y | Y-N | Y-Y | Y-Y | Y-Y | Y-Y | N-N | Y-Y | Y-Y | M |
| 35 | N | N | M-M | N-N | Y-Y | Y-Y | Y-N | N-N | Y-Y | Y-N | Y-N | Y-Y | Y-N | Y-Y | N-N | Y-Y | N-N | Y-Y | N-N | M |
| 36 | N | N | L-H | N-N | Y-Y | Y-Y | Y-N | N-N | N-Y | N-Y | Y-Y | Y-N | Y-Y | Y-Y | Y-Y | N-Y | N-N | Y-Y | Y-Y | M |
| 37 | N | Y | M-M | Y-Y | N-N | N-N | N-N | N-N | N-N | N-N | Y-Y | Y-Y | Y-Y | Y-Y | N-N | Y-Y | N-N | Y-Y | Y-Y | M |
| 38 | N | Y | H-H | N-N | Y-Y | N-Y | Y-N | N-N | Y-Y | N-N | Y-Y | N-Y | Y-Y | Y-Y | Y-Y | Y-Y | N-N | Y-Y | Y-Y | M |
| 39 | N | N | M-L | N-N | Y-Y | N-Y | Y-N | N-Y | N-N | N-N | Y-Y | Y-Y | Y-N | Y-Y | Y-Y | Y-Y | N-N | Y-Y | Y-Y | M |
| 40 | N | Y | H-L | Y-Y | N-N | N-N | N-N | N-N | N-N | N-N | Y-Y | Y-Y | Y-Y | Y-Y | N-N | Y-Y | N-N | Y-Y | Y-Y | M |

EXERCISE: N = None
L = Light (1-2 times/week)
M = Moderate (3-4 times/week)
H = Heavy (5 or more times/week)

SOCIOECONOMIC CLASS: L = Lower Class
M = Middle Class
H = Higher Class

TABLE XXVII

SMOKING, ALCOHOL, EXERCISE AND DIET HABITS, AND SOCIOECONOMIC CLASS OF EAST AND SOUTHEAST ASIAN STUDENTS

| Subj No. | Smok | Alco | Exer | Vege | Meat Eater | Beef | Lamb | Pork | Poul | Fish | Rice | Pota | Bean | Lett Toma etc. | Dairy | Eggs | Trop Fruits | Fruit | Cake and Sweets | Class |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | H-US | H-US | H-US | H-US | H-US | H-US | H-US | H-US | H-US | H-US | H-US | H-US | H-US | H-US | H-US | H-US | H-US | |
| 1 | Y | N | L-L | N-N | Y-Y | Y-Y | N-N | N-N | Y-Y | Y-N | Y-N | N-Y | N-N | Y-Y | Y-Y | N-N | Y-N | N-Y | N-N | M |
| 2 | N | N | L-N | N-N | Y-Y | N-Y | N-N | Y-Y | Y-Y | N-N | Y-N | N-N | Y-N | Y-N | Y-Y | Y-Y | Y-N | N-Y | N-N | M |
| 3 | N | N | M-L | N-N | Y-Y | N-N | N-N | Y-Y | N-N | Y-Y | Y-N | N-Y | Y-N | Y-Y | Y-Y | N-N | N-N | Y-Y | N-Y | M |
| 4 | Y | N | N-N | N-N | Y-Y | Y-Y | N-N | Y-Y | N-Y | Y-N | Y-N | N-Y | Y-N | Y-Y | N-N | Y-Y | N-N | Y-Y | N-N | M |
| 5 | N | N | M-L | N-N | Y-Y | Y-Y | N-N | N-N | Y-Y | Y-N | Y-Y | Y-Y | N-N | Y-Y | Y-Y | N-N | Y-N | N-Y | N-N | M |
| 6 | N | N | N-N | N-N | Y-Y | N-Y | N-N | Y-Y | Y-Y | Y-N | Y-N | Y-Y | Y-N | Y-Y | N-Y | Y-Y | Y-N | N-Y | N-N | M |
| 7 | N | N | L-N | N-N | Y-Y | N-Y | N-N | Y-Y | N-N | Y-Y | Y-N | N-Y | Y-Y | Y-Y | Y-Y | N-N | Y-N | N-Y | N-N | M |
| 8 | N | N | L-L | N-N | Y-Y | Y-Y | Y-N | Y-Y | Y-Y | Y-N | Y-N | N-Y | Y-N | Y-Y | Y-Y | N-Y | Y-N | N-Y | N-Y | M |
| 9 | N | Y | L-L | N-N | Y-Y | Y-Y | N-N | Y-Y | Y-Y | N-N | Y-Y | N-N | Y-Y | Y-Y | Y-Y | Y-Y | Y-N | N-Y | Y-Y | M |
| 10 | N | N | L-L | N-N | Y-Y | Y-Y | N-N | Y-Y | Y-Y | Y-N | Y-N | N-Y | N-N | Y-Y | Y-Y | N-Y | Y-N | N-Y | Y-Y | M |
| 11 | Y | N | L-N | N-N | Y-Y | Y-Y | N-N | Y-Y | Y-Y | Y-N | Y-Y | Y-Y | Y-Y | Y-N | N-N | N-N | Y-N | N-Y | Y-Y | M |
| 12 | N | N | L-L | N-N | Y-Y | Y-Y | N-N | Y-Y | N-N | N-N | Y-Y | N-N | Y-Y | Y-Y | N-N | Y-Y | Y-N | N-Y | Y-N | M |
| 13 | Y | N | L-N | N-N | Y-Y | Y-Y | N-N | Y-Y | Y-Y | Y-Y | Y-Y | Y-Y | Y-Y | Y-Y | Y-Y | Y-Y | N-N | Y-Y | N-Y | H |
| 14 | N | Y | M-L | N-N | Y-Y | Y-Y | N-N | N-N | Y-Y | Y-N | Y-Y | N-N | N-N | Y-Y | Y-Y | Y-Y | Y-N | N-Y | Y-Y | H |
| 15 | Y | Y | L-L | N-N | Y-Y | Y-Y | N-N | Y-Y | Y-Y | N-N | Y-N | N-Y | Y-N | Y-Y | Y-N | Y-N | N-N | Y-Y | N-N | M |
| 16 | N | N | L-N | N-N | Y-Y | Y-Y | N-N | N-N | N-N | Y-N | Y-Y | N-N | N-N | Y-Y | N-Y | Y-Y | Y-N | N-Y | N-N | M |
| 17 | N | N | H-L | N-N | Y-Y | Y-Y | N-N | N-N | Y-Y | Y-N | Y-Y | N-N | Y-Y | Y-Y | Y-Y | Y-Y | Y-N | N-Y | N-N | M |
| 18 | N | N | H-L | N-N | Y-Y | N-N | N-N | N-N | Y-Y | Y-Y | Y-Y | N-N | N-N | Y-Y | Y-Y | N-N | Y-N | N-Y | N-N | L |
| 19 | N | N | L-Y | N-N | Y-Y | Y-Y | Y-Y | N-N | N-N | Y-Y | Y-Y | Y-Y | N-N | Y-Y | Y-Y | Y-Y | Y-N | N-Y | N-N | M |
| 20 | N | N | L-L | N-N | Y-Y | N-Y | N-N | Y-Y | N-N | Y-N | Y-N | N-Y | N-N | Y-Y | Y-Y | N-N | Y-N | N-Y | N-N | M |
| 21 | Y | N | N-N | N-N | Y-Y | N-N | N-N | Y-Y | Y-Y | N-N | Y-Y | N-N | Y-Y | Y-Y | Y-Y | Y-Y | Y-N | N-Y | Y-Y | M |
| 22 | N | Y | L-N | N-N | Y-Y | N-Y | N-N | Y-Y | N-N | N-N | Y-N | Y-Y | Y-N | Y-Y | Y-Y | Y-Y | Y-N | N-Y | N-N | M |
| 23 | N | Y | M-L | N-N | Y-Y | Y-Y | N-N | Y-Y | Y-Y | N-N | Y-Y | Y-N | N-N | Y-Y | N-Y | Y-Y | Y-N | N-Y | Y-N | M |
| 24 | N | N | M-N | N-N | Y-Y | Y-Y | N-N | Y-Y | N-N | N-N | Y-Y | N-N | N-N | Y-Y | Y-Y | Y-Y | Y-N | N-Y | N-N | M |
| 25 | N | N | M-L | N-N | Y-Y | Y-Y | N-N | N-N | Y-Y | N-N | Y-N | N-Y | Y-N | Y-Y | Y-Y | Y-Y | Y-N | N-Y | N-N | M |
| 26 | N | Y | M-M | N-N | Y-Y | Y-Y | N-N | Y-Y | Y-Y | Y-Y | Y-Y | N-N | N-N | Y-Y | Y-Y | Y-Y | N-N | Y-Y | N-N | H |
| 27 | Y | N | M-N | N-N | Y-Y | Y-Y | N-N | Y-Y | Y-Y | N-N | Y-Y | N-N | N-N | Y-Y | Y-Y | Y-Y | Y-N | N-Y | N-N | M |
| 28 | Y | Y | L-N | N-N | Y-Y | Y-Y | N-N | Y-Y | Y-Y | N-N | Y-Y | N-Y | N-N | Y-Y | N-N | Y-Y | Y-N | N-Y | Y-Y | H |
| 29 | N | Y | N-N | N-N | Y-Y | Y-Y | N-N | Y-Y | Y-Y | N-N | Y-Y | N-Y | N-Y | Y-Y | Y-Y | Y-Y | Y-N | N-Y | N-N | M |
| 30 | Y | Y | N-N | N-N | Y-Y | Y-Y | N-N | Y-Y | Y-Y | N-N | Y-Y | Y-Y | Y-Y | Y-Y | N-N | Y-Y | N-N | Y-Y | N-N | M |
| 31 | N | N | M-H | N-N | Y-Y | N-Y | N-N | Y-Y | Y-Y | N-N | Y-N | Y-Y | N-N | Y-Y | Y-Y | Y-Y | N-N | Y-Y | N-N | M |
| 32 | Y | Y | L-N | N-N | Y-Y | Y-Y | N-N | N-N | Y-Y | N-N | Y-Y | N-N | N-N | Y-Y | N-N | N-N | Y-N | N-Y | Y-Y | M |
| 33 | N | Y | M-N | N-N | Y-Y | Y-Y | N-N | N-N | Y-N | N-N | Y-Y | N-N | Y-Y | Y-Y | Y-Y | N-N | N-N | Y-Y | N-N | M |
| 34 | N | N | L-L | N-N | Y-Y | Y-Y | N-N | Y-Y | Y-Y | Y-Y | Y-Y | Y-Y | Y-Y | Y-Y | Y-Y | N-N | Y-N | N-Y | Y-Y | M |
| 35 | N | N | M-L | N-N | Y-Y | N-N | N-N | Y-Y | N-N | Y-Y | Y-Y | N-N | Y-Y | Y-Y | N-N | N-N | Y-N | N-Y | Y-Y | M |
| 36 | N | N | L-N | N-N | Y-Y | N-N | N-N | Y-Y | Y-Y | N-N | Y-Y | N-N | Y-N | Y-Y | N-N | N-N | Y-N | N-Y | N-N | M |
| 37 | Y | N | L-N | N-N | Y-Y | Y-Y | Y-Y | Y-Y | N-N | N-N | Y-Y | Y-Y | Y-Y | Y-Y | Y-Y | Y-Y | Y-N | N-Y | Y-Y | M |
| 38 | N | N | M-N | N-N | Y-Y | Y-Y | N-N | Y-Y | N-N | Y-N | Y-Y | N-N | Y-Y | Y-Y | Y-Y | N-N | N-N | Y-Y | N-N | M |
| 39 | N | N | M-N | N-N | Y-Y | Y-Y | N-N | Y-Y | Y-Y | N-N | Y-Y | N-N | N-N | Y-Y | N-N | Y-Y | Y-N | N-Y | Y-Y | M |
| 40 | N | Y | M-N | N-N | Y-Y | Y-Y | N-N | Y-Y | Y-Y | N-N | Y-N | N-Y | Y-N | Y-Y | Y-Y | Y-Y | Y-N | N-Y | Y-Y | M |

EXERCISE: N = None
L = Light (1-2 times/week)
M = Moderate (3-4 times/week)
H = Heavy (5 or more times/week)

SOCIOECONOMIC CLASS: L = Lower Class
M = Middle Class
H = Higher Class

# APPENDIX B

# ADDITIONAL DATA

HEALTH AND FITNESS CENTER
Oklahoma State University

The following information is needed for our records and in assessing your current health and fitness status. By providing as much of this information as possible in advance, time will be saved during the evaluation. All information provided will be held in strict confidence.

NAME ______________________________ DATE ______________________________

ADDRESS: Street ______________ City ______________ State ______ ZIP ______

HOME PHONE ______________ EMPLOYER ______________________________

OCCUPATION ______________ BUSINESS ADDRESS ______________ PHONE ______

AGE LAST BIRTHDAY ______ BIRTH YEAR ______ Does your job require physical activity? ______

Do you currently smoke? _____ If so, what? ______________ number/day ______
If not, have you ever smoked? _____ If yes, what? ______________ no/yrs _____ yrs. quit _____

Do you ever drink alcoholic beverages? _____ If yes, approx. no.: less than 1/day _____
1-2 per day _____ 3 or more per day _____

Do you currently participate in any form of exercise on a regular basis? ______
Indicate no. of times/weekly of participation: walking _____ jogging _____ swim _____
golf _____ basketball _____ handball/racquetball _____ tennis _____ other (name) _____
If you walk, job or swim, please indicate distance and time covered each session and approximate pace ______________________________

What is your estimate of your current medical condition? ex.___ good___ fair___ poor___
What is your estimate of your current physical fitness? ex.___ good___ fair___ poor___

Circle the number of blood relatives (parents, grandparents, brothers, sisters, that have been diagnosed as having some form of heart disease:
Under 60 years of age: 1 2 3 4 5 6 7 8 9 Over 60 years of age: 1 2 3 4 5 6 7 8 9

Have you ever been told that you have any form of heart disease? _____
Have you ever been told that you have diabetes? _____
Do you have blood relatives with diabetes? _____ If so, how many? _____

Do you consider yourself to be overweight? _____ If so, approx. how many lbs.? _____
Do you have any medical conditions (other than heart disease or diabetes) that might affect your exercise performance? _____ If so, please list ______________

Who is your family physician? ______________ City ______________
Address, if known ______________ date last medical exam ______________
Would you like your stress test records sent to this physician? _____
If you would prefer to have your records sent to another physician, please list name and address ______________________________

Are you currently taking any kind of medication? _____
If yes, is it non-prescription? _____ If so, name ______________
If yes, is it prescription? _____ If yes, give name if possible ______________

Have you ever been told that you had high cholesterol or high triglyceride levels in the blood? Cholesterol: yes___ no___ Triglyceride: yes___ no___

If you know your cholesterol and/or triglyceride levels, please list

Cholesterol _________ Triglyceride _________

Treadmill Results

NAME ______________________ AGE ________ SEX ________ DATE ____________

Resting: Heart Rate Blood Pressure Cat. ______________

Supine ______________ ______/______

Standing ______________ ______/______

3.4 mph

| Grade | METS | / 02 | Heart Rate | BP | EKG Comments |
|---|---|---|---|---|---|
| 0 | 3.4 | 11.2 | | | |
| 2 | 4.2 | 14.5 | | | |
| 3 | 4.7 | 16.5 | | | |
| 4 | 5.1 | 18.0 | | | |
| 5 | 5.7 | 20.0 | | | |
| 6 | 6.1 | 21.5 | | | |
| 7 | 6.6 | 23.0 | | | |
| 8 | 7.1 | 24.5 | | | |
| 9 | 7.5 | 26.5 | | | |
| 10 | 8.0 | 28.0 | | | |
| 11 | 8.5 | 29.5 | | | |
| 12 | 9.0 | 31.5 | | | |
| 13 | 9.4 | 33.9 | | | |
| 14 | 9.9 | 34.5 | | | |
| 15 | 10.3 | 36.0 | | | |
| 16 | 10.8 | 37.5 | | | |
| 17 | 11.2 | 39.0 | | | |
| 18 | 11.7 | 41.0 | | | |
| 19 | 12.2 | 43.0 | | | |
| 20 | 12.7 | 44.5 | | | 21-32 cont. on back |

Recovery: HR BP

3 min. ______________ ________/________

5 min. ______________ ________/________

8 min. ______________ ________/________

Reasons for Stopping: Anxiety ☐ Dyspnea ☐ Nausea ☐ Dizziness ☐ Chest Pain ☐
Leg Weakness ☐ Claudication ☐ Gen. Fatigue ☐
Hypotension ☐ EKG Changes ☐ Hypertension ☐
Other ________________________________

| Grade | METS / 02 | | Heart Rate | BP | EKG Comments |
|---|---|---|---|---|---|
| 21 | 13.2 | 46.0 | | | |
| 22 | 13.6 | 47.0 | | | |
| 23 | 14.0 | 49.0 | | | |
| 24 | 14.9 | 51.9 | | | |
| 25 | 15.3 | 53.6 | | | |
| 26 | 15.8 | 55.7 | | | |
| 27 | 16.3 | 56.9 | | | |
| 28 | 16.7 | 58.5 | | | |
| 29 | 17.2 | 60.2 | | | |
| 30 | 17.7 | 61.8 | | | |
| 31 | 18.13 | 63.5 | | | |
| 32 | 18.6 | 65.1 | | | |

Cooper's Fitness Classification: Men

| Category | Measure $O^2$ml/kg/min | Age 13-19 | 20-29 | 30-39 | 40-49 | 50-59 | 60+ |
|---|---|---|---|---|---|---|---|
| I. Very Poor | | < 35.0 | < 33.0 | < 31.5 | < 30.2 | < 26.1 | < 20. |
| II. Poor | | 35.0-38.3 | 33.0-36.4 | 31.5-35.4 | 30.2-33.5 | 26.1-30.9 | 20.5-26. |
| III. Fair | | 38.4-45.1 | 36.5-42.4 | 35.5-40.9 | 33.6-38.9 | 31.0-35.7 | 26.1-32. |
| IV. Good | | 45.2-50.9 | 42.5-46.4 | 41.0-44.9 | 39.0-43.7 | 35.8-40.9 | 32.2-36. |
| V. Excellent | | 51.0-55.9 | 46.5-52.4 | 45.0-49.4 | 43.8-48.0 | 41.0-45.3 | 36.5-44. |
| VI. Superior | | > 56.0 | > 52.5 | > 49.5 | > 48.1 | > 45.4 | > 44. |

Coopers Fitness Classification: Women

| Category | Measure $O^2$ml/kg/min | Age 13-19 | 20-29 | 30-39 | 40-49 | 50-59 | 60+ |
|---|---|---|---|---|---|---|---|
| I. Very Poor | | < 25.0 | < 23.6 | < 22.8 | < 21.0 | < 20.2 | < 17. |
| II. Poor | | 25.0-30.9 | 23.6-28.9 | 22.8-26.9 | 21.0-26.4 | 20.2-22.7 | 17.5-20. |
| III. Fair | | 31.0-34.9 | 29.0-32.9 | 27.0-31.4 | 24.5-28.9 | 22.8-26.9 | 20.2-24. |
| IV. Good | | 35.0-38.9 | 33.0-36.9 | 31.5-35.6 | 29.0-32.8 | 27.0-31.4 | 24.5-30. |
| V. Excellent | | 39.0-41.9 | 37.0-40.9 | 35.7-40.0 | 32.9-36.9 | 31.5-35.7 | 30.3-31. |
| VI. Superior | | > 42.0 | > 41.0 | > 40.1 | > 37.0 | > 35.8 | > 31. |

VITA

Kemal Tamer

Candidate for the Degree of

Doctor of Education

Thesis: A MEASUREMENT AND COMPARISON OF SELECTED PHYSICAL FITNESS COMPONENTS OF AMERICAN, MIDDLE EASTERN, AND EAST AND SOUTHEAST ASIAN MALE STUDENTS AT OKLAHOMA STATE UNIVERSITY

Major Field: Higher Education

Minor Field: Health, Physical Education and Recreation

Biographical:

Personal Data: Born in Boğazliyan, Yozgat - TURKEY, September 15, 1954, the son of Ali and Emine Tamer.

Education: Attended elementary school in Boğazliyan, Yozgat - Turkey. Attended Mimar Sinan Teacher Training School in Pazarören, Kayseri - Turkey; graduated from Teacher Training School in 1972. Attended Istanbul Ataturk Education Institute in Istanbul - Turkey, from 1972 to 1974 and transferred to Oklahoma State University, Stillwater, Oklahoma. Received the Bachelor of Science in Secondary Education degree from Oklahoma State University in May, 1978; received the Master of Science degree in HPELS from Oklahoma State University in May, 1979. Completed requirements for Doctor of Education degree at Oklahoma State University in July, 1982. Received a scholarship from the Turkish Government while attending Mimar Sinan Teacher Training School, Istanbul Ataturk Education Institute, and Oklahoma State University.