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

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CHAPTER I

INTRODUCTION

Mankind can be divided into three major races and three peripheral variations: Negroid, Caucasoid, and Mongoloids as primary categories, and Bushmen, Australia, and Pacific island people as secondary variations (1).

The people in these races live in different parts of the world. They vary greatly in physical appearance, dress, manners, and ideals. They eat different kinds of food, build houses that range from grass huts to skyscrapers, and enjoy pleasures as diverse as skiing and cockfighting. They differ especially in their ways of work and the kinds of occupations by which they earn a living. Differences in language, government, education and religion are conspicuous. Some of differences are biological; people are born with a certain complexion. Other differences are cultural; people have invented tools and worked out certain ideas in some places and not in others. Still other differences result from contrasts in the physical environment.

Mankind ranges in skin color from nearly black to nearly white, with the majority in mid-range of some shade of brown. Types of hair vary from the tight tufts of the South African Bushmen to the long straight hair of the Mongols of Inner Asia. Much of mankind falls in between with wavy to curly hair. The races of men vary in average size from less than five feet for males of some races to over six feet for others, a significant variability percentagewise, which is especially striking when individuals from the extremes are seen side by side (2).

In many studies that have involved the examination of the people in the various ethnic and cultural groups, it has been found that there are many differences among them in the state of physical fitness and the anthropometric characteristics. It can be expected to be influenced by such factors as age and sex, the state of nutrition, acute and chronic disease, the cultural and social patterns of living, work and physical capacity, the physical environment, and heredity (3).

As far as sex and age are concerned, many studies from several laboratories have demonstrated that maximal oxygen uptake and related physiological parameters show considerable variation with sex and age (4, 5, 6). Height and weight have also been found to vary with sex and age. In 1970 some researchers studied height and weight in 104 school children between 7 and 19 years of age from nine different schools in Oslo, Norway. They found that body height increased at approximately the same rate in both girls and boys up to the age of 13 years. From then on, the body height of the girls started to level off, whereas in boys it continued to increase almost linearly up to the age of 18 years. The changes in body weight of boys and girls showed almost the same general pattern of development as that for body height. However, there was a tendency toward a higher rate of increase between 11 and 12 years of age in body weight in the girls than in the boys (3).

Bjelke (7) used a mail survey to collect detailed statistics on the interactions of height, weight and age for a randomly selected sample of the Norweigian population (8638 men, 79% of respondents; 10331 women, 82% of respondents) aged from 37 to 71 years. In the men, weight at a given height increased by only 10-15 kg. over this age span, but in the women the gain was 6.7 - 8.1 kg. Much of the data was analyzed as W/H^2 ratios. Perhaps because mascularity and obesity are confounded in all weight/height relationships, no gradation of W/H^2 was seen with social class. However, the ratio was negatively correlated with both habitual physical activity and cigarette smoking. Among the female subjects, W/H^2 was greater for married than for single women. North American samples, particularly in the U.S.A., have generally shown a greater body fat than those from Europe. Narris, Lundy and Shock (8) described the anthropometric characteristics of a group of men living in the Baltimore area. They seemed to be typical United States citizens: busy, successful people, active in community life, engaged in sedentary work, and for the most part did not engage in strenuous physical activites. Between the age of 25 and 65, there was a weight gain of over 8 kg., although the older subjects were 4.4 cm. shorter than the 25 years old; 6.3 kg. of the additional weight was gained between 25 and 35 years of age. Even the young subjects were quite obese, and there was surprisingly little change of body density between 25 years (specific gravity 022, equivalent to 33% body fat) and 65 years (specific gravity of 1.019, 34.3% body fat).

Young (9) compared body density and potassium 40 estimates of body composition in a "fairly representative" group of 100 midwestern males, aged 15 to 87 years. Body density readings suggested an increase from 12.7 percent body fat at 19.9 years to 23.4 percent body fat at 71.1 years. The 40 K+ readings indicated a much larger increase, from 14.9 percent to 36.2 percent body fat, and the author suggested that in the older subjects the body potassium figures may have been distorted by an increase in the ratio of connective tissue to muscle.

Parizkova (10) found average skinfold readings (ten sites) of 10.8 and 12.0 mm. in Czechoslovak men aged 30 and 60 years respectively, while her readings for women were 14.0 and 16.0 mm. at the same ages. The body density of 16 to 17 years old boys was 1.070; this dropped to 1.053 at age 30, and 1.048 at age 60, the latter being equivalent to 21.9 percent body fat. For 17 to 18 years old girls, readings average 1.043 dropping to 1.029 at age 30, and 1.033 at age 60, the last reading corresponding to 28.2 percent body fat.

Muscle strength generally decreased with age. Shephard (11) found that the hand-grip force of the men remained relatively constant at an average of 54 kg. for age 25 to 45; thereafter, it declined by 20 percent to a figure of 44 kg. at age 65. Asmussen and Mathiasen (12) reported that Danish men reached a peak hand-grip force of 55-65 kg. at the age of 30 with a subsequent decline, 10 percent at 60 years of age. Danish women had 55-65 percent of the strength of men, with peak readings (35-40 kg.).

The state of nutrition of the individual and population in general also affects the physical fitness. In the underdeveloped nation, there is generally a lack of first class protein during the growing period, fats usually are in short supply, and most of the calories come from cereals, which are very bulky. The people in these areas are generally of short stature and are lean with very low skinfold thickness. When these men enter industry, work hard, and are provided with a good diet which is high in animal protein and in calories (as happens to the Bantu in the gold mines of South Africa), they gained 3.0 kilograms on the average, in the first month (3). Probably because of nutritional factors and the harder physical work they perform, the Bantu male does not show the increase in weight that the European does after the age of 30 years. It appears that the European male pays dearly for his diet and sedentary habits which lead to obesity. Falkner (13) has mentioned that growth, weight, and the composition of the body depend in part upon the supply of nutrients available to the body.

The working capacity of many indigenous people still seems limited by malnutrition, particularly in tropical regions. The activities necessary for subsistence are often completed in the face of severe constitutional handicaps. Thus MacPherson (14) described the highland populations of New Guinea:

> . . . Although malnutrition has been amply demonstrated in children and protein deficiency is frequent in pregnant and lactating women, and skinfold thickness measurements are low and there is a decline in the weight-height ratio with age and the serum albuminum is low, both men and women perform physical feats and show sustained stamina that few of us could match (p. 98).

Disease is one of many factors that affects the physical activity. Rode and Shephard (15) made a careful study of the import of respiratory disease on the physical working capacity of the Canadian Eskimo. They found that Iglooik Eskimos with a previous history of pulmonary disease were on an average 0.7 percent shorter than healthy villagers of the same age, presumably reflecting a systemic effect of tuberculosis upon growth and development. The diseased group also weighed 8.5 percent less than healthy subjects. In men the weight loss was partly muscle and partly fat, reflecting a systemic effect of the disease. However, the younger women had greater skinfold thickness than those who were healthy, probably reflecting the inactivity imposed during treatment of their disease. Both sexes showed an association between a history of chest disease and poor muscular strength, the deficit amounting to 2.6 percent for hand-grip and 5.8 percent for leg strength. Aerobic power was also reduced by disease, the deficit averaging 12.1 percent in absolute units (1/min) and 9.0 percent when related to body weight (ml/kg. min.).

Some studies have generated the hypothesis that individuals in cultures where strenuous physical exertion is not very essential for satisfying primary motives or discharing occupational tasks are "cursed" with an inferior level of cardiovascular fitness (16, 17, 18). For example, it is to be expected that the people who live off the land in an arctic area to have a high physical performance capacity which is higher than those who live in a tropical climate. The rationale for this is that people who live in an arctic area perform hard physical work in the process of gathering and hunting for food, making adequate housing, and carrying on other necessary tasks. On the other hand, the inhabitants of a tropical or subtropical area do not need to perform hard work in order to construct strong or solid houses or to collect the necessary amount of food for living. Therefore, it may be possible that exposure to either desert heat or arctic cold and stressful climate has produced strong and physically fit individuals who are able to survive to a greater extent than those in a warm and pleasant climate (19, 20).

Some observers have considered the indigenous population of hot and humid areas as lazy. Thus, Bates (21) wrote of the Amazon people:

> . . . Our neighbours, the Indian and Mulatto inhabitants of the open palm thatched huts, as we returned home fatigued with our ramble, were either asleep in their hammocks or seated on mats in the shade, too languid even to talk (p. 26).

Many researchers have agreed that the people who live at high altitudes are very physically fit. Durnin and Passmore (22) reported that the maximum daily caloric expenditure of Swiss peasants was 5,000 kcal. and 3,860 kcal. in women. Sinnett and Soloman (23) studied 152 of the 2000 Enga-Speaking people in the western highlands. The average altitude of residence was 2,485 m. (8150 ft.). Activity comprised mainly cultivation and harvesting of sweet potatoes, collection of firewood, and occasional house building. The aerobic power of these people as predicted by the bicycle ergometer was 45.1 ml./kg.min.

Vaughon and Mialls (24) have found that the major influences that affect cardiovascular variables within and between similar population are largely environmental in nature rather than genetic. However, they have mentioned that the genetic factors can not be separated from the environmental factors, and they interact constantly.

Physical condition and fitness are also influenced by race. Electrocardiographic data which has been used to assess the heart condition has also been proved to be substantially influenced by race and sex. From comparing the ECG between black and white adolescents, Reiley and co-workers (25) found that sex and race influence the ECG in the adolescents as well and that normal electrocardiogram standards in adolescents should be sensitive to sex and race. He has also found that race is one of the major constitutional variables affecting QRS voltages and components of the S-T segment and T wave.

Some studies have concluded that blacks are superior to whites in certain sports by reason that the bodies of blacks are proportioned differently than those of whites. They have longer legs and arms, shorter trunks, less body fat, more slender hips, more tendon and less muscle, a different heel structure, wider calf bones, more slender calf muscle, greater arm circumferences, and more of the muscle fibers needed for speed and power, and fewer of those needed for endurance (26).

Cluver, de Jongh and Jokl (27) classified 9214 South African children as white, Bantu, and Asiatic. The Bantu were smaller than the Whites and were commonly affected by malnutrition and parasitic infections, but nevertheless in the pre-pubertal period they excelled at both 100 and 600 yard runs, with the white boys performing better at the strength demanding shot-put. After puberty, the white boys had the best scores on all tests, and white girls also excelled at the 100 yard run. The Asiatic children were inferior at all tests.

Ponthieux and Baker (28) compared Negro and White children living in Texas. They found that the Negro children performed better on most items of the AAHPER test battery. A comparison of performance scores for Asian children (29) showed the best results for the Japanese, equal and lower scores for students in Hong Kong, Taiwan, and Korea, and the poorest results for the Phillipines, Thailand and Vietnam. Average heights and weights showed a similar gradation (Japan > Korea, Taiwan and Hong Kong > Thailand and Philippines > Vietnam).

Since the physical fitness and anthropometrical data have been found by many researchers to be influenced by many factors, the focus of this study was to compare the people from many different parts of the world in this particular aspect. More specifically, it was feasible to utilize the international students of Oklahoma State University since there was a sufficient amount of them available. In addition, there was an adequate physical fitness testing facility available at the institution. In view of these facts, it seemed appropriate to inquire about the physical fitness status of these groups of adult men.

Statement of the Problem

The purpose was to measure and compare the anthropometrical characteristics and the current physical fitness status between two groups of male international students of Oklahoma State University. One group was 40 international students who came from the various countries in Southeast Asia and East Asia, and the other group was 40 male international students who came from the various countries in Middle East Asia. These subjects were in the age group of 20 to 30 years old.

The investigation was undertaken to find the similarities and differences of the anthropometric characteristics and physical fitness variables of the students from the different geographical regions of the world.

The measurements specifically undertaken to ascertain the physical fitness of the subjects were: height, weight, skinfold thickness, percent of body fat, body circumferences, the weight residual, reaction time, strength, flexibility, and the characteristics of the resting electrocardiogram which were of interest. They were heart rate, the wave amplitudes (resting R and T wave amplitudes), time intervals (P-R), rest/work ratio, and QRS electrical axis.

Sub-Problems of the Study

1. The researcher determined whether or not there would be any differences in the physiological measures between the subjects in each group who had been in the United States for less than

one year with those who had been in the United States for more than three years.

2. The researcher analyzed exercise and diet habits of the subjects and how they related to the fitness components.
3. The researcher compared the results of the physiological measures between the international students and the United States population by using the standard norms which had been established in the United States.

Delimitations

1. The subjects were 80 male international students in the 20 to 30 years of age group, who were attending the classes at Oklahoma State University during the academic year of 1981-1982.
2. The subjects were selected from the international students of the various countries in Southeast Asia, East Asia and Middle East Asia.

Limitations

The following conditions are limitations of the study:

1. Since it was impossible to select representative samples from the international students culture, the subjects were selected from those who attended Oklahoma State University. Due to lack of representative samples, the results of this study could not be generalized across the cultures. Generalization must be limited to the populations of International students at Oklahoma State University from which those subjects were

chosen. Therefore, the interpretation of the findings could only be made possible along the findings of other studies testing similar hypotheses.

2. There was no control of diets, sleep, and other routines of the subjects.

Assumptions

1. It was assumed that the subjects understood the test instructions.
2. It was assumed that the subjects made a maximum effort on test performance.
3. It was assumed that the nomogram for the prediction of the percentage of body fat was applicable in this study.

Hypotheses

1. There is no significant difference of strength (grip strength test) among the three groups of subjects.
2. There is no significant difference of flexibility (Sit and Reach Test) among the three groups of subjects.
3. There is no significant difference of reaction time among the three groups of subjects.
4. There are no significant differences of height and weight among the three groups of subjects.
5. There is no significant difference of the weight residual between the students from Middle East and the students from East and Southeast Asia.
6. There is no significant difference of each of the following

skinfold thicknesses between the students from Middle East and the students from East and Southeast Asia:

a. bicep
b. chest
c. tricep
d. iliac
e. scapula
f. abdomen

7. There is no significant difference in the sum of six skinfold thicknesses (bicep, chest, tricep, iliac, scapula, and abdomen) between the students from Middle East and the students from East and Southeast Asia.

8. There is no significant difference of each of the following skinfold thicknesses among the three groups of subjects:

    a. tricep
    b. iliac
    c. scapula
    d. abdomen

9. There is no significant difference of the sum of four of skinfold thicknesses (tricep, iliac, scapula and abdomen) among the three groups of subjects.

10. There is no significant difference in the percentage of body fat among the three groups of subjects.

11. There is no significant difference of each of the following body circumferences among the three groups of subjects:

    a. shoulder
    b. chest

c. abdomen

d. buttock

e. thigh

f. bicep

g. forearm

h. wrist

i. knee

j. calf

k. ankle

12. There is no significant difference of each of the following electrocardiogram characteristics among the three groups of subject:

a. heart rate

b. R wave amplitude

c. T wave amplitude

d. P-R interval

e. rest/work ratio

f. QRS electrical axis.

13. There are no significant differences of the anthropometrical and physical fitness variables between the two foreign student groups that had been in the United States 1) less than one year, and 2) longer than three years:

a. height and weight

b. weight residual

c. skinfold thickness

d. percentage of body fat

e. shoulder circumference

f. chest circumference

g. abdominal circumference

h. thigh circumference

i. bicep circumference

j. forearm circumference

k. wrist circumference

l. knee circumference

m. calf circumference

n. ankle circumference

o. strength

p. flexibility

q. reaction time

r. heart rate

s. R amplitude

t. T amplitude

u. P-R interval

v. rest/work ratio

w. QRS elecrical axis.

Selection of Measurements

For this study, the measurements to assess the physical fitness were the Sit and Reach Test, grip strength test, electrocardiogram, skinfold thickness and body circumference measurements, height and weight measurements, and reaction time. A brief rationale of each test is included in the following discussion.

Sit and Reach Test

Since flexibility is specific to each joint, no generalized flexibility test is available. Because the emphasis of this study was on adult physical fitness, lower back flexibility was the type to be assessed due to the prevalence of and disability among men and women in the adult population. Much of this problem is related to the lack of flexibility in the back of the leg (hamstrings), hips and lower back (30). To measure this area, a simple field test called the "Sit and Reach Test" can be used.

The Sit and Reach Test of Wells and Dillon has been widely used as a test of back and leg flexibility. The validity coefficient of 0.90 and a reliability of 0.98 has been reported (31).

Grip Strength Test

Grip strength was employed to measure the muscular strength since grip strength alone responds remarkably well to changes in general physical condition and the reliability coefficient of grip tests is comfortably above 0.90 (32).

The Electrocardiogram

The electrocardiogram (ECG) is a graph that expresses certain electrophysiologic phenomena manifested by the heart during the phases of contraction and relaxation.

It is generally contended that the electrocardiogram may be utilized under certain conditions for normal subjects to indicate a strong heart or one less strong by the height of the R and T waves. Very small T waves (below 2 mm.) and R waves (below 5 mm.) in all leads in the quiet state may be indicative of weak heart action. Cureton (33) found that R and T wave amplitudes are of some value for indicating the circulatory fitness of individuals.

Heart rate may indicate the level of fitness of the individual. Hamola (34) stated that the resting heart rate of a non-athlete is usually around 72 to 84 beats per minute. As a person increases his level of fitness, the heart rate will decrease. For example, the average marathon runner's heart rate is about 58 beats per minute. Some highly trained distance men have resting heart rates of 38-42 beats per minute.

Also, the electrocardiogram can indicate left and right axis deviation of the heart (35). Left axis deviation indicates that the heart rotates anatomically around its anteroposterior axis in an anticlockwise direction, then the electrical axis would also be seen to have rotated in the same direction. This might occur in obese individuals with an elevated left diaphragm or as a result of cardiac displacement to the left from scoliosis. Similarly, if the left ventricle became enlarged with a resulting increased in electrical activity, then the electrical axis would rotate in an anti-clockwise direction. Left axis deviation occurs in 10 percent of normal individuals. If there is right ventricular enlargement, the electrical axis would change its direction towards the right, and right axis deviation would exist. This would, of course, also occurs if there is rotation of the heart around its anteroposterior diameter in a clockwise direction in thin asthemic individuals.

The P-R interval may indicate a heart condition. Sensebach (36) pointed out that the P-R interval normally extends to .22 second, and it may go to .28 with no evidence of heart disease. However, Cureton (33) pointed out that excessively long P-R interval (above .24 sec.) is usually associated with heart block. The criteria committee indicates the normal upper limits to 0.20 second in adults with normal heart rate, and would be found in the longest interval of any of the standard leads (37).

According to the Health and Fitness Center of Oklahoma State University, rest/work ratio may also be the indication of the physical condition level. Rest/work ratio of less than 1.5 indicates the poor level. Rest/work ratio of between 1.5 and 2.00, and over 2.00 indicate good and excellent level, respectively (38).

Skinfold and Circumference Measurements of the Body

Many techniques have been developed for estimating the composition of human body. One technique which is based on the Archimedes' principle has been found to be most accurate in the estimation of the body fat. This technique is underwater weighing (39).

Although quite accurate, determining body fat by the underwater weighing technique is not always practical due to the length of the time required to administer such a test. Therefore, anthropometric measurements which consisted of measuring skinfold thickness and body circumferences was used to estimate the body fat and the body composition.

The employment of skinfold measurements as described by Durnin and Rahaman (40) were used in this study to measure the body fat of the subjects. Another procedure used to estimate optimal body weight was the body circumference measurements developed by Behnke et al., (41).

Height and Weight

Accurate and scientific data on height and weight of a population are not only necessary as a reference standard for comparison with other populations and to study the effect of racial, genetic, nutritional and other environmental factors operating adversely or favorably in a group, but also serve as the simplest measure of the size, form and to some extent physical pattern of an individual or a group. These data are also essential for estimation of various body attributes and functions, such as surface area, metabolic and fluid requirements, vital capacity and other which may be required for estimation of health or disease and for establishing their expected values and norms. The damage of drugs and its effect may depend on these, particularly the weight of an individual. This information is vital for the designers of various kinds of equipment, machines, and wearing apparel for human beings whether in industry, military, or in medicine. These are the commonest parameters used for assessing the nutritional level of an individual and making an estimate whether his being overweight or underweight is due to under-nutrition or disease. In growing children, it is the commonest, simplest and a fairly good measures of growth and physical development (42).

Height and weight are also the repeated measurements that demonstrate normal or abnormal growth increments at any age. As far as composite height and weight charts are concerned, they are of considerable value for comparing adolescent groups living under different social and environmental conditions. They may also serve a very useful purpose for comparing the physique of present day students with those of succeeding generations in the same country (43).

Reaction Time

The ability of an individual to react to an external stimulus shows the level of his neuromuscular co-ordination. A quicker or slower reaction or movement or a good or poor ability to co-ordinate the use of limbs and body might facilitate, impede or limit the timing ability of a given subject in a specified act or event that requires an accurate timing sense (44, 45, 46, 47).

Various aspects of neuromuscular responses depending upon the measurement of time involved in the completion of a simple reflex action such as the ratellar or archilles jerk to more complicated acts of conscious behavior have been reported (48, 49, 50).

Most of the studies of the conscious behavior have involved the measurement of time elapsing between the presentation of the stimulus and the response of the individual by movement of the fingers (51, 52, 53).

Cureton (54) has stated that speed of reactions to light and sound stimuli can be improved by training, and such improved responsiveness is reflected in other systems, even paralleling the improvement of plasma flow through the kidneys and basal metabolic rate. Speed of reaction improves somewhat with improved glandular functioning.

Significance of the Study

Fitness for work is a changeable characteristic, probably subject through all phases of human living to improvement or reduction. The state of fitness is different in various ethnic and cultural groups, and little doubt exists in the minds of scientists in sport medicine that wide differences in work capacity and physical fitness exist among individuals living under varying cultural and physical environmental conditions throughout the world. General observations and clinical examinations yield support for the judgement.

Except for a few selected populations, the physical fitness of the human races of the world is unknown. This study was concerned with a comparison of the results in the anthropometrical and physiological measurements between students from different cultures and also to test whether there were any significant differences in the results between the values of certain independent variables such as length of time spent in the United States.

It is a fact that we still do not know if the capacity to work is genetically determined or if it is culturally or geographically determined. Studies such as this one should shed some light on these questions. In short, this study might be the first one in which people from many different cultures participated in order to test for significant differences of the results in the anthropometrical and physiological measurements. Due to the limited number of cultures participating in this study, the hope is that this study will be followed by more investigations of physical fitness from many more different cultures all over the world.

Definition of Terms

Anthropometry: Science of measuring the human body and its parts.

Reaction time: The term "reaction time" refers to the interval of time elapsing from the instant a stumulus is presented until the instant any measureable amount of movement is made in response to the stimulus. For this study, "reaction time" is the interval of time which elapses from the sound of an audio stimulus until the subject initiates movement in the thumb of his dominant hand to press a button. This time interval is a reflexion of the time it takes nerve impulses to transmit directions to muscles through the central nervous system after receiving a stimulus.

Flexibility: The functional capacity of the joints to move through a full range of motion.

Strength: The maximal one-effort force that can be exerted against a resistance.

Electrocardiograph: The record of the electrical potential of the heart.

Heart Beat: A pulsation or throb resulting from contraction of the heart or the passage of blood through a vessel.

R wave: A part of the curves of the electrocardiograph that is caused by passage of the cardiac impulse through the ventricles.

T wave: A part of the curves of the electrocardipgraph that is caused by the return of ions into the ventricular muscle fiber at the end of the refractory period.

Rest/work ratio: The time from the end of the T wave to the beginning of the next ST segment (rest time) divided by the time of the ST interval (work time).

P-R interval: The P-R interval represents the time required to depolarize the atrial musculature plus the delay in the transmission of the impulse through the atrio ventricular node to the beginning of ventricular depolarization. The P-R interval is measured from the beginning of the P wave to the beginning of the QRS complex.

Weight residual: Excess weight. Actual weight minus ideal weight.

Ideal weight: A predicted optimum weight based on height, circumference measures and percent body fat.

CHAPTER II

REVIEW OF RELATED LITERATURE

The term "physical fitness" is interpreted in many different ways. Cureton (55) identified three principal approaches to physical fitness as (1) appraisal of physique, (2) appraisal of organic capacity, and (3) appraisal of motor fitness.

It the three approaches are broken down into greater specifics, physical fitness takes on distinct characteristics as a healthy and robust appearance, muscular development, and good posture. Organic capacity takes on characteristics such as fit glands, digestive system, nervous system, cardiovascular and respiratory systems. The motor fitness approach is characterized by at least average capacity in a variety of motor abilities such as balance, felxibility, strength, coordination, power, and stamina.

This chapter will be devoted to literature as it pertains to the selected physical fitness measures in this study as follows: (1) height and weight, (2) body circumferences, (3) skinfold thickness, (4) percentage of body fat, (5) strength, (6) flexibility, (7) reaction time, and (8) electrocardiogram.

Physical fitness variables will be reviewed in terms of racial, cultural, environmental and other factors which may influence the state of these variables. In addition, the results of some physical fitness variables that were collected from the various countries will also be presented.

Height and Weight

Studies of the attributes of height and weight in the population provide a yardstick against which objective clinical assessments of individual subjects may be made. In additon, these attributes form part of several anthropometric indices for the definition and comparison of physiques in different population groups. Moreover, height and weight measurements are still considered by many as one of the simplest and best means for determining the general health and nutritional status during the growth period of life.

Height is a familiar normal physical measurement, the determinants of which are complex. It is generally accepted as an example of a multifactorial character responding to both genetic and environmental influences, its genetic component being polygenic and acting partly through endocrine systems and hormonal action (particularly growth hormone), carbohydrate metabolism, rate and timing of growth processes, and other such functional variables, and its environmental components including nutrition, disease, diurnal rhythm, postural habits, as well as other less obvious factors (56).

In general, it has been recognized that environmental factors are stronger determinants of growth than are genetic attributes. Of the environmental factors, nutrition is the single most important determinant (57).

Roberts (58) examined the heat production in indigenous people by reference to the climates of their habitats and suggested that a relationship existed between body weight and mean environmental temperature. He studied and compared the geographical distribution of the series of 116 males mean body weights from the various countries around the world. He concluded that there was apparent a marked tendency for most "very high" weights to occur in cold areas and for "very few" high weights in hotter regions. Medium weights above average predominated in more temperate and cooler regions, those below average in warmer area. A temperature relationship also appeared to exist within continental groups. In Europe and Eastern Asia weights tended to increase from warmer south to cooler north. In America, the gradient of weight from cold to hot areas was somewhat less clear. For African groups the mean environmental temperatures covered a smaller range, some 17^{o}F. Comparison of racially and culturally similar groups, e.g. Ituri Bantuti with Ruanda Batwa, Bahutu at low, medium and high altitudes, suggested weight variation either with altitude or concomitantly temperature. Differences were also suggested among continental groups. In oceania, Polynesians seemed to be characterized by higher weights than Malenesians. Europeans appeared to be heavier than East Mongoloids at similar temperatures. Occupation also seemed to exert some influence, e.g. when the sample of Chinese at Changsha was subdivided into occupation groups, heavier weights tended to occur in the more laborious occupation groups and among students.

Some researchers studied about the relationship between a genetic factor and the general weight level, and suggested that some genetic factor had an effect on the general weight level.

These studies can be summarized for examples as follows:

1. Studies of twin by Newman (59) showed that more than 75 percent

of observed variablility in weight might be attributed to genetic influence.

2. Meredith (60) showed that mean weight of viable negro infants at birth was about 4 percent lighter than that of American white infants living in the same area; further, between negro and white infants receiving adequate dietary and medical care, there was no difference in mean stature at ages of six months, nine months, and 12 months, but white infants were slightly heavier at each age.

Weights also increase with age in the technically-advanced countries. For example, although in 1955 an average American woman of 55.5 years was 0.2 inches shorter, she weighted 22.0 lbs. more than a woman 30 years younger (61). In less developed countries, at least among the peasants, this increase in weight with age does not occur, e.g. in Vietnam (62).

The relationship between stature, weight and physical efficiency was studied by Seltzer (63) in several group of Harvard college students. Height, weight, and physical fitness scores were obtained before and after the training period to determine the relationship of these variables. The physical fitness tests in this study were Pack test, Step test and treadmill test. The data indicated a virtual absence of relation between stature and weight with physical fitness indices derived from the Pack test and Step test in a group of aviation cadets before and after a severe physical training period. In spite of the low coefficent values there were suggestions that before training, the extremely short individuals with stature below 165 centimeters showed a slight tendency to have rather low physical fitness indices, and the individuals with low physical fitness indices tended more frequently to be above the mean in body weight. The data also indicated that the subjects who were stocky, and thick-set in body build tended to have low physical fitness indices before training. However, the relation disappeared when the individuals approached their optimum state of physical efficiency.

Berry (64) collected the data on height and weight of 863 college men between the ages of 18 and 28 years from two colleges in Nagpur, Central India. The data were presented in the form of 3rd, 10th, 15th, 50th, 75th, 90th, and 97th percentiles of height, weight and weight for height. The height and weight of these men were representative of the parameters of college men of this age group in Central India for that period. Comparing with height and weight of white Americans both in average height and weight, the mean height in this study was less by 3 inches (65.66 inches and 68.6 inches) and mean weight at age 18 by about 41 lb. (108 and 149 lb). Compared with British young men at age 18, the young men in Central India were lighter about 30 lb. (50th percentile, 108 lb. and 138 lb.) and less in height by more than 5 inches (65 inches and 69 inches). While a young man in the United Kingdom with 69 inches height (50th percentile) and 130 lb. weight, a young college man of the same height in Central India weighed only 126 lb. and an American college man with his height 68.6 inches, weighed 141 lb. The results showed that these young men in this study were not only shorter and lighter but also weighed less than British young men and much less than American College men for every inch of height. Berry suggested that at least part of this poorer height and weight was due to poor economic conditions which resulted in undernutrition and ill- health.

During the year 1971-1972, Trivedi (65) scrutinized the medical check-up forms of all boys and girls of 12 colleges in Gujarat University, India. The medical check-up was mandatory for all new entrants to university education. The purposes of this study were to find the mean height and weight and to evaluate the personal hygiene of the students in this university. The results were also compared with figures available from the United Kingdom and the United States. The study sample was comprised of 3,215 boys and 2,075 girls. The ages of the subjects ranged from 15 years old to 21 years old. The results showed that the mean height and weight of the subjects were greater than the all India figures although they were much lower than those of the United Kingdom. Maximum limit of height-weight range of Gujarat University students was much lower than the minimum limit of the U.S.A. students. The researchers suggested that the higher percentage of overweight among the United Kingdom students and the Untied States students could be attributed to consumption of rich foods along with the use of sweet meats and sticky foods, associated with poor oral hygiene which could predispose to higher evidence of dental disorder.

During the years from 1966 to 1971, 412 male and 247 female Armenian students were examined by Karayan (66) as a routine preregistration medical examination done for admission to the American University of Beirut and to Haigazian College, an Armenian College, in Beirut. Their heights and weights were also measured in the medical examination. The great majority (98%) of students were between the ages of 18-25 years, the remaining 5 percent were between 26-40 years. The mean height and weight of the male and female Armenian student was 170.8

centimeters with standard deviation of 4.94 and 66.9 kg. with standard deviation of 10.3, respectively.

Kadri (67) collected the data on the measurement of weights and heights of 1,836 male and female students attending the University of Malaya at Singapore, with a view to providing mean standards for the individual Malayan University student. Overall age-range of the subjects varied form 17 years to 26 years; but 85 percent of them fell in the range of 18 years to 22 years. Average weight of male students of 17 years was 117.9 lbs., and with the rise of chronological age there was almost a gradual smooth rise in weight which at the age of 26 years was noted to be 130.9 lbs. Average body-weight of university boys was 122.4 lbs., whereas that of girls was 103.1 lbs. Average stature of male students was 5 feet 6.1 inches, while that of female students was 5 feet and 1.9 inches.

Nagamine and Suzuki (68) carried out a study between 1958 and 1960 to establish the criteria of body composition of young Japanese men and women and to compare them between races. The subjects comprised healthy college students in Tokyo. Height and weight of 96 men, 18 to 27 years old, and 11 women, 18 to 23 years old, were measured. The mean height and weight of men were 167.2 cm. with standard deviation of 5.80 and 58.9 kg. with standard deviation of 7.70 respectively.

During 1969-1979, Bunnag and Piampi (69) initiated a study to obtain the average weight and height of Thai people by collecting the data from 11,050 men and 11,960 women. The results showed that the average weight for all men in the sample was 55 kilograms and 48 kilograms for all women. The average height for men and women was 165 centimetera and 154 centimers, respectively. After classification into two age groups, it was found that the younger generation of both sexes was one centimeter taller and weighed four kilograms less than the older groups. In this study, the trend toward an increase in height of the younger generation was more apparent in men. It was found that 76 out of 100 men in both groups were in the range of 160-170 centimeters. Only 10 percent of the older age group were taller than 170 centimeters and the remaining 14 percent were shorter than 160 centimeters. On the contrary, 14 percent of the younger men were taller than 170 centimeters. For women of both groups almost 80 percent were in the range of 150-160 centimeters, and less than 10 percent were taller than 160 centimeters.

It has been generally observed that urban and rural children from lower socioeconomic backgrounds in developing countries are considerably shorter and lighter than their age and sex peers in the upper social strata of their own countries and their age and sex peers in developed countries (70). Although a child's size at any given point in time is the product of the complex interaction between his genetic potential and environmental influences (such as education, family size, etc.). Available data by Jackson (71) suggested that suboptimal nutrition during infancy and early childhood delays and even stunts growth. Scrimshaw et al. (72) stated that the role of suboptimal nutrition in effecting growth is possibly enhanced by interaction with infectuous disease.

Most other studies have confirmed this observation. A comparison of the mean measurements of the urban and rural population in the area of Jamaica by Ashcroft et al., (73) indicated that urban men were taller and heavier than rural men at 15, 16, and 17 years old. From 20 to 30 years old, differences were small, but after the age of 30 urban men were taller and substantially heavier. The authors mentioned that several factors might be responsible for the differences in size between rural and urban Jamaicans. The greater height of urban men might have been due to the better standards of living during their period of growth. The most probable explanation of the greater stoutness of urban people in middle age was that they were less active physically than those in rural areas.

In 1970, heights and weights of a random sample of 11,829 Costa-Rican children from birth to 18 years obtained in urban and rural areas of the country were compared with 1,946 Iowa standards commonly used to assess physical growth and nutritional status of children (74). The data obtained showed that Costa-Rican children were smaller and weighed considerably less than North American children of the same age. A remarkable difference in the rate of growth was evident between high and low socio-economic groups of the urban population. This difference depicted the great disparity in the basic standard of living between the wealthy minority and the large segment of population living under substandard environmental and nutritional conditions, a phenomenon common to most developing countries. The authors mentioned that with continuing progress and economic advance of the country, with the improvement of nutritional and environmental conditions of the whole population, the larger proportion of the population would develop to reach their full growth potential.

Height and weight of government and public school children aged 8 to 16 years belonging to Punjabi Khati and Aora in India were compared by Sikri (75). In both traits, the public school children were better placed than the governmental schools. The superiority of the public school children over the governmental schools in growth performance indicated that it was mainly the socioeconomic and other environmental factors which caused this difference, though the children belonged to the same population group.

Ashcroft et al., (76) studied the effect of genetic on the size of children in Kingston, Jamaica. The subjects were grouped as being predominantly of African, European, Afro-European or Chinese racial origin. Heights and weights of about 5,000 children aged 11 to 17 years old, were measured. The stature of Africans, Afro-Europeans and Europeans was similar, indicating that in Jamaica the potential height of the African is at least as great as that of the European race, but the Chinese of both sexes were lighter and shorter than those from the other racial groups. Since the Chinese were relatively prosperous members of the Kingston community, the authors suggested that their characteristic build had a genetic basis.

Body Circumferences

Literature related to the body circumferences are concerned with the usefulness of body circumferences in determining the body weights and revealing certain aspects of body configuration, and the comparison of body circumferences of the people from the different countries, as far as the author could find in the literature.

An accurate appraisal of body composition provides an important basis for formulating an intelligent basis for a program for total fitness. The frequently used standard, the age-height-weight table, is of limited value in evaluating physique, for it is now established that overweight and overfat are not the same thing. This point is clearly illustrated with athletes. Many of these individuals are quite muscular and in excess of some average weight for their age and height, but otherwise lean in terms of body composition. For such people, a weight loss program is unnecessary and may even be harmful to sports performance. On the other hand, it is possible to be "average" for body weight yet still possess undesirable excess of body fat. In this situation, a weight loss or body composition modification program may be desirable (77).

Therefore, there is considerable interest in using body composition analysis in sports and physical fitness programming to determine desirable body weight. The unusual reason for using such an anlysis is to avoid the weaknesses of age-height-weight table or to get a more precise measure of body composition.

The best procedure is to use body densitometry (usually by the method of underwater weighing) or some other accepted laboratory procedure to find the relative fat content (percent fat) and fat and lean body weight (LBW) of the individual. There is an inverse relationship between body density and body fat content which is taken advantage of to compute the percent of body fat. The LBW is then used to compute a target weight (TW) that has a predetermined percent of body fat content according to the equation (78):

$$\text{Target weight} = (100\text{-LBW}) \times (100 - \text{predetermined \% fat}). \qquad (1)$$

In most instances, however, it is not practical for the teacher, coach, or trainer to use such sophisticated techniques. Consequently, the practitioner turns to the use of anthropometric measures such as skeletal lengths and breadths, body circumferences, or skinfolds in previously established regression equations estimate body density, percent of body fat, fat or lean body weight.

Although large quantities of body fat are undesirable for good health and fitness, precise statements can not be made as to an optimum level of body fat or body weight for a particular individual. More than likely, this optimum varies from person to person and is greatly influenced by a variety of genetic factors. It does appear that it would be desirable to maintain body fat at about 15 percent of body weight or less for men, and 25 percent or less for women. The desirable body wieght can then be computed based on a desired body fat levels as follows (77):

Desirable body weight = lean body weight (1.00 - % fat desired) (2)

Desirable body weight can be figured from the body circumference measurements. Behnke (79) found a remarkably high correlation (0.98) existed between body weight and anthropometric circumferences and stature. He has stated that the sum of 11 circumferences (shoulder, chest, abdomen, buttocks, thighs, biceps, forearm, wrist, knee, calf, and ankle), divided by a constant (K = 300), may be converted into a quotient (d) which serves as a geometrical dimension, so that

$$D^2 \times h = w, \quad (3)$$

where h = stature and w = weight.

In turn, each circumference of the group of 11, when divided by a suitable constant (K), can be converted into at least 11 components. Therefore, from a few easily made measurements, it is possible to assess body build quantitatively and to relate anatomical divisions of the body rather than body weight to physiologic parameters.

Behnke (79) also indicated that conversion constants (k values) are applicable to additional population samples of men and women whose individual members reflect the extremes of fatness, muscularity, stature, and age, which are characteristics of a random population.

The use of a tape measure for anthropometric assessment can also provide a wealth of valuable information about physique because the circumference measures are ideal for computing somatographic evaluations as well as a variety of ponderal and fractional equivalents that permit in-depth analysis of body size and physique (80).

The factors determining the shape and the size of the human body are of fundamental importance in physical anthropology. According to Waddington (81), both the body and skeleton possess a complex but characteristic form and it is difficult to express in words, but rather definitely recognizable in practice. It is common knowledge that malnutrition, illness or other environmental factors affect the size of the body, but also there is evidence that a force works to stabilize and return the body size to a predetermined growth curve after illness or starvation (82).

Bharadwaj (83) compared the body circumferences of high-altitude natives with those of sea-level residents. The studies were also conducted both at high altitude and sea level situations. The sea-level residents were 30 young and healthy Indian subjects belonging to the state of Tamil Nada, India. The high-altitude residents were 45 young Indian local inhabitants of high-altitude (3962 m. above sea level). The last group was 17 young and healthy Indian soldiers, who were continuously exposed to an altitude of 3962 m. for 10 months. The results showed that the abdominal circumference I, abdominal circumference II, and chest circumference of the high altitude inhabitants were greater than those of the sea-level residents (96.57 cm. > 71.93 cm., 74.35 cm. > 73.79 cm,. 86.75 cm. > 85.24 cm., respectively). Thigh and knee circumferences of the sea-level residents were greater than the high-altitude natives (48.75 cm. > 48.14 cm. and 34.41 cm. > 34.33 cm.). The third group had four weeks' acclimatization and 10 months continuous stay at the altitude of 3962 m. The results showed that means of the chest circumference, and knee circumference of the subjects after four weeks' acclimatization were lesser than after 10 months' continuous stay.

Nigamine and Suzuki (68) measured the body circumferences (chest, upper arm, thigh, and calf) of 96 Japanese men, 18 to 27 years old, and 112 women, 18 to 23 years old. The results of men's body circumferences were shown as following: chest - 96.33 cm., upper arm - 26.20 cm., forearm - 24.99 cm,. thigh - 50.34 cm., and calf - 34.79 cm. When these results were compared with those of American youths, Japanese men and women were smaller in the development of body circumferences.

Chen et al., (84) investigated the body form and body composition of 31 Chinese young men (17 to 29 years old) and middle-aged men (30 to 56 years old). The results showed that the subjects in the middle-aged group had greater body circumferences than those in the young men group (chest - 86,64 cm. > 81.91 cm., abdomen - 72.26 cm. > 65.59 cm., upper arm - 24.61 cm. > 23.38 cm., forearm - 24.68 cm. > 24.07 cm., thigh - 47. 67 cm. > 45.65 cm., and calf - 33.98 cm. > 32.69 cm.). Compared to American young men, the results showed that the body circumferences in both groups of Chinese men (young and middle-aged men) were lesser than American young men.

Hieurnaux and Hartono (85) measured the various anthropometric characteristics of 486 adult Hadza in both sexes living in Tanzania. These subjects were drawn from the population whose lives were very physically active in a hot climate. The results of body circumferences (neck, upper arm and calf) which were some of the various anthropometric characteristics showed that males had neck circumferences, upper arm circumference, and calf circumference as follows: 32.87 cm., 26.12 cm., and 32.36 cm., respectively. Those of females were as follows: 28.94 cm., 24.47 cm., and 31.17 cm., respectively.

Ashcroft et al., (86) compared the anthropometric characteristics of two races living in a uniform environment. The subjects were 417 male and 436 female Guyana people in the middle-ages (35-44 years old) of East Indian and African origin living side by side with similar occupations and standards of living. The results showed that African men had larger upper arm circumferences and smaller tricep skinfolds than East Indians, an indication of greater muscular development. Also, the African's shoulders were broader and their hips were slightly narrower.

Smit (87) undertook a basic investigation aimed at discovering the general anthropometric differences between the various races. The subjects included the four main racial groups of the Republic of South Africa (White, Bantu, Coloured, and Indian) comprising a total of 2,250 children of 6 to 15 years. Upper arm circumference and calf circumference were two of many anthropometric variables in this investigation. The circumferences of the upper arm and calf showed no significant difference in the case of Banty, Coloured, and Indian subjects, but both measurements differed significantly in Whites as compared with those of the other three racial groups.

Singh (88) meassured the body circumferences of 18 year old Punjabi males, living in New Delhi, India. The results were recorded as follows: arm - 22.79 cm., chest - 78.94 cm., calf - 10.77 cm., and wrist - 15.38 cm.

Percentage of Body Fat

Health problems associated with obesity are far reaching. Respiratory problems are quite common along the obese. They have difficulty in normal breathing, a greater incidence of respiratory infection, and a lower exercise tolerance. Lethargy, associated with increased levels of carbon dioxide in the blood, and polyenthymia (increased red blood cell production) because of lowered arterial blood oxygenation, are commonly found in obese persons. These can lead to blood clotting (thrombosis), enlargement of the heart, and congestive heart failure. Hypertension and atherosclerosis have also been linked to obese individuals, as have metabolic and endocrine disorders, such as impaired carbohydrate metabolism and diabetes. Obesity has also been associated with an increased risk of gall bladder disease, digestive diseases, and nephritis. More importantly, the mortality rate of the obese is substantially higher than for people of normal weight (39).

Obesity is defined as the condition where the individual is 20 to 30 percent over fat. That is, one's total fat weight greatly exceeds that considered normal for the body weight. Normally, the fat weight is expressed as a percentage of the indvidual's total body weight. According to Pollock et al., (39) the upper limit of ideal weight for men would include no more than 16 to 19 percent fat and for women, 22 to 25 percent fat.

The causes of obesity are many and are often quite complex. Pollock et al., (39) stated that obesity has been linked with genetic factors, physiological and psychological trauma. Hormonal imbalances, emotional trauma (anxiety and depression), and alterations in various mechanisms that regulate or control body stability have all been shown to be either directly or indirectly related to the onset of obesity. Environmental factors such as cultural habits, inadequate physical activity, and improper diets have also been shown to contribute to the problem of obesity and probably constitute the primary cause for the majority of obese population.

The influence of poor nutrition upon the "normal" increase of body fat is well illustrated by the data of Frisch and Revelle (89) for South American and Asian countries. The data are summarized in Table I.

Table I shows that in only two of 11 nations was the daily energy supply greater than 2500 Kcal. In these countries (Uruguay and Chile), there was an increase of body weight from 22 to 62 years, much as in more-developed nations. The diet of the remaining nine nations provided an anverage of only 2127 Kcal/day; here, the men lost an average of 2.0 Kg., and the women lost an average of 1.8 kg. between the ages of 22 to 62.

In an excellent review on "Economics and Fatness," Garn and Clark (90) have shown that "the poorer are fatter and the richer the leaner . . .", and noted that "female outer fatness can be notable" (p. 19). In seeking an explanation they concluded that dietary quality can not be the explanation for fatness in females and leaness in males. Other aspects of poverty and affluence must be explored to provide the answers.

TABLE I

THE RELATIONSHIP BETWEEN CALORIE SUPPLY AND WEIGHT CHANGE FROM AGE 22 TO 62 YEARS

Nation	Caleries supply per day (Kcal)	Change in Weight Men (Kg.)	Women (Kg.)
Uruguay	3030	+ 3.0	+ 10.3
Chile	2610	+ 10.4	+ 7.2
Malaya	2400	- 1.6	- 1.2
Japan	2360	- 2.2	- 2.0
Venezuela	2330	+ 2.1	- 0.5
Colombia	2280	- 7.6	+ 0.2
Thailand	2120	- 3.6	- 5.2
Ecuador	2100	0.0	+ 0.5
Bolivia	2010	- 2.0	- 4.9
Vietnam	1944	- 1.5	+ 1.4

The contribution of socio-economic factors to the development of body fat was further demonstrated by Ashcroft et al., (91). They found that in rural areas Jamaican men lost 4.5 Kg. (10 pounds) of body weight from age 25 to 55, and women gained only 0.5 Kg. (1 pound) over the same period. However, in an urban environment, the men gained 2.7 Kg. (6 pounds), and the women 8.2 Kg. (18 pounds). An equally dramatic example was provided by Evans and Prior (92), also compared body weights and weight/height indices for Polynesians living at subsistence level (coconut, toro, and fish) on Pukapuka with the town dwellers of Rarotonga (who were eating mainly European-type food). On Pukapuka, the men gained 2.9 Kg (6.4 pounds) from 25 to 65 years, and the women lost 0.99 Kg. (2.4 pounds). However, on Rarotonga, the men gained 4.67 Kg. (10.3 pounds) and the women 14.47 Kg. (31.9 pounds).

Garn et al., (93) studied the relationship between level of fatness in adults with level of education and level of income in 2310 adult males and 2626 adult females. The results indicated that the levels of fatness in men increased with educational level such that those with more than 12 years of education are fatter than those with eight years of education or less. Males with college and/or professional education were approximately 10 percent fatter than those with less than high school education. For adult females fatness decreases with increasing educational level. Much the same trend appeared when household income was employed as the socioeconomic indicator, the higher income males were fatter in triceps, subscapular, abdominal, and iliac fatfolds. The higher income females were leaner than those in the lower income category in every site measured.

Glick and Schwartz (94) compared data on four groups of Israelis whose parents had migrated respectively from Europe (Germany, Australia, Poland, Russia, Rumania, Hungary, and Czechoslovakia), North Africa

(Morocco, Tunisia, and Algeria), Iraq, and the Yemen. In terms of the percentage of body fat, the European group were found to have 14.6 percent body fat which was higher than Iraquis (10.0% body fat), North Africans (9.9% body fat) and Yemenites (7.7% body fat), respectively. The authors concluded that the causes of the differences needed to have further experimentation, however, it might be due to a result of genetic differences among these groups.

Etta and Watson (95) collected the anthropometric data and cholesterol values from 402 male Nigerians with the purpose of establishing norms for Nigerians. The subjects were randomly sampled from university students, adult soldiers, and out-patients. The results showed that the values of serum cholesterol of the subjects were generally lower than the mean value of 226 mg% for factory workers in New England, U.S.A. The authors suggested that the general lower cholesterol values were probably attributable to the higher content of vegetables in their diet. Their percentages of body fat were also found much lower than those reported for average in industrialized countries but very similar to those of the lean subjects of those countries. The mean percentage of body fat values of 12.11 were found in university students with 12.6 percent and 11.2 percent in adult soldiers and in outpatients, respectively.

Shephard (96) determined the body composition of 74 adult Canadian Eskimos (33 males and 41 females) by a deuterium oxide dilution method. The figures for lean mass were comparable with those for the "white" population when reported on an absolute basis, but were large if expressed per unit of standing height. Percentage of body fat (average 13.4% in males, 22.6% in females) were of the same order as seen in moderately fit "white" subjects. The possibility was suggested that body fat had a different regional distribution in the Eskimo.

Nagamine and Suzuki (68) studied body composition of 96 young Japanese men and 112 young Japanese women. The subjects were comprised of healthy college students in Tokyo. The mean ages were 22.1 years for men and 21.3 years for women. The authors found that the mean body density was 1.0694 for men and 1.0472 for women. The density for Japanese was higher than the mean of 1.0342 for American young women. The mean body fat calculated from the density was 11.5 percent of body weight for men and 19.9 percent for women. These figures, as the authors concluded, showed that the adiposity of Japanese youths was less than that of American youths.

In his dissertation, Dogu (97) collected the percentage of body fat value from 84 male Turkish students, age 18 to 25, with the purpose of establishing norms for young educated Turkish. The results showed that the mean value was 14.06 percent body fat with a standard deviation of 5.07. The minimum and maximum values were 4.435 and 31.85 percent body fat, respectively.

Many authors studied and collected the percentages of body fat from the children (boys and girls) from the various countries in the more developed countries and primitive population. Data are summarized in Table II and Table III. The overall results showed that the children in the more developed countries tended to have the greater percentage of body fat than the children in the primitive countries.

TABLE II

BODY FAT PERCENTAGE - CHILDREN OF MORE DEVELOPED COUNTRIES

Population	Age (year) 7-8	9-10	11-12	13-14	15-16	17-18	Author
Boys							
Canada							
Anglophone	-	-	15.6	-	-	-	Shephard et al. (99)
Francophone							
Rural	-	-	19.1	-	-	-	Shephard et al. (99)
Urban	-	-	17.7	-	-	-	Shephard et al. (99)
Czechoslovakia							
Cross-sectional	14.5	14.0	16.0	14.0	11.5	10.5	Parizkova (100)
Longitudinal	-	-	17.5	15.5	15.0	11.3	Parizkova (100)
Denmank	-	20.0	18.0	-	-	-	Friis-Hansen (101)
Hungary	-	-	-	12.1	10.0	9.4	Bugyi (102)
U.S.A.	-	-	23.4	20.3	16.1	12.1	Heald et al. (103)
	-	18.7	-	-	-	-	Wilmore and McNamara (104)
Girls							
Canada							
Anglophone	-	-	29.7	-	-	-	Shephard et al. (98)
Francophone							
Rural	-	-	23.2	-	-	-	Shephard et al. (99)
Urban	-	-	23.7	-	-	-	Shephard et al. (99)
Czechoslovakia							
Cross-sectional	19.0	20.0	22.0	18.0	24.0	22.0	Parizkova (100)
Germany	-	-	-	38.6	-	-	Burmeister (105)

TABLE III

BODY FAT PERCENTAGE - CHILDREN OF PRIMITIVE POPULATION

Population	Age (year) 7-8	9-10	11-12	13-14	15-18	Author
Boys						
Canada						
Eskimo	-	-	-	-	12.7	Shephard et al. (106)
East Africa	-	7.0	-	-	-	Di Prampero and Cerreletti (107)
Italy						
Alps	-	-	16.6	-	-	Steplock et al. (108)
Girls						
Canada						
Eskimo	-	-	-	-	19.4	Shephard et al. (106)
East Africa	-	8.0	-	-	-	Di Prampero and Cerretelli (107)
Italy						
Alps	-	-	23.3	-	-	Steplock et al. (108)

Skinfold Thickness

Obesity can also be measured by measuring the subcutaneous fat which is deposited directly under the skin by means of a suitable instrument. The results are believed to be useful as indices of nutritional status, and in particular have been related to the caloric value of the diet (109).

Garn et al., (110) considers that in both children and adult these measurements are reliable indicators of fatness. These workers have shown that there is a correlation between fat fold and weight. Also, those differences in rate of growth, and in skinfold fatness are known to prevail in different ethnic groups.

Robson (111) stated that because of the function of subcutaneous fat as a thermal insulator, it is theoretically possible that its amount is influenced by climatic condition. For example, a thin layer of subcutaneous fat might be considered an adaptation of body form to assist heat elimination.

At a first glance, the published measurements in Table IV would seem to indicate such a development. However, equally thin folds have been reported for those working in mountainous and circumpolar regions. These data are summarized in Table V and Table VI.

Shephard et al., (106) indicated that several of the tropical populations face problems of heat conservation at night. A well-adapted individual must have the capacity to gorge himself and then to live on his reserve of fat and protein for an extented period; thus skinfolds are compatible with this lifestyle only if the main reserves of body fat are held elsewhere than in the subcutaneous tissues.

Katzarski and Ofasu-Amaak (121) found differences in the distribution of body fat between caucasion and non-caucasion populations. They found that in African subjects fat distribution, as given by skinfold thicknesses, tended to be greater in the subscapular than in the triceps region, whereas the reverse was true of caucasion populations.

TABLE IV

AVERAGE SKINFOLD THICKNESSES OF YOUNG MEN LIVING IN TROPICAL AREAS

Population	Average Skinfold Thickness (mm)	Author
Arabs (Chaamba)	6.15	Wyndham (112)
Austrialia (Aborigines)	6.63	Wyndham (112)
Ethiopia (Adi Arkai)	6.03	Anderson (113)
New Guinea	5.00	Sinnett and Whyte (114)
South Africa		
Bantu	5.25 - 5.95	Wyndham (112)
Kalahari Bushmen	4.47 - 4.73	Wyndham (112)
Tanzania		
Active Indiginous	6.35	C.T.M. Davries and
Inactive Indiginous	6.52	Van Haaren (115)
Trinidad		
Negroes	7.90	Edwards et al. (116)
East Indians	10.62	Edwards et al. (116)

TABLE V

AVERAGE SKINFOLD THICKNESSES OF YOUNG MEN LIVING AND/OR WORKING IN RUGGED MOUNTAINOUS AREAS

Population	Average Skinfold Thickness (mm)	Author
Canada Iglooik Eskimos		
Active Hungers	5.6	Shephard (117)
Settlement Dwellers	7.3	Shephard (117)
Ethiopia		
New Guinea	5.0	Sinnett and Solomon (118)
Peru		
Sea-Level Quechua	6.3	Buskirk et al. (119)

Robson (111) observed that comparing values he obtained from a group of healthy Tanganyikan African adolescents with those of Hammond (122) for English adolescents of "poor" nutritional states, but the subscapular skinfold thickness of the African subjects were comparable to those of English adolescents of "good" nutritional status.

Albrink and Meigs (123) found that the mean triceps skinfold thickness of lean Cape Verde Islanders, 20-29 years of age, was 5.5 mm. compared to a mean value of 11.6 mm. found in factory workers in the United States.

Watson et al., (124) collected anthropometric information from the African atheletes who participated in the First African University Games

TABLE VI

AVERAGE SKINFOLD THICKNESSES OF YOUNG MEN
LIVING IN COLD ENVIRONMENT (120)

Population	Average Skinfold Thickness (mm)	Season
Argentina		
Alcaluf Indians	7.90	Winter 1960
Austrialia		
Central Aborigines	7.04	Summer 1959
Tropical Aborigines	9.10	Summer 1959
Eskimos		
Fort Chino Eskimos	5.80	Summer 1970
Iglooik Eskimos	5.50	Summer 1970
Canada		
Arctic Indians	5.79	Fall 1960
	6.65	Spring 1960
Japan		
Ainu (Hokkaido)	5.30	Summer 1971
Scandinavian		
Lapps	7.7	Summer 1963
United States		
Alaskan Eskimos	6.0	Summer 1963
	11.0	Summer 1969

at the University of Ghana, Legan, in December 1974. The subjects were drawn from 13 different countries within Africa. The results indicated the small amount of skinfold thickness in this population. The mean values of the biceps skinfold for males and females were between 3 and 4 mm., 5 and 6 mm., respectively. The mean values of the triceps skinfold for males were between 4.5 and 5.5 mm., with the exception of those from Egypt (6.1 mm.). Those of females were approximately 10 mm. with the exception of those from Liberia (8.7 mm.) and Sierra Leone (12.0 mm). The mean values of subscapular skinfolds for males were between 7.8 and 8.8 mm., and those for females were between 9.0 and 10.5 mm. The mean values of supra-iliac skinfolds for males were between 6.0 and 7.0 mm., with the exception of North African and Sudanese which had mean values of 9.8 mm. and 8.3 mm., respectively. Those of females were between 10 and 11 mm. with the exception of Liberians (13.9 mm.) and Egyptian (13.0 mm.). The total skinfold thickness values for males were between 22 and 24 mm. with the exception of Egyptians (28.7 mm.), Gaonese (24.9 mm.) and Nigerians (25.1 mm.), and for females, values were between 35 and 38 mm., with the exception of Egyptians (38.9 mm.) and Ghanians (40.4 mm.). The data in this study served to provide information for the compilation of the anthropometric standards of reference applicable to African population groups.

Nagamine and Suzuki (68), between 1958 and 1960, studied body composition, skinfold thickness and body density for use in the evaluation of the nutritional status of young Japanese men and women. In this study, the skinfold thicknesses at six sites ranged from 8.0 mm. on the chest to 22.6 mm. on the abdomen in women. The thickest pads were found at the subscapular site in men and at the umbilicus in women.

There have been several extensive studies of skinfold thicknesses of children in the more developed countries. The summarized data in Table VII show the studies that were done in various countries around the world. Sum of three folds ($\Sigma\overline{3}$) refers to sum of tricep, subscapular and suprailiac skinfold; sum of two folds ($\Sigma\overline{2}$) refers to tricep and subscapular; and one fold ($\overline{1}$) refers to tricep skinfold.

From Table VII, the statistics are remarkably similar for most industrialized nations. The boys show a small increase, from 6 to 7 mm. at age seven to 8 to 10 mm. at maturity. Three studies from the United States (138, 139, 140) have shown rather thicker folds than in most other nations. The children of Italian ancestry (135) whose families had remained residents in Palerno or had migrated to Rome had quite lean skinfolds. When the parents or grandparents had migrated to Boston, U.S.A., average values were 2 to 3 mm. larger.

In Czechoslovakia, urban boys had slightly more subcutaneous fat than those from rural areas, this being particularly true of a high school sample in Prague (131). However, among French Canadian boys, the urban sample was thinner than the rural (98). Although Francophones from Montreal (130) appear to be fatter than a random sample of Toronto school children (99), this is an artifact due to the use of only two folds by Jemicek and Demirjian (129); data for the triceps and the subscapular folds are closely similar in the two communities.

A study of 3,975 boys and 3,903 girls southern Chinese living in Hong Kong, illustrates the importance of economic status. At all ages, children from high income families had more subcutaneous fat than those from middle and low income families (134).

TABLE VII

SKINFOLD THICKNESS (MM) - CHILDREN OF MORE DEVELOPED COUNTRIES

Population	Age (year) 7-8	9-10	11-12	13-14	15-16	17-18	Author
Boys							
Austrailia($\Sigma\bar{3}$)	6.3	-	-	-	-	-	Roche and Cahn (125)
Belgium($\Sigma\bar{3}$)		-	7.2	7.4	7.4	-	Simons et al. (126)
Canada($\Sigma\bar{3}$)							
Anglophone	-	7.9	7.3	7.7	-	-	Shephard et al.(127)
Anglophone	-	6.9	8.6	8.0	-	-	Bailey et al. (128)
Francophone Metropolitan	7.1	7.4	8.5	8.8	8.6	8.3	Jenicek and Demirjiad (129)
Rural	-	-	7.7	-	-	-	Shephard et al. (99)
Urban	-	-	7.0	-	-	-	Shephard et al. (99)
Czechoslovakia($\Sigma\bar{3}$)							
Prague	4.8	5.3	7.0	8.2	8.5	-	Parizkova (130)
Prague	-	-	9.5	-	-	-	Parizkova et al. (131)
Rural	-	-	7.5	-	7.6	-	Seliger (100)
Urban	-	-	-	-	-	-	Seliger (132)
Holland	-	-	-	8.1	7.6	7.6	Bink (133)
Hong Kong($\Sigma\bar{3}$)							
High-income	6.1	6.4	7.4	7.0	7.9	8.8	Fry et al. (134)
Middle-income	5.9	5.8	6.1	6.5	7.2	7.8	Fry et al. (134)
Low-income	5.3	5.5	5.8	6.2	7.1	7.8	Fry et al. (134)
Italy($\Sigma\bar{3}$)							
Boston	-	-	9.0	9.1	9.1	10.2	C.M. Young (135)
Rome	-	-	6.8	6.9	6.9	6.5	C.M. Young (135)
Norway($\Sigma\bar{3}$)	-	7.0	-	7.0	-	-	Andersen and Ghesqiere (136)

TABLE VII (Continued)

Population	Age (year) 7-8	9-10	11-12	13-14	15-16	17-18	Author
U.K.(Σ$\overline{3}$)	6.2	6.6	7.3	7.5	7.5	-	Tanner and Whitehouse (137)
U.S.A.							
Σ$\overline{2}$	7.0	8.2	9.0	-	-	-	F.E. Johnston et al. (138)
Σ$\overline{3}$	-	-	-	11.7	12.1	9.2	Novak (139)
Σ$\overline{2}$	-	-	-	9.5	10.0	10.0	Montoye et al. (140)
<u>Girls</u>							
Australia(Σ$\overline{3}$)	8.2	-	-	-	-	-	Roche and Cahn (125)
Canada(Σ$\overline{3}$)							
Francophone Metropolitan ($\overline{2}$)	8.7	9.3	10.0	11.5	12.7	-	Jenicek and Demirjian (129)
Rural	-	-	-	9.3	-	-	Shephard et al. (99)
Urban	-	-	-	10.00	-	-	Shephard et al. (99)
Czechoslovakia(Σ$\overline{3}$)							
Prague	5.8	7.2	9.2	12.0	13.5	-	Parizkova (130)
Prague	-	-	12.4	-	-	-	Parizkova (130)
Rural	-	-	8.7	-	11.5	-	Seliger (132)
Urban	-	-	10.0	-	12.9	-	Selinger (132)
Hong Kong (Chinese)(Σ$\overline{3}$)							
High-income	7.1	7.6	8.8	10.8	12.0	13.3	Fry et al. (134)
Middle-income	6.5	6.8	7.5	9.7	11.4	11.8	Fry et al. (134)
Low-income	6.0	6.4	6.8	9.0	11.3	11.9	Fry et al. (134)
Italy(Σ$\overline{3}$)							
Rome	-	-	9.3	9.8	11.3	11.3	C.M. Young (135)
Norway(Σ$\overline{3}$)	-	9.0	-	13.7	-	-	Andersen and Ghesquiere (136)

TABLE VII (Continued)

Population	Age (year) 7-8	9-10	11-12	13-14	15-16	17-18	Author
U.K.($\Sigma\overline{3}$)	7.4	8.3	9.3	10.5	12.1	-	Tanner and Whitehouse (137)
U.S.A($\Sigma\overline{3}$)	-	-	-	12.9	14.1	15.0	Montoye et al. (140)

Sexual differences in both the average skinfold thickness and the distribution of body fat are established at an early age (130). According to Tanner and Whitehouse (137), and Parizkova (130), the sex difference for the means of skinfold thickness (triceps, subscapular and suprailiac) is no more than 0.5 to 1.0 mm. in the young child, but it increases rapidly with the onset of puberty, to reach a differential of 5 to 6 mm. in late adolescence. The difference between United States and European samples seems smaller for the girls than for the boys, and indeed the fattest group of girls come from Norway (18). In both Czechoslovakia and French-speaking Canada, girls from an urban environment have slightly thicker skinfolds than those from a rural milieu (132, 99).

Among less-developed and primitive communities, skinfolds are generally thinner than in the more-developed nations, equally for boys and girls. The summarized data of the skinfold thickness in the less-developed and primitive communities are shown in Table VIII.

TABLE VIII

SKINFOLD THICKNESS (MM) - CHILDREN OF PRIMITIVE POPULATION

Population	Age (year)						Author
	7-8	9-10	11-12	13-14	15-16	17-18	
Boys							
Austrailia($\Sigma\overline{3}$)							
Aborigines	5.6	4.9	5.1	5.1	5.2	6.9	Abbie (141)
Canada($\Sigma\overline{3}$)							
Eskimo	-	4.1	5.5	4.6	4.9	6.0	Rode and Shephard(142)
Cook Islands($\Sigma\overline{2}$)							
Polynesians	6.2	7.1	8.5	8.8	10.6	14.0	Fry (143)
Dominica	5.6	5.8	-	-	-	-	Robson et al. (144)
Ethiopia($\Sigma\overline{3}$)							
Public school	-	4.7	-	5.2	-	-	Areskog et al. (145)
Private school	-	5.4	-	6.7	-	-	Areskog et al. (145)
Public school ($\Sigma\overline{2}$)	4.8	4.9	5.1	5.2	4.5	-	Eksmyr (146)
Lapps($\Sigma\overline{2}$)	-	-	-	6.7	-	-	Andersen et al.(147)
Libya($\Sigma\overline{3}$)	5.3	5.3	5.5	6.0	-	-	Ferri-Luzzi and Ferri-Luzzi (148)
Malaya($\Sigma\overline{3}$)							
Muar	5.7	5.5	6.2	6.2	-	-	Wadsworth and Lee (149)
Morocco	5.2	5.3	5.7	5.9	6.7	7.1	Ferri-Luzzi and Ferri-Luzzi (148)
New Guinea($\Sigma\overline{3}$)							
Biak	4.6	4.3	5.6	4.8	-	-	Jansen (150)
Nubuai	3.5	3.3	4.3	-	-	-	Jansen (150)
Serong	4.0	3.7	3.7	3.8	-	-	Jansen (150)

TABLE VIII (Continued)

Population	Age (year) 7-8	9-10	11-12	13-14	15-16	17-18	Author
Tanzania							
($\Sigma\overline{2}$)	-	-	-	-	-	-	Robson (144)
($\Sigma\overline{1}$)	-	-	4	4	4	-	C.T.M. Davries et al. (151)
Tunisia($\Sigma\overline{2}$)	4.8	4.9	5.5	-	-	-	Lowenstein and Connell (152)
Tunis($\Sigma\overline{3}$)	-	-	8.8	-	-	-	Parizkova et al. (132)
<u>Girls</u>							
Australia($\Sigma\overline{3}$)							
Aborigine	6.0	7.9	7.1	7.8	9.5	12.0	Abbie (141)
Canada($\Sigma\overline{3}$)							
Eskimo	-	5.6	6.4	7.9	11.1	9.7	Rode and Shephard (142)
Cook Island ($\Sigma\overline{1}$)							
Polynesians	9.5	9.4	11.4	12.2	14.7	18.9	Fry (143)
Dominica($\Sigma\overline{2}$)	6.2	6.3	-	-	-	-	Robson et al. (144)
Ethiopia($\Sigma\overline{2}$)							
Private school	5.7	6.0	6.7	8.0	8.5	-	Eksmyr (146)
Lapps($\Sigma\overline{2}$)	-	-	9.3	-	-	-	Andersen et al. (147)
New Guinea($\Sigma\overline{3}$)	5.8	7.2	9.2	12.0	13.5	-	Parizkova (130)
Serong	4.0	3.7	3.7	8.4	-	-	Jansen (150)
Nubuai	3.5	3.3	4.3	4.6	-	-	Jansen (150)
Biak	4.6	4.3	5.6	5.1	-	-	Jansen (150)

TABLE VIII (Continued)

Population	Age (year) 7-8	9-10	11-12	13-14	15-16	17-18	Author
Tunisia(Σ3)							
Tunis	-	-	10.0	-	-	-	Parizkova et al. (131)

From Table VIII, it can be seen that in some groups such as the Canadian Eskimo (142), a high level of physical activity and the need for heat dissipation without soaking the clothing in sweat may favor a reduction of subcutaneous fat, but generally the main responsible factor seems a lower standard of living than that current in an industrialized community, with a less ready availability of "rich" foods. Thus, Abbie (141) described the Autralian Aborigine's diet as "lean meat protein and a varying amount of vegetables, but almost completely lacking in sugar and in animal fats". The importance of nutritional status was well brought out by the comparison between poor Tunisian children (152) and the wealthy group attending a Tunis high school (131).

Relatively thin skinfolds were found in two samples of Ethiopians attending private schools (145, 146); these observations have been linked with the thin skinfolds of older Tanzanian boys (144) to generate the hypothesis that Africans have a more different distribution of body fat than white people.

Fry (143) obtained rather large skinfold readings on a sample of 221 Rarotongan children. He used a non-standard form of skinfold caliper, but it is difficult to dismiss his readings on this count, since they were confirmed by soft tissue radiographs. Presumably, food is more plentiful and activity levels are lower in Rarotonga than in many primitive communities.

Electrocardiogram

As mentioned before, the electrocardiogram (ECG) is a graph that expressed certain electrophysiologic phenomena manifested by the heart during the phases of contraction and relaxation.

Electrocardiographic variations may be produced by many factors. Sensenbach (153) summed up the effects of environmental influences on the ECG. He listed 47 conditions other than disease which affect the ECG, including: tobacco smoking, exercise, obesity, hyperthyroidism, hypoglycemia, thiamin cloride deficency, neorocirculatory asthenia, and fear.

The effect of caloric undernutrition on the ECG was of interest to many researchers. Simonson et al., (154) studied the ECG of 34 healthy young men (20 to 33 years of age) before and during six months on starvation. The control maintenance diet averaged 3,490 calories, and the starvation diet averaged 1,600 calories (vitamins were added). In periodic clinical examinations, no evidence of disease was found during the semistarvation period, and the subject lost from 27 to 65 pounds, with an average loss of 24 percent of their initial weight. There were highly significant electrocardiographic changes. The mean heart rate decreased from 55 to 37 beats per minute, together with the disappearance of the normal respiratory sinus arrhythmia. The absolute Q-T interval increased from .36 to .46 seconds, but K_{Q-T} decreased slightly. The amplitudes in all deflections (P waves, QRS complex, and T wave) decreased continuously and considerably, for example, the mean R_2, went from 9.91 mm. to 6.23 mm., T_2 from 2.73 mm. to 1.7 mm., and QRS from 23.5 to 14.4 mm. There was a significant right axis shift of both the QRS and T axes, but no correlation between QRS changes and anatomic or T axis changes. In some of the subjects, values for the amplitudes of the QRS and T wave became subnormal with reference to standards for this age group.

Sinus bradycardia, low QRS and T voltage, and the right axis shift were also reported by Tur (155) during the siege of Leningard and by Lopez et al., (156) in 29 patients with severe undernutrition, but control tracings before the malnutrition were not available.

The consumption of food fats may be indirectly related to electrocardiographic records. There was one "chronic" experiment in which Kipshidze (157) found a parallel between decreased QRS amplitude and myocardial fibrosis produced in rabbits by feeding of cholesterol.

Chronic effects of high altitude on the electrocardiogram have been studied in 100 apparently healthy natives and residents at high altitudes (4,500 meters above sea level, between the ages of 24 and 58 years by Rotta (158)). The QRS axis was either markedly deviated to the right (between 90° and 180° in 59 subjects) or to the left (in 21 subjects). In only 20 percent was the QRS axis within the normal range as defined by the researcher (-10° to $90^{\circ}.0$). The mean amplitude of R_1 and R_2 was 3.35 and 6 mm. When comparing to the American means of the same age group, these R values were lower. On the other hand, the mean

S_1, S_2, and S_3 amplitudes were larger. Seven percent of the subjects had right bundle branch block. T was inverted in V_1 and V_2 in 18 percent of the subjects and from V_1 to V_3 in 10 percent of the subjects.

Among Peruvian soldiers born at an altitude of 10,500 feet, Alzania and Monge (159) found that the QRS and T amplitudes increased in nearly all leads progressively during residence at sea level, together with a gradual QRS axis shift to the left.

Definite elevated arterial blood pressure will ultimately produce the ECG pattern of left ventricular hypertrophy. Rautaharju and Blackburn (160) compared mean spatial QRS and T vectors among three blood pressure groups (under 140/90 mm.Hg; 90 to 159/59 mm.Hg; 160/95 mm.Hg. and over) in 468 Finnish laborers 20 to 60 years of age. All subjects were putatively healthy, and blood pressure elevation was not a ground for rejection if it was asymptomatic. This elevation angle of mean spatial QRS vector was greater with higher blood pressures, corresponding to a left QRS axis shift, and the angle between the mean spatial QRS and T vectors increased with higher blood pressure. The significant positive correlation of the QRS elevation angle and the angle between the mean spatial QRS and T vectors with blood pressure was unchanged after the effects of age and relative body weight were eliminated. This observation also suggested that serial ECG observations may provide a sensitive index for early left ventricular hypertrophy in persons with slight or moderate arterial hypertension although the electrocardiograph findings at any given time may be within the wide normal range limits.

Age is biologically the most important variable of the ECG in the adult population, both in regard to the magnitude of changes and in the implications for interpretations. Highly significant age trends have been found by Simmonson and Keys (161) in nearly all of 43 ECG items measured in 157 normal men between 45 and 55 years of age. The results showed that there was a substantial decrease (about 30%) in the amplitudes of R_2, T_2, and Σ QRS, and Σ T, together with QRS and T axes deviation to the left, and a small, but significant increase in the P-R interval, but not in the QRS interval, in the older group. The difference between the longest and shortest R-R interval (ΔR-R) was smaller in the older group; i.e., the sinus rhythm is more regular. In the same electrical position, the amplitudes of QRS and T in V_R, V_L and V_F were lower in the older group.

The electrocardiogram in men and women of the same age also has been found to be different. Simonson et al., (162) found the amplitudes of the R, S, and T waves to be significantly smaller in women in all precordial leads, particularly for V_2 and V_5. The largest sex differences in the R wave amplitudes occured in V_5 (about 25% larger in men) and in the S and T wave amplitudes in V_3. The mean R/S ratio in V_1 was similar in men (0.22) and women (0.21). The mean QRS transitional zone was farther to the right (counter clockwise rotation). However, in both sexes, the QRS transitional zone was most frequently located in V_3. Extreme counterclockwise rotation (transitional zone to the right of V_2) and clockwise rotation (transitional zone in V_5 or to the left of V_5) were rare in both men and women. The QRS and P-R intervals were significantly shorter in women.

There is reason to believe that chest configuration significantly affects transfer impedence from the heart to anatomically specified electrocardiographic leads and that the electrocardiogram recorded with such leads must depend on chest size and shape. Simonson et al,, (163) investigated the statistical relationships between body dimensions and the spatial orientation and magnitude of QRS and T vectors and several components of the conventional scalar electrocardiogram of 70 healthy older men. The results indicated that there were significant mean differences in at least one vectorial or conventional ECG item for all the other chest measurements. In the selected conventional ECG items, the T wave was more frequently influenced by chest configuration than the QRS complex. The QRS axis rather than the QRS amplitude (Σ QRS and R_2) was affected but less so than the T axis. The researchers concluded that chest configuration had a significant influence on the electrocardiogram.

Race is also one of the major factors affecting the electrocardiogram. Standard 12 lead electrocardiogram were recorded in 114 black and white healthy adolescents in both sexes by Reiley et al., (164). The most significant racial differences were higher R-wave amplitudes in the middle and left precordial leads, as well as in lead I. Black subjects had higher means and ranges for the criteria of left ventricular hypertrophy. Black male subjects had a slightly different QRS axis in the frontal plane (mean - 59°: range - 20° to 90°) than white male subjects (mean - 69°; range - 20° to 95°). Black male adolescents had lower means and ranges for the precordial T-wave amplitudes. Precordial S-T segment deviations were smaller and less frequent in white subjects. Between black and white female subjects, no important racial differences in QRS voltages existed for the two groups of female subjects, except that black female subjects had higher means and ranges for one criterion of left ventricular hypertrophy. Although white female adolescents had a lower incidence of biphasic or inverted precordial T waves, T-wave amplitudes tended to be similar in both races. Black female subjects also had higher precordial ST segment elevation.

The electrocardiogram particularly its S-T segment and T wave has been found to be abnormal in a high percentage of normal individuals from a number of different countries in Africa. Grusin (165) reported abnormal ECG in 63 percent of 159 patients and 22 percent of healthy nurses among the South African Bantu. The abnormalities were limited to S-T segments and T waves in the precordial leads. There were depressed S-T segments and an inverted T waves in 33.9 percent of the patients and 14 percent of the nurses. On the other hand, the S-T segments were elevated with tall peaked T waves in 25.2 percent of the patients and 4 percent of the nurses. In a number from each group the ECG had reverted to normal within 1 to 12 months.

Brink (166) also reported significant S-T and T changes in a large proportion of healthy adults among South African Bantu.

Pyke (167) did electrocardiograms on 128 healthy adult West Indians and found S-T segment elevations in precordial leads in 44 percent of the females and in 8 percent of the males. The corresponding figures for Caucasians were S-T elevation in 5 percent of males but none on females; T inversion in 8 percent of the females and in none of the males.

Dharmadasa and Nadarajah (168) investigated 196 healthy Ceylonese young adults (100 men and 96 women) between the ages of 20 and 30 years old, many of whom were university undergraduates and student nurses. Elevation of the S-T segment of 1 mm. or more in one or more precordial leads was found in 90 percent of men and in only 2 percent of women, and an elevation of 2 mm. or more was seen in 33 percent of men and in none of the women. The highest S-T elevation noted was 3.5 mm. Tall T waves were common in the right and mid precordial leads in men, 96 percent of them having at least one precordial T wave of 6 mm. or more, whereas only 9 percent of women has such T waves. Thirty-seven percent of men had precordial T waves of 10 mm. or more, whereas the tallest T wave in the females was 7.5 mm. T wave inversion in V_1 was present in 10 percent of men and 59 percent of women, and T wave inversion in V_1 and V_2 was seen in 3 percent of women and in none of the men. Prominent U waves in the precordial leads were seen in 97 percent of the men and 27 percent of the women. These were best seen in V_2 to V_4. The duration and height of the P wave, the length of the P-R and Q-T intervals and the voltages and duration of the QRS complex are similar to the findings reported from western countries.

Eptein et al., (169) carried out an electrocardiographic survey in 132 members of the Peruvian armed forces. Their average age was 21 years. One tracing was compatible with a diagnosis of posterior myocardial infarction. Seven tracings were suggestive of some right ventricular enlargement. Forty-six percent of the electrocardiograms exhibited strikingly tall T-waves over the right precordium. T wave amplitudes were compared with those found in American population and were found to be tall, out of proportion to the QRS amplitudes, in the right precordial leads.

Oyedium et al., (170) examined the electrocardiograms of 200 healthy Nigerian soldiers. The results showed that the mean value of P-R interval was 0.16 sec. The maximum P wave duration was 0.09 second and the maximum QRS duration was 0.07 second. One hundred and ninety six subjects had regular sinus rhythm but four had ectopic beats. The maximum amplitudes of the R-wave in lead AVL was 14 mm. in one subject and 11 mm. in another. In all the others it was below 11 mm. The mean value for the whole group was 2.85 mm. Most of the subjects had positive T-waves well within the accepted normal limits. S-T segment elevation equal to or greater than 2 mm. was common in leads V_1 to V_4 in the subjects. It occured in 129 subjects (64.5%) in lead V_2, in 83 subjects (41.5%) in lead V_3, but was much less common in leads V_1 and V_4.

Pongpanich et al., (171) compared the electrocardiogram in 50 healthy Thai and 50 healthy Caucasian children in the age group of 5 to 10 years. All subjects were selected from healthy school children in the Bangkok area. The results showed that the QRS duration was significantly larger in the Thai group (p < 0.001). QRS interval in Caucasian subjects ranged from 0.04 to 0.08 seconds, with a mean value of 0.062 second, and in Thai subjects the range was from 0.04 to 0.10 second with a mean value of 0.067 seconds. There were no significant differences between the two groups in PR and QT interval, amplitude and duration of P wave, or R wave voltage in the standard and unipolar leads. The subjects in both races had the same mean values of P-R interval (0.13 second). For the Q-T value, the mean values of Thai and Caucasian were .337 second and .332 second, respectively.

Tseng et al., (172) studied the electrocardiograms of 901 Chinese men and 745 women over 40 years of age in Taipei City, Taiwan. In sum, 540 subjects (32.81%) showed abnormal electrocardiographic findings. Major codable ECG items in descending order included high R wave in left (13.79%), left axis deviation (3.89%), flat or diphasic T waves (3.72%), border line S-T segment depression (1.88%), ventricular premature contraction (1.52%), complete right bundle branch block (1.24%), border line inverted T wave (1.09%). Minor codable ECG items in ascending order were abnormal U wave (0.18%), complete left bundle branch block (0.24%), sinus bradycardia (0.36%), first degree A-V block (0.43%), abnormal P wave (0.49%), atrial fibrillation (0.67%), sinus tachycardia (0.85%), atrial premature contraction (0.85%) and high R wave (0.91%). By comparing these results to the data obtained from American population in Tecumseh, Michigan, the researchers found that these following items were lower in Chinese population and were significantly different from the American population: left axis deviation, low voltages of QRS, borderline ST depression, borderline inverted T waves, diphasic or flat T waves, complete left bundle branch block, extrasystole and first degree A-V block.

Dembo et al., (173) investigated the ECG of 366 healthy young men in Russia. The investigation showed that healthy young Russian people were characterized by fluctuation of the frequency of the cardiac rhythm and variation in the severity of sinus arrhythmia over a wide range. The mean cardiac frequency of the subjects was 68.3 beats per minute. In 71 percent of them the mean cardiac frequency was between 60 and 79 beats per minute, in 16 percent of subjects sinus bradycardia was present, and 13 percent had sinus tachycardia of between 80 and 99 beats per minute. The position of the electrical axis of the overwhelming majority of subjects was between $+1^{\circ}$ and $+89^{\circ}$, with a semivertical or vertical electrical position. The amplitude of the ECG waves (P, Q, R, S, T) in the usual 12 leads were also investigated and compared to American norms. The analysis showed that the mean value obtained for the ECG waves in practically all leads was a little higher than the values of the American population. The researchers suggested that this can be explained by the great homogeneity of the sample as regards ECG characteristics and, probably the greater motor activity of the young subjects tested in this study.

Simonson (174) compared the means of selected ECG items (P-R interval, R wave amplitudes, QRS axis, and T waves), in young and older Japanese and American men and women. The age range of the younger group (20 to 29 years) was identical. Most of the older group (85%) were in the age range 40 to 49 years; therefore, they were compared with American men and women 40 to 49 years of age. The results showed that most electrocardiographic items were significantly larger in Japanese than American of both sexes of the same age. The author also stated that the number of electrocardiographic items and number of subjects (375 Japanese and 575 Americans) compared was sufficient for documentation of significant racial difference in the electrocardiogram.

Reaction Time

Reaction time represents an important consideration in an individual's performance in physical activity, not only in physical education and sports but also in daily living. While reaction time is but one of a number of determinants of the caliber of performance in physical activity, in many cases it may spell the difference between success and failure or even between life and death in emergencies.

Singer (175) stated that reaction time involves an integration of the higher centers of the nervous system, perception of the stimulus (a noise, light, or the like) and the initiation of the appropriate movement. It is the elapsed interval of time from the presentation of stimulus to the initiation of a response. A reflex is usually nonvolitional, involving the lower centers of the nervous system. It is an automatic response, predictable, and does not require perceptability.

Physiologists and experimental psychologists have investigated and suggested theories about the internal mechanism activated during a response to the light or sound stimuli. For example, Botwinick and Thompson (176) proposed that reaction time be thought of as involving premotor and motor time. Premotor time includes the time elapsed from the stimulus presentation to the muscle firing, and motor time describes the point when the muscle fires to the actual response. They also indicated that premotor and reaction time were highly related while no direct relationship could be discerned between motor and reaction time.

Singer (175) emphasized that reaction time does not seem to be an inherent constant response to a stimulus. Rather, it varies with the existence of the following certain conditions: (1) type of stimulus, (2) the strength and/or duration of the stimulus, (3) the readiness for response, (4) practice, (5) age, and (6) the physiological and psychological state of the subject.

Fulton (177) studied the effects of sex, age, and sexual maturation on reaction time of males and females at age 9, 11, 13, 15 and 17. The mean reaction times showed that females tended to be faster than males, and reaction time decreased markedly with age in females. Males improved in reaction time at all ages (9, 11, 13, 15 and 17 years old), but females tended to level off between the age of 15 and 17. The 9 year olds were significantly different in reaction time than all other age groups. More mature subjects at the same age (either at the age of 9, 11, 13, 15 or 17) tended to have faster reaction time.

Botwinick and Thompson (176) suggested that simple reaction time (SRT) and discrimination reaction time (DRT), rather than being simply a function of age, might also be a function of an individual's physiological condition, i.e., physical fitness level. They found in their study that young athletes' times were significantly faster than young non-athletes' times. Assuming that athletic participation results in higher level of fitness, they suggested that physical fitness is a factor that determines age differences in neuromuscular parameters.

Two basic rationales have been constructed by Spirduso (178) to explain the faster central processing times of active individuals. The first of these involves the nutritive and life going function of a healthy cardiovascular system. In summary, this rationale is a biological one, in which excellent (CNS - Central Nervous System) circulation maintains an optimal neuronal longevity as well as processing efficiency. The second rationale, involves the direct effect of the stimulation of physical activity upon the CNS. When neuronal cells fail to receive and process stimuli, eventually they involute and atrophy. Physical activity, particularly as occurs in a competitive sport, generates - both internally and externally - a virtual storm of impinging stimuli. The excitation that occurs during physical activity affects the entire chain of neurons involved, from motor neurons to the higher cortical centers. According to this rationale, the author stated that the best protection against senile involution of brain cells in cerebral activity is exercise, which unlike mental activity, stimulates metabolism, respiration, blood circulation, digestion and glands of external secretion.

In 1962, Tweit et al., (179) conducted experiments testing total body reaction time before a training period and a retest after six weeks of participants in a vigorous training program. It was their purpose to verify previous studies on reaction times which had displayed that athletes possess shorter reaction times than non-athletes among both men and women. In an attempt to more easily produce and detect changes, individuals of low fitness were used. They found that total body reaction time scores in sub-fit individuals were significantly improved by participation in a strenuous physical training program. This study indicated that though correlation was relatively low, between individual fitness tests and total body reaction time, in a composite score of the fitness test there was some correlation with total body reaction. The experimenters concluded that total reaction time could be improved by training. This study added evidence to former studies indicating that athletes had faster reaction times than non-athletes. It was also concluded that reaction time is not dependent on muscular strength.

According to an experiment by Howell (180) emotional tension was mentioned as having an effect on the speed of both reaction and movement time. There was also a relationship between personal evaluation and emotional conditions and the degree of emotional tension as evident by false starts, perspiration, and an apprehensive appearance.

In his doctoral dissertation, Derby (181) studied the effects of varied combinations of temperature and humidity on physical work output and reaction time of individuals high on physical efficiency. The subjects were tested under nine temperature and relative humidity combinations utilized were : (52° - 52%), (52° - 73%), (52° - 93%), (72° - 52%), (72° - 73%), (72° - 93%), (92° - 52%), (92° - 73%), and (92° - 93%). Physical work output performance was tested by a one-minute "all out" effort work bout on a bicycle ergometer with four kiloponds of pressure applied to the wheel. Pretest and posttest dominant foot reaction time was measured immediately before and following each work bout through the use of Dekan Performance Analyzer, utilizing visual stimuli. The results showed that temperature and humidity had an overall significant effect upon physical work output performance. There was an overall significant difference in pretest reaction time under the nine prescribed environmental conditions. There was no significant difference in reaction time after physical work output under the nine prescribed environmental conditions.

Cotten et al., (182) studied the immediate effects of smoking cigarettes on the simple reaction time of college male smokers. The subjects were 15 Georgia Southern College males with smoking histories (10 to 30 cigarettes daily) ranging from six months to 5 years. During each experimental session, the subjects were given 20 trials to measure simple reaction time prior to smoking. Each subject then smoked one cigarette and was instructed to inhale each puff. Another 20 trials were given immediately after smoking and again 5 minutes, 15 minutes, 25 minutes, 40 minutes, and 55 minutes afterwards. The results indicated that the mean reaction time immediately following cigarette smoking was significantly slower ($p < .05$) than on all other test intervals. The test-retest reliabilities after smoking were lower (.50 to .78) than those under the control condition (.67 to .84). Cigarette smoking impedes simple reaction time for a short period. They concluded that smoking immediately before performing a motor skill requiring quick reaction would probably reduce the performance level.

Talland (183) conducted two experiments to test the normal reaction time of men and women with a history of prolonged alcoholism. One experiment compared the performance of 20 men and women in psychiatric treatment for their problems with alcohol against 20 men and women matched for age and without a record of alcoholism, in tests of manual response. The second experiment compared two age-matched groups of 27 men each (both inmates of a correction institution), the one for offenses associated with alcohol intoxication, the other for crimes of a different kind. Both experiments demonstrated that persons with a history of prolonged alcoholism tend to have slower reaction times, and do so irrespective of the testing conditions, the modality by which the signals are given, the hand used for response, or the length of the warning period. The provision of warning signals and the increase of the number of choices according to which disjunctive response is made, further widened the difference between the latencies of the alcoholic and control groups. Alcoholic subjects were more variable as well as slower in reaction time, but within their own group their relative efficiency tended to be the same under the several condition testing.

Shephard (184) has stated that the reaction time differs substantially from one individual to another. It is not clear how far this variation is an inherited feature, and how far it is a reflection of practice.

There have been only a minimum amount of experiments undertaken to determine the difference of reaction time between races. Of the experiments that have been done, the majority tended to compare the reaction time between blacks and whites.

In his master thesis study, Ferguson (185) compared the reaction times of Negro and white athletes at Oklahoma State University. There were 20 Negro athletes and 20 white athletes involved in the study. The results showed that the Negro group had a faster mean reaction time than the white group to a degree of .007 of a second. This difference was not great enough to justify significance of difference between the races.

Hipple (186) compared blacks and whites in a study involving the influence of motivation on muscular tension, reaction time, and speed of movement. Thirty subjects of each race were utilized and they ranged in age from 12 to 14 years. The results showed no significant differences between the races during the unmotivated portion of the study. The portion of the study in which external motivating devices were used produced a significantly faster reaction time within the white group.

Brown (187) compared the patellar results of 82 white subjects produced a eman patellar relex time of .088 $\pm$ .0013 while 81 Negro subjects produced aa mean time of .0074 $\pm$ .0009. The difference between the groups was 5.43 times the probably error of difference which made the findings significant.

Flexibility

The area of flexibility is seen as an area distinct from the others. Cureton (55) reported that good flexibility was a concomitant of gradual and thorough body conditioning. It is a rough indication of physiological youthfulness, an important characteristic of tissues and healthy blood vessels.

Falls et al., (188) described flexibility as one of the components of health-related fitness. In the physical education and sport context, flexibility refers to the degree to which a joint may move through its maximal possible normal range of motion. The determining factor in joint range of motion is the extensibility of the associated connective tissue in and around the joint (tendons and ligaments). Any restriction in the normal extensibility of a joint's connective tissue defines a flexibility problem. In the lower back as well as in certain other areas of the body, a dense connective tissue known as fascia has the function of reinforcement of active muscle contraction. This holding action of connective tissue "spells off" the antigravity muscles of the back and serves as an energy conserving mechanism. When the antigravity muscles fatigue, and their burden is borne completely by the heavy connective tissue of the back, the fascia may become adapted to the stress of bearing the weight. A body position that is sustained, as in an increased lower back curve, often results in shortening of these times. Once adaptive shortening has occured, the need for flexibility becomes evident.

Good back flexibility is one indication that a person has no serious impairment of the joints and tissues involved. Maurice et al., (189) indicated that the habitual exerciser had a small decrease in trunk flexion and an improvement in trunk extension, whereas the non-exercisers had deterioration in both trunk flexion and extension. They further indicated that one of the principal reasons why tension builds and is reflected in low back pain is that members of the civilized society are constantly prevented from expressing the natural response to unnatural strains on their system. This failure to respond by physical outlets prevents the underexercised muscles from getting rid of their tension and chronic complaints, such as low back pain ensue.

Flexibility can be affected by many factors such as: (1) activity, (2) sex, (3) age, (4) temperature, and (5) ischemia.

Activity

It has been found by McCue (190) that active individuals tend to be more flexible than inactive individuals. This is in accord with the well-known fact that connective tissues tend to shorten when they are maintained in a shortened position.

Sex

The results of two investigations agree that among elementary school age children girls are superior to boys in flexibility (191, 192). It is likely that this difference exists at all ages and throughout adult life.

Age

The results of many tests indicate that elementary school age children become less flexible as they grow older, reaching a low point in flexibility between 10 and 12 years of age (193). From this age upward flexibility seems to improve toward young adulthood, but it never again achieves the levels of early childhood. Dynamic flexibility apparently grows steadily poorer from childhood on with increasing age (194).

Temperature

Wear (195) investigated the relationship between dynamic flexibility and temperatures and concluded that dynamic flexibility is improved 20 percent by local warming of a joint to 113° F, and it is decreased 10 to 20 percent by cooling to 65°F. Devries (196) indicated that static flexibility is probably similarly affected by temperature changes.

Ischemia

According to Wright and Johns (194), dynamic flexibility is markedly reduced by arterial occlusion for 25 minutes. The physiology underlying this phenomena has not been elucidated, but it would appear to have important implications for the study of joint disease.

There is some controversy concerning the effect of body build on flexibility. Wear (195) found that the Sit and Reach Test was significantly related to excess trunk plus arm length over leg length. The relationship of trunk plus arm length to leg length in the ability to perform the Toe Touch Test has been studied by Broer and Galles (196). The results indicated a relationship of reach length to leg length is not an important factor in performance of this test for persons with average body builds. It was indicated, however, that persons with extreme body builds, a longer trunk plus longer arm measurement in relation to shorter legs would have an advantage in the performance of the Toe Touch Test. It might be concluded from this study that flexibility scores could be affected by irregular body proportion.

As far as the author could find in the literature, there has been only one study from the Indonesian population that reported the results of the Sit and Reach Test. It seemed fitting to examine this study.

Toda et al., (197) studied the physical fitness of inhabitants in Surabaja, Indonesia. The Sit and Reach Test was one of the fitness variables which was investigated. The total number of subjects was 750 persons, 379 of whom were male, 371 were female and about 12 percent of them were children. For males between the age group of 20 and 24 years old, the mean of the Sit and Reach Test was 10.9 inches with standard deviation of 5.5 and for females in the same age group, mean of the Sit and Reach Test was 9.6 inches with standard deviation of 5.49. In this study, the authors also compared the results of Indonesian to the Japanese norm. The comparison showed that means and standard deviation of the Sit and Reach Test for male and female Japanese between the age group of 20 and 24 years old was 14.9 inches with standard deviation of 5.62 and 15.5 inches with standard deviation of 4.84. These results were higher than Indonesian's results in both sexes.

Grip Strength

In a review of the literature the area of strength was often studied and clearly defined. Cureton (33) described strength as a complex human quality involving will power, the number of muscle fibers that can be brought into the act, and the nutritive state of the muscles involved, all developed into coordinated effort against the particular strength; speed and endurance are not primary considerations.

Rogers (198) made some very positive statements about the relationship between strength tests of maximum effort and various aspects of physical fitness, for instance:

> . . . The positive and very high relation of muscular strength to general health, physical fitness, or capacity for activity can hardly be questioned. With no strength there can be no physical activity; moreover, when muscular strength is low, all other life functions are handicapped. One can hardly see as much, hear as much, meet as persons, or contribute as much to social life when one in continually fatigued by the most necessary activities of life - eating, digestion, attention to environment, and the physical movements incident upon travel from one group of surroundings to another. Practically every change in the condition or functioning of the vital organs has a corresponding change in the condition or functioning of voluntary muscles. It is the prime function of respiration, circulation, digestion, elimination, and even celebration, to maintain the effectiveness of muscles as means of locomotion and manipulation (p. 43).

McCloy (199) supported this position with a slightly different viewpoint:

> . . .Each individual is required to carry or support his bodily weight from morning to night. He must do this with the musculature he has. It is known that a muscle that is too weak for its task works at a lower efficiency than does one that is adequately developed. Hence, an individual who is markedly underdeveloped is working inefficiently, so far as his muscles are concerned, and is suffering greater fatigue, both locally and generally. He has less energy with which to approach his tasks, suffers more from fatigue toxemia, and works under a greater nervous strain. Hence, in addition to its indications as to general medical condition, the strength tests in the form of physical fitness index tell much about the individual's general fitness for living and working (p. 260).

According to Jones (200), grip strength tests when properly administered indicate the maximal voluntary force an individual can exert with the finger flexors. It is a simple measure of human strength, highly reliable and related to physical fitness and other motor traits. It is also closely associated with biological growth.

Bookwalter (201) stated that grip strength is one of the most reliable dynamometrical measures of human strength. It is a relatively economical measure, is easily administered and is a direct measure of applied force. Accordingly, grip strength is a likely component of strength batteries, a strength item in a "fitness" battery, or single item reasonably representative of total body strength.

Fischer (202) studied the effect of temperature on the muscle strength. The experimental period covered a period from early fall, 1945 to summer, 1946. The number of subjects were not indicated but the author mentioned that there were several. The subjects gripped with maximal efforts a Smedley hand dynamometer ten times in successions. The data collected in this study, as the author concluded, were not sufficient to permit any final statement about the effect of weather changes and muscle strength, although they were rather indicative that the weather represented a factor of significant importance, at least from a theoretical point of view. The results also suggested a correlation between daily muscle strength and front passages.

Jones (203) in a study on 80 boys, found a correlation of 0.61 between strength and mesomorphy when height and weight were partialled out. He pointed out that individual differences in both strength and physique are chiefly dependent on common hereditary factors. Training does influence strength scores and when the same amount of training is provided for all, it is probably that individual differences will increase. In further analysis of the strength component, the author concluded that weight accounts for only 25 percent of the variance and is controlled when the components of body build are included with weight and height in proportions based on a multiple regression equation. Apparently, static dynamometric strength is not dependent on gross body size, but a combination of size and body build provide a fairly adequate representation of the factors determining strength.

Bale (204) studied the relationship of physique and body composition to strength in a group of physical education students. Fifty-three students were measured anthropometrically and from these measurements somatotype and body composition were estimated. Leg, back, and grip strength dynamometers were used to measure indices. The moderate relationship of the strength variables with the muscular rating, whether expressed as mesomorphy or lean body weight suggested that the higher a subject's muscular component the greater the dynamic strength.

Everett and Sills (205) studied the relationship of grip strength to stature, somatotype components, and anthropometric measurements of the hand. By using correlational analysis, the authors concluded that weight, and anthropometric measurements of the hand, height, and mesomorphy were the most influential variables in the production of hand grip strength.

Data on hand grip strength of the adults in the various countries are sparse. However, in some countries, these data have been reported for children and adolescents (see Table IX)

From Table IX, among the children (age 8 - 18) in both sexes from the western population, much higher average hand-grip readings have been reported from Oakland, California (200), and from Copenhagen, Denmark (211), than from random samples of Belgians, Canadians, and students in other parts of the United States. However, it is not clear how far these differences simply reflect differences of sampling and test equipment, rather than true inter-population discrepancies. Within Canada, differences between urban and rural children, and between Anglophones and Francophones, are both small (208). For the Canadian

TABLE IX

GRIP STRENGTH VALUE OF THE VARIOUS POPULATION (KG.)

Population	Age (year) 8	10	12	14	16	18	18-25	Author
Male								
Belgium	13.5	17.5	23.5	-	-	-	-	Hebblenick and Borms (206)
Canada								
Edmonton	14.9	19.4	23.4	34.5	-	-	-	Howell et al.(207)
Francophone								
Rural	-	19.0	19.0	19.0	-	-	-	Shephard et al.(208)
Urban	-	19.0	19.0	19.0	-	-	-	Shephard et al.(208)
Eskimo	-	14.8	19.0	30.0	39.4	45.2	-	Rode and Shephard (209)
Indian	8.1	12.4	16.9	21.7	-	-	-	Singh et al.(210)
Denmark	17.8	23.0	28.0	35.0	-	-	-	Asmussen et al.(211)
Ethiopia								
Public School	-	13.8	16.8	16.8	16.8	-	-	Areskog et al.(212)
Private School	-	13.0	19.2	19.2	19.2	19.2		
Workers (Addis Ababa)	-	-	-	-	-	34.6	-	Areskog et al.(212)
Hong Kong	-	-	-	-	-	45.6	-	Areskog et al.(212)
Japan	13.5	-	28.4	-	-	49.4	-	Meshizuka and Nakanashi(213)
Korea	-	-	-	-	-	44.5	-	Meshizuka and Nakanashi(213)
	11.3	16.3	21.8	31.3	29.6	29.6	37.4	Park(217)
Indonesia	-	11.8	14.1	30.2	29.6	29.6	37.4	Yoshiaki et al.(197)
Taiwan	-	-	-	-	-	46.2	-	Meshizuka and Nakanashi(213)
Thailand	7.8	-	21.5	-	-	38.5	-	Meshizuka and Nakanashi(213)

TABLE IX (Continued)

Population	Age (year) 8	10	12	14	16	18	18-25	Author
U.S.A.								
Oakland	-	-	26.0	37.0	50.0	58.0	-	Jones(200)
Saginaw, Michigan	14.4	17.4	21.4	30.7	41.2	45.2	-	Montpetit and Monteye(215)
Venezuela								
Waraa	-	-	-	-	-	-	42.5	Gardner(216)
Female								
Canada								
Edmonton	13.0	16.2	21.3	26.0	-	-	-	Howell et al.(207)
Toronto	-	15.5	23.1	-	-	-	-	Shepard et al.(217)
Francophone								
Rural	-	17.0	17.0	17.0	-	-	-	Shephard et al.(208)
Urban	-	17.0	17.0	17.0	-	-	-	Shephard et al.(208)
Eskimo	-	11.0	20.4	24.7	29.0	27.8	-	Rode and Shephard (209)
Denmark	15.4	20	25	31	-	-	-	Asmussen et al.(211)
Hong Kong	-	-	-	-	-	27.1	-	Meshizuka and Nakanashi(213)
Indonesia	-	9.7	17.1	18.2	22.9	22.9	23.2	Yoshiaki et al.(197)
Japan	12.6	-	26.0	-	-	34	-	Meshizuka and Nakanashi(213)
	-	16.3	21.8	26.2	28.3	28.3	38.4	Yoshiaki et al.(197)
Korea	-	-	-	-	-	24.8	-	Meshizuka and Nakanashi(213)
	9.4	14.0	19.4	24.2	26.5	24.8	-	Park(214)
Taiwan	-	-	-	-	-	27.5	-	Meshizuka and Nakanashi(213)
Thailand	7.7	-	21.8	-	-	26.7	-	Meshizuka and Nakanashi(213)

TABLE IX (Continued)

Population	Age (year) 8	10	12	14	16	18	18-25	Author
U.S.A.								
Oakland	-	-	26	32	35	36	-	Jones(200)
Saginaw, Michigan	12.8	15.3	19.3	23.6	25.8	-	-	Montpetit and Monteye(215)

Eskimo children, the grip strength was not particularly large. Rode and Shephard (209) suggested that this might reflect the wearing of clumsy mittens for much of the year.

Among the children in Asian groups, the highest values have been reported from Japan (213). The values show a general gradient with nutritional status, with particularly poor readings for Vietnam and Indonesia children.

The values of hand-grip strength of the adults (18 to 25 years) from Table IX show that the highest reading has been reported from the Eskimo Canadian with the poorest reading from Indonesian (197).

Data from Table IX tend to support the investigation by Burke (218). In his study, he observed that there was a rapid increase in maximum grip strength form 12 to 25 years of age. After the 25th year there was a gradual decrease in grip strength up to 79. The maximum grip strength of the 25 to 79 years age group was approximately equal to that of the 12 to 15 year age group.

Fisher and Birre (219) cautioned that increasing age may be accompanied by advancement to the more sedentary administrative or supervisory jobs with resulting loss of strength through disuse.

Summary

Literature pertaining to the physical fitness variables in this chapter were concerned with (1) height and weight, (2) body circumference, (3) skinfold thickness, (4) percent of body fat, (5) strength, (6) flexibility, (7) reaction time, and (8) electrocardiogram.

Height and weight were found to be affected by many factors such as genetic and envrionment factors. Comparing races and nationalities, it was reported by some authors that part of the poorer height and weight, especially in the under-developed countries was due to poor economic conditions , undernutrition, and ill-health. On the contrary, overnutrition and the consumption of rich foods in the developed countries were reported by some authors to lead to higher percentage of overweight among the population. However, in the developed countries, there were differences in height and weight between the urban and rural population. Sub-optimal nutrition in relation to infectuous diseases during the period of growth were stated as causes. Generally, urban men were taller and heavier than the rural men in the same population.

Body circumferences can be used to determine the desirable body weight and also can be used to reveal the certain aspects of body configuration. The variation of body circumference among the people may be affected by malnutrition, illness, environmental and genetic effects.

Obesity can be expressed as a percentage of the individual's total body weight. The upper limit of ideal weight for men would include no more than 16 to 19 percent fat and for women, 22 to 25 percent fat. The causes of obesity were reported to be linked with many factors such as genetic factors, physiological and psychological trauma, hormonal imbalances, emotional trauma, alteration in various mechanism that regulate or control body stability, and the environmental factors. The overall results of the measurement of the percentage of body fat from the various population from the more developed and less developed countries showed that the population in the more developed countries tended to have a greater percentage of body fat than the population in the less developed countries.

Obesity can also be assessed by measuring the subcutaneous fat which is deposited directly under the skin. It was believed that the amount of subcutaneous fat is influenced by climatic condition. Several authors found differences in the distribution of body fat between caucasian and non-caucasian population. The skinfold thickness among less-developed and primitive communities were found to be generally thinner than in the more-developed nations, equally for male and female. The main responsible factor seemed a lower standard of living than that in an industrialized community with a less ready availability of "rich" foods.

The electrocardiogram (ECG) is a graph that expresses certain electrophysiologic phenomena manifested by the heart during the phases of contraction and relaxation. Electrocardiographic variations are produced by many facters such as tobacco smoking, exercise, obesity, hyperthyroidism, hypoglycemia, thiamin cloride deficiency, neurocirculatory asthenia, fear, undernutrition, chronic effects of high altitude, elevated arterial blood pressure, age, sex, and chest configuration. In race was reported to be one of the major factors affecting the electrocardiogram. For example, it was found by one researcher that black subjects had higher means and ranges for the criteria of left ventricular hypertrophy. Black male subjects had a slightly different QRS axis in the frontal plane than white male subjects. Another example for the Peruvian population indicated that T wave amplitudes were found to be taller and out of proportion to the QRS amplitudes when comparing to the American population.

Reaction time represents an important consideration in an individual's performance in both physical activity and in daily living. Reaction time varies to sex, age, sexual maturation, emotional tension, temperature and humidity, cigarette smoking, and alcohol. In addition, reaction time might also be a function of an individual's physiological condition, i.e., physical fitness level. One experiment indicated that total reaction time could be improved by training.

Studies of reaction time between races tended to be based on the comparisons between blacks and whites. Results showed that blacks had the tendency to have faster reaction times than whites.

Flexibility is one of the components of health related fitness. Flexibility can be affected by many factors such as: (1) activity, (2) sex, (3) age, (4) temperature, and (5) ischemia. There is some controversy concerning the effects of body build on flexibility. For example, one author found that the Sit and Reach Test was significantly related to excess trunk plus arm length over leg length.

Many authors made some very positive statements about the relationship between strength and various aspects of physical fitness. Grip strength tests are a simple measure of human strength, highly reliable and related to physical fitness and other motor traits. Grip strength can be affected by temperatures, weight, body build and size. In addition, an increasing age may be a factor in affecting the loss of strength through disuse of muscle because of the more sedentary lifestyle.

Based on the literature, there are the differences in some tested variables that the researcher expected to occur in this study. Such variables are height, weight, percent body fat, P-R interval, R wave amplitude, T wave amplitude, QRS axis and grip strength.

The expectation of the results are as follows:

1. The United States population have the highest mean values of height and weight. Middle Eastern students have the next high mean values and East and Southeast students have the lowest mean values of this variables.
2. Middle Eastern students have the highest mean value of the percentage of body fat. The United States population have the next high mean value, and East and Southeast Asian students have the lowest mean value of this variable.
3. East and Southeast Asian students have higher mean values of P-R interval, T wave amplitude, R wave amplitude, and QRS axis than the United States population.
4. The United States population have higher mean value of grip strength than East and Southeast Asian students.

CHAPTER III

METHODS AND PROCEDURES

The procedures followed during the course of this study were organized under the following headings: (1) selection of subjects; (2) personal data collected; (3) test administration; (4) statistical procedure; and (5) description of instruments.

Selection of Subjects

The subjects in this study consisted of 80 Oklahoma State University international male students between the ages of 20 and 30 years old who were attending Oklahoma State University or the English Language Institute during the academic year of 1981-1982. These subjects were divided into two groups. The first group consisted of 40 subjects who were randomly selected from 620 students stratified by the various countries in Middle East Asia. The countries and number of subjects from the respective countries represented the Middle East are presented in Table X. The second group consisted of 40 subjects who were randomly selected from 262 students stratified by the various countries in East and Southeast Asia. The countries and number of subjects from the respective countries represented the East and Southeast Asia are presented in Table XI. Each group was stratified into three subgroups, and the number of subjects for each subgroup was randomly selected according to its total number of students. The subgroups were the students who had been in the United States: (1) less than a year, (2) two and three years, and (3) longer than three years.

TABLE X

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

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.

TABLE XI

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
Tailand	2	4	2	8
TOTAL	10	19	11	40

Personal Data Collected

The personal data collected from each subject was gathered through an interview before each test session. Each subject was questioned in order to collect information concerning his age, medical history, smoking history, alcohol consumption history, family history, activity patterns and medication. All pertinent information gathered in the interview was recorded on individual forms (see Appendix A). In addition to the questionnaire form, these following information was also obtained: diet and living patterns in home country and in the United States.

Test Administration

The subjects arrived at the Physiology of Exercise Laboratory wearing shorts, shirt, socks, and tennis shoes. The sequence of events were as follows: (A) the collection of personal data, (B) height and weight measurements, (C) the reaction time measurements, (D) the skinfold measurements, (E) the body circumferences measurements, (F) flexibility measurements, (G) the grip strength tests, and (H) the administration of an electrocardiogram.

Height and Weight

All subjects were weighed in pounds on a lever-scale weighing machine without foot-wear and wearing only shorts. Heights were measured on a measuring scale fitted with a sliding headpiece that can be brought down to touch the top of the head. The subjects were asked to stand as erect as possible with their eyes looking straight ahead. Statures were recorded to the nearest quarter inch.

Reaction Time

Simple Reaction Time (SRT) was measured on the Dekan Automatic Performance Analyzer by having each subject respond as quickly as possible to an auditory stimulus (buzzer). The hand device was placed in his dominant hand with the index finger on the top button.

A signal of "ready" was given by the researcher upon activation of the timing device. Each subject was given two unrecorded trials to familiarize himself with the equipment and procedure. The next ten trials were then recorded to the nearest 1/100th of a second. The ten trials were averaged for the SRT score.

Skinfold Measurements

The Lange Skinfold Caliper was utilized to obtain skinfold thickness at six sites: biceps, triceps, iliac, abdominal, chest, and back (subscapula). The figures obtained were then utilized for predicting percent of body fat. Triceps, chest and abdominal measurements were used in nomogram by Best (220). Tricep, bicep, iliac and back readings were used in the age adjusted sum of fours chart by Durnim and Wormsley (221). (See Appendix A.)

Body Circumference Measurments

Each subject was measured with a metal anthropometric tape for certain body circumference measurements. Circumferences measurements were first taken of the shoulders, chest, abdomen, buttocks, left and right wrists, forearms, and upper arms. The subject then stood on a stool in order that measurement could be taken more easily of both right and left thighs, knees, calves, and ankles. Each measurement were measured according to the measurement technique described by Behnke (222) and was recorded in centimeters, and the average for each measurement of the extremities was computed. These values were entered in the table, and calculation which is based on the Behnke (222) eleven measure formula, (see Appendix A) to determine the predicted weight of each subject. The difference between the predicted weight and the actual weight was then computed to determine the weight residual.

Flexibility

The degree of trunk flexion was dependent upon the length of the trunk extensor muscles of the back and also the hamstring muscles. The subjects were told to assume a sitting position with the knees fully extended and locked with feet flush against the flexibility box. After sufficient static warm up, the subject was instructed to bend at the hips and stretch the hands and arms forward as far as possible, and this position was held for three seconds. Where the subject touched the recording stick was measured as flexibility.

Strength

The Harpenden hand dynamometer was used to measure the force of the hand's muscular contraction. It was placed in the palm of the hand with dial facing the palm. The subject was then asked to squeeze as tightly as possible with the hand and the arm away from the body. The hand or the upper arm may not push against any other object or against any part of the body. Two proximal trials were taken with each hand and the highest was recorded on the appropriate form (see Appendix A).

The Electrocardiogram

The subject was asked to remove his shirt and lie on a table. The electrode paste was then applied on the body surfaces where the EKG electrodes were placed, and the electrodes were attached to his limbs and chest. The 12 lead EKG electrode placement was done according to the technique described by Dubin (223). Following this, a Birtcher Electrocardiograph was utilized to record the electrocardiogram.

The primary interest in this study was concerned with the resting heart rate, the amplitude of the R and T waves, time interval (P-R), rest/work ratio, and QRS electrical axis.

Heart rate was measured according to the measurement technique described by Dubin (223). R wave, T wave, P-R interval, rest/work ratio were measured according to the measurement techniques described by Cureton (33).

Statistical Procedure

The data for this study were reported descriptively and comparatively. The descriptive data consisted of an analysis of means and standard deviations of each group of the subjects.

The comparative data consisted of multiple t-tests to determine:

1. the differences on each physical fitness variable between the United States population, Middle Eastern, and East and Southeast Asian students;
2. the differences on each physical fitness variable between the foreign students who had been in the United States for less than one year and those students who had been in the United States for more than three years; and,
3. the differences on each fitness variable of foreign students in terms of smoking, drinking, exercise, various diet habits and the socio-economic classes.

The criteria for accepting or rejecting a comparison as significant was placed at the .05 level of confidence.

The data obtained from this study were analyzed at the Oklahoma State University Computer Center.

Description of Instruments

Scales: An instrument used to measure height and weight (Detecto-Medic, Detecto scales, Brooklyn, New York).

Harpenden Hand Dynamometer: An instrument used to measure grip strength (British Instruments, Ltd., London, England).

Flexibility Box: A device used to measure hip trunk forward flexion or sit and reach flexibility.

Reaction Time Devices: An Athletic Performance Analyzer (APA) is used to measure all reaction and movement times. It is calibrated to 1/100th of a second and reading is recorded to the nearest .005 of a second.

Skinfold Calipers: A device for the measurement of skinfold thickness designed whereby the jaw surfaces are always parallel and the spring tension is always constant regardless of the degree to which the calipers are open (Lange Skinfold Caliper, Cambridge Scientific Industries, Inc., Cambridges, Maryland).

Metal Anthropometric Tape: A measuring tape marked in centimeters that is used to obtain data related to body part circumference (Metal tape, 0-201 cm. in length, Preston Corporation, New York, New York).

Electrocardiograph: The Birtcher Electrocardiograph is the instrument used to assess the ability of the heart to transmit the cardiac impulse. By placing electrodes on the arms, legs and chest and connecting these to the recording instrument, the impulse generated during each heart beat is recorded (Birtcher Electrocardiograph, Model 344, Medical Specialty Company, Fort Worth, Texas).

CHAPTER IV

RESULTS AND DISCUSSIONS

A total of 80 foreign students who were attending Oklahoma State University during the academic year of 1981 - 1982 participated in a study to determine if any differences in the selected physical fitness components existed between the students from the various countries in East and Southeast Asia and those students from the various countries in Middle East Asia. The results were also compared with the American population.

The mean age of the subjects from the East and Southeast Asia and Middle East Asia were 24.5 years and 23.57 years, respectively. Twenty-seven physical fitness variables were selected to be appraised in this study.

The total population of the subjects was divided into two groups according to the area where the subjects came from. Each group consisted of 40 foreign students. In each group, the subjects were divided into three subgroups according to the duration of stay in the United States. The purpose was to compare the physical fitness of the subjects who had been in the United States less than one year with those students who had been in the United States more than three years.

Table XII lists the means, minimum and maximum values, standard deviations, and standard errors of the mean of the physical fitness

TABLE XII

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

Variables	N	Mean	Minimum Value	Maximum Value	Standard Deviation	Standard Error of the Mean
MIDDLE EAST						
		R L	R L	R L	R L	R L
Grip Strength (kg)	40	41.75 41.31	27.0 24.0	55.0 55.0	7.10 6.72	1.222 1.062
Sit and Reach Test (Inch)	40	12.025	1.5	18.5	4.064	0.642
Reaction Time (1/100 sec.)	40	.175	0.13	0.37	0.046	0.007
Height (cm.)	40	171.440	159.00	184.80	6.261	0.990
Weight (Kg.)	40	72.982	54.09	100.00	10.336	1.634
Skinfold Thickness (mm.)						
Biceps	40	6.850	2.00	19.00	4.092	0.647
Triceps	40	12.250	3.00	30.00	6.586	1.041
Iliac	40	21.425	3.00	61.00	11.747	1.857
Abdomen	40	25.450	5.00	65.00	14.089	2.228
Chest	40	15.525	3.000	44.000	10.163	1.607
Scapula	40	14.000	6.000	32.000	5.519	0.847
Body Fat (%)						
Nomogram	40	13.15	3.000	31.000	7.570	1.197
Sum of fours	40	19.91	7.600	31.200	5.359	0.847
Body Circumferences (cm.)						
Shoulder	40	111.830	102.500	123.000	5.133	0.812
Chest	40	92.393	80.500	108.000	6.001	0.949
Abdomen	40	81.910	68.000	105.000	8.719	1.379
Buttock	40	94.47	83.00	118.700	6.600	1.043
Thigh	40	56.278	44.300	73.500	4.856	0.768
Bicep	40	29.888	23.000	37.000	2.945	0.466
Forearm	40	26.473	23.400	31.300	1.723	0.273

TABLE XII (Continued)

Variables	N	Mean	Minimum Value	Maximum Value	Standard Deviation	Standard Error of the Mean
Body Circumferences (cm.) (Continued)						
Wrist	40	17.055	15.500	21.000	1.110	0.175
Knee	40	36.518	33.200	42.500	2.323	0.357
Calf	40	36.648	31.500	43.700	2.660	0.421
Ankle	40	23.138	20.300	38.900	1.754	0.277
Electrocardiogram						
Heart Rate (beat)	40	68.125	46.00	94.000	10.778	1.704
R Amplitude (mm.)	40	13.025	3.00	26.00	5.176	0.818
T Amplitude (mm.)	40	3.325	1.00	7.00	1.309	0.207
P-R Internal (second)	40	.159	.129	.200	0.021	0.003
Rest/Work Ratio	40	1.963	1.000	3.100	0.470	0.074
Electrical Assis (Degree)	40	+ 58.050	- 16.000	+100.00	26.419	4.177

EAST AND SOUTHEAST ASIA

Variables	N	Mean	Minimum Value	Maximum Value	Standard Deviation	Standard Error of the Mean
		R L	R L	R L	R L	R L
Grip Strength (kg)	40	39.875 35.913	22.0 17.0	57.0 53.0	8.957 8.469	1.415 1.339
Sit and Reach Test (Inch)	40	11.288	1.500	18.500	3.990	0.631
Reaction Time (1/100 sec.)	40	.165	0.115	2.39	0.027	0.004
Height (cm.)	40	168.805	156.200	180.900	5.810	0.919
Weight (Kg.)	40	62.500	45.450	82.270	7.590	1.200
Skinfold Thickness (mm.)						
Biceps	40	6.050	2.000	19.000	3.021	0.478
Triceps	40	11.850	4.000	35.000	6.138	0.970
Iliac	40	18.650	4.000	43.000	8.562	1.354
Abdomen	40	22.275	4.000	51.000	11.815	1.868

TABLE XII (Continued)

Variables	N	Mean	Minimum Value	Maximum Value	Standard Deviation	Standard Error of the Mean
Skinfold Thickness (mm.) (Continued)						
Chest	40	12.675	3.000	27.000	6.700	1.059
Scapula	40	13.275	6.000	25.000	4.101	0.648
Body Fat (%)						
Nomogram	40	11.875	2.000	32.000	6.056	1.956
Sum of fours	40	18.918	47600	31.100	4.999	0.790
Body Circumferences (cm.)						
Shoulder	40	105.348	93.500	121.200	6.020	0.952
Chest	40	86.507	94.000	94.900	5.406	0.855
Abdomen	40	75.425	60.500	97.500	7.479	1.183
Buttock	40	87.593	79.500	98.000	4.735	0.749
Thigh	40	52.458	45.300	65.300	4.187	0.662
Bicep	40	27.513	21.800	33.300	2.550	0.403
Forearm	40	24.783	20.100	28.000	1.631	0.258
Wrist	40	16.095	13.200	31.000	2.671	0.422
Knee	40	35.018	29.600	41.300	2.027	0.320
Calf	40	35.185	29.900	40.000	2.473	0.391
Ankle	40	21.258	18.900	23.500	1.117	0.177
Electrocardiogram						
Heart Rate (beat)	40	68.375	48.000	88.000	8.869	1.402
R Amplitude (mm.)	40	13.550	2.000	26.000	6.152	0.973
T Amplitude (mm.)	40	3.800	1.000	13.000	1.990	0.315
P-R Internal (second)	40	.165	.120	.200	0.024	0.004
Rest/Work Ratio	40	1.937	1.290	3.000	0.375	0.059
Electrical Assis (Degree)	40	+ 71.750	- 8.000	+104.000	+ 23.892	+ 3.778

TABLE XII (Continued)

Variables	Age	N	Mean		Minimum Value		Maximum Value		Standard Deviation		Standard Error of the Mean	
THE UNITED STATES												
			R	L	R	L	R	L	R	L	R	L
Grip Strength (kg)(224)	19.5	1719	49.401	46.194	-	-	-	-	9.377	9.042	-	-
Sit and Reach Test												
(Inch) (225)	18-21	100	13.375		-		-		1.691		-	
Reaction Time												
(1/100 sec.) (226)	20	20	.163		-		-		.018		-	
Height (cm.) (227)	18-24	772	177.04		-		-		7.11		-	
Weight (Kg.) (227)	18-24	772	74.84		-		-		13.42		-	
Skinfold Thickness (mm.) (228)												
Biceps		-	-		-		-		-		-	
Triceps	19.3	53	13.1		-		-		4.6		-	
Iliac	19.3	53	21.7		-		-		9.4		-	
Abdomen	19.3	53	20.0		-		-		9.6		-	
Chest	-	-	-		-		-		-		-	
Scapula	19.3	53	13.6		-		-		5.1		-	
Body Fat (%) (228)	19.3	53	15.3		-		-		5.7		-	
Body Circumferences (cm.)(228)												
Shoulder	19.3	53	101.7		-		-		17.3		-	
Chest	19.3	53	92.0		-		-		5.0		-	
Abdomen	19.3	53	80.4		-		-		7.4		-	
Buttock	19.3	53	94.1		-		-		6.1		-	
Thigh	19.3	53	55.4		-		-		4.1		-	
Bicep	19.3	53	27.7		-		-		2.3		-	
Forearm	19.3	53	26.0		-		-		1.3		-	
Wrist	19.3	53	16.1		-		-		0.7		-	

TABLE XII (Continued)

Variables	Age	N	Mean	Minimum Value	Maximum Value	Standard Deviation	Standard Error of the Mean
Body Circumferences (cm.) (Continued)							
Knee	19.3	53	36.5	-	-	1.9	-
Calf	19.3	53	37.1	-	-	4.3	-
Ankle	19.3	53	21.9	-	-	1.6	-
Electrocardiogram (33)							
Heart Rate (beat/min.)	20-29	81	64.5	-	-	8.58	-
R Amplitude (mm.)	20-29	81	13.19	-	-	3.94	-
T Amplitude (mm.)	20-29	81	4.20	-	-	1.50	-
P-R Internal (second)	20-29	81	.1717	-	-	.019	-
Rest/Work Ratio	20-29	81	2.6000	-	-	.462	-
Electrical Axis (Degree)	20-29	81	64.6	-	-	24.7	-

variables of foreign students from East and Southeast Asia and Middle East Asia.

Table XIII and Table XIV show the means and standard deviations of the physical fitness variables of the subjects in each group who had been in the United States less than one year and more than three years.

Height and Weight

Mean and standard deviation values of height and weight of the students from the Middle East, East and Southeast Asia, and the United States population are presented in Table XV. The results showed that the United States population had the highest mean values of height and weight among the subjects from these three areas (177.04 centimeters and 74.89 kilograms). The students from the Middle East had the next high mean values of 171.44 centimeters and 72.78 kilograms. The students from East and Southeast Asia had the lowest mean values of 168.81 centimeters and 62.5 kilograms.

The t-test analysis showed that there was no significant difference in height between the students from Middle East and East and Southeast Asia, but there was a significant difference in weight between the students from both areas. It also indicated that there was a significant difference in height between the students from Middle East and the United States population, but there was no significant difference in weight between the students from both areas. However, there were significant differences in both variables between the students from East and Southeast Asia and the United States population at the confidence level of .05.

TABLE XIII

MEAN AND STANDARD DEVIATION VALUES OF THE PHYSICAL FITNESS VARIABLES OF FOREIGN STUDENTS FROM MIDDLE EAST WHO HAD BEEN IN THE UNITED STATES FOR LESS THAN ONE YEAR AND MORE THAN THREE YEARS

Variables	Group 1			Group 3		
	N	Mean and Standard Deviation		N	Mean and Standard Deviation	
		R	L		R	L
Grip Strength (kg)	7	40.64 ± 8.57	40.00 ± 7.78	13	43.96 ± 7.17	44.35 ± 5.68
Sit and Reach Test (Inch)	7	9.43 ± 4.36		13	12.81 ± 4.39	
Reaction Time (1/100 sec.)	7	.172 ± 0.05		13	.184 ± 0.07	
Height (cm.)	7	174.61 ± 6.04		13	170.31 ± 6.18	
Weight (Kg.)	7	69.81 ± 10.92		13	70.28 ± 9.04	
Skinfold Thickness (mm.)						
Biceps	7	6.71 ± 3.35		13	6.00 ± 4.08	
Triceps	7	10.57 ± 5.91		13	10.38 ± 9.8	
Iliac	7	20.29 ± 9.67		13	16.15 ± 8.16	
Abdomen	7	26.14 ± 13.7		13	20.54 ± 12.89	
Chest	7	11.71 ± 4.96		13	13.31 ± 10.47	
Scapula	7	14.29 ± 4.72		13	12.69 ± 6.81	
Body Fat (%)						
Nomogram	7	11.57 ± 5.74		13	10.84 ± 8.25	
Sum of fourschart	7	19.44 ± 4.18		13	17.85 ± 5.29	
Body Circumferences (cm.)						
Shoulder	7	109.83 ± 5.60		13	110.92 ± 5.68	
Chest	7	91.34 ± 5.73		13	90.5 ± 5.48	
Abdomen	7	79.07 ± 7.99		13	79.37 ± 7.12	
Buttock	7	92.00 ± 6.05		13	92.71 ± 5.85	
Thigh	7	55.05 ± 3.64		13	54.86 ± 4.64	
Bicep	7	28.47 ± 2.66		13	29.58 ± 3.34	
Forearm	7	26.36 ± 2.31		13	26.36 ± 1.74	

TABLE XIII (Continued)

Variables	Group 1 N	Group 1 Mean and Standard Deviation	Group 3 N	Group 3 Mean and Standard Deviation
Body Circumferences (cm.)				
Wrist	7	17.00 ± 1.85	13	16.98 ± 0.88
Knee	7	36.66 ± 2.77	13	35.6 ± 1.89
Calf	7	35.96 ± 3.80	13	35.53 ± 2.16
Ankle	7	22.80 ± 2.84	13	22.72 ± 1.59
Electrocardiogram				
Heart Rate (beat)	7	73.28 ± 11.77	13	65.85 ± 8.73
R Amplitude (mm.)	7	10.00 ± 4.55	13	13.38 ± 5.77
T Amplitude (mm.)	7	3.14 ± 1.07	13	3.61 ± 1.26
P-R Internal (second)	7	.16 ± 0.00	13	.16 ± 0.02
Rest/Work Ratio	7	1.68 ± .38	13	2.09 ± 0.40
Electrical Assis (Degree)	7	67.14 ± 22.10	13	63.54 ± 23.37

Group 1 = The students who had been in the United States less than one year.
Group 3 = The students who had been in the United States for more than three years.

TABLE XIV

MEAN AND STANDARD DEVIATION VALUES OF THE PHYSICAL FITNESS VARIABLES OF FOREIGN STUDENTS FROM EAST AND SOUTHEAST WHO HAD BEEN IN THE UNITED STATES FOR LESS THAN ONE YEAR AND MORE THAN THREE YEARS

Variables	Group 1			Group 3		
	N	Mean and Standard Deviation		N	Mean and Standard Deviation	
		R	L		R	L
Grip Strength (kg)	10	40.25 ± 7.97	35.35 ± 7.16	11	45.0 ± 7.95	40.77 ± 6.02
Sit and Reach Test (Inch)	10	11.6 ± 4.20		11	12.81 ± 4.39	
Reaction Time (1/100 sec.)	10	.1588 ± 0.02		11	.184 ± 0.07	
Height (cm.)	10	169.95 ± 5.68		11	170.31 ± 6.18	
Weight (Kg.)	10	64.08 ± 5.00		11	70.28 ± 9.04	
Skinfold Thickness (mm.)						
Biceps	10	6.0 ± 1.41		11	6.45 ± 5.07	
Triceps	10	11.0 ± 2.62		11	11.24 ± 9.91	
Iliac	10	18.5 ± 5.64		11	20.45 ± 11.94	
Abdomen	10	21.8 ± 8.32		11	23.0 ± 15.58	
Chest	10	11.4 ± 4.47		11	11.64 ± 8.23	
Scapula	10	13.8 ± 3.29		11	13.36 ± 5.35	
Body Fat (%)						
Nomogram	10	11.1 ± 3.07		11	11.64 ± 9.05	
Sum of fourschart	10	19.45 ± 2.22		11	18.2 ± 7.29	
Body Circumferences (cm.)						
Shoulder	10	106.5 ± 3.03		11	117.98 ± 6.94	
Chest	10	87.15 ± 4.24		11	88.94 ± 5.32	
Abdomen	10	75.29 ± 5.97		11	75.71 ± 8.31	
Buttock	10	88.17 ± 3.56		11	87.58 ± 5.85	
Thigh	10	54.26 ± 5.09		11	52.26 ± 4.05	
Bicep	10	27.92 ± 1.63		11	27.79 ± 2.87	
Forearm	10	25.21 ± 0.86		11	24.93 ± 1.53	

TABLE XIV (Continued)

Variables	Group 1 N	Group 1 Mean and Standard Deviation	Group 3 N	Group 3 Mean and Standard Deviation
Body Circumferences (cm.) (Continued)				
Wrist	10	17.66 ± 4.79	11	15.85 ± 0.88
Knee	10	34.71 ± 1.98	11	35.79 ± 2.44
Calf	10	36.07 ± 1.89	11	34.90 ± 2.89
Ankle	10	21.78 ± 1.02	11	20.73 ± 1.15
Electrocardiogram				
Heart Rate (beat)	10	66.9 ± 11.47	11	68.0 ± 8.83
R Amplitude (mm.)	10	14.3 ± 6.50	11	11.0 ± 6.93
T Amplitude (mm.)	10	3.6 ± 1.35	11	3.18 ± 1.47
P-R Internal (second)	10	.164 ± .04	11	.164 ± .01
Rest/Work Ratio	10	1.99 ± .44	11	1.860 ± .44
Electrical Assis (Degree)	10	75.4 ± 20.99	11	61.27 ± 30.3

Group 1 = The students who had been in the United States less than one year.
Group 3 = The students who had been in the United States for more than three years.

Mean values of height and weight of the students from Middle East and East and Southeast Asia who had been in the United States less than one year and more than three years are presented in Table XVI . For the Middle East area, the students who had been in the United States less than one year showed a larger mean value of height than the students who had been in the United States more than three years (174.6 centimeters > 170.31 centimeters). However, the students who had been in the United States less than one year had a smaller mean value of weight than the students who had been in the United States more than three years (69.81 kilograms < 70.28 Kilograms).

TABLE XV

MEAN AND STANDARD DEVIATION VALUES OF HEIGHT AND WEIGHT OF THE STUDENTS FROM MIDDLE EAST, EAST AND SOUTHEAST AISA, AND THE UNITED STATES POPULATION

Area	N	Height	Weight
Middle East	40	171.44 ± 6.26	72.78 ± 10.34
East and South East	40	168.81 ± 5.81	62.5 ± 7.59
United States(229)	772	177.04 ± 7.11	74.89 ± 13.42

NOTE: Data source for United States population shown in parentheses.

TABLE XVI

MEAN AND STANDARD DEVIATION VALUES OF HEIGHT AND WEIGHT OF THE STUDENTS FROM MIDDLE EAST AND EAST AND SOUTHEAST AISA WHO HAD BEEN IN THE UNITED STATES LESS THAN ONE YEAR AND MORE THAN THREE YEARS

	N	Height	Weight
MIDDLE EAST			
Group 1	7	174.61 ± 6.04	69.81 ± 10.92
Group 3	13	170.31 ± 6.18	70.28 ± 9.04
EAST AND SOUTHEAST ASIA			
Group 1	10	169.95 ± 5.68	64.08 ± 5.00
Group 3	11	171.20 ± 6.45	63.92 ± 9.35

Group 1: The students who had been in the United States less than one year.
Group 3: The students who had been in the United States more than three years.

For the East and Southeast Asia group, the students who had been in the United States less than one year showed the smaller mean value of height than the students who had been in the United States more than three years (169.95 centimeters < 171.20 centimeters). However, the mean value of weight of the students who had been in the United States less than one year was larger than the students who had been in the United States more than three years (64.08 kilogram > 63.93 kilograms). There were no significant differences in both variables between the students who had been in the United States less than one year and those who had been in the United States more than three years in both areas at the confidence level of .05. These results indicated that duration of stay in the United States had no affect on either variables for the students in both areas.

The relationship between the socio-economic classes and height and weight were also analyzed in the study. However, the researcher is not certain that the socio-economic classes of the students were the real classes that the students belonged to because the indications of the socio-economic class are varied from one country to the other. Even though the results may not reflect the real relationship between these variables, it is interesting to report these values.

It was reported that ten students (12.5%) came from high socio-economic class. Sixty-nine students (86.25%) came from middle socio-economic class, and only one student (1.25%) came from low socio-economic class. Since there were not enough students to represent the students in low socio-economic class, the mean values of height and weight and any physical fitness variables of the students in this class would not be reported.

The results showed that the students in high socio-economic class had larger mean value of height (170.50 centimeters) than the students in middle socio-economic class (168.22 centimeters). However, when weight was analyzed between these two groups of students, the students in high socio-economic class had smaller mean value of weight (66.96 kilograms) than the students in middle socio-economic class (72.94 kilograms). There were no significant differences in height and weight between these two groups of students at the .05 confidence level.

Table XVII lists the mean and standard deviation values of height and weight of the students in high and middle socio-economic class.

TABLE XVII

MEAN AND STANDARD DEVIATION VALUES OF HEIGHT AND WEIGHT OF THE STUDENTS IN HIGH AND MIDDLE SOCIO-ECONOMIC CLASS

Socio-economic Class	N	Height	Weight
High	10	170.50 $\pm$ 5.41	66.96 $\pm$ 9.1
Middle	69	168.22 $\pm$ 9.99	72.94 $\pm$ 16.98

Interestingly, when the mean values of height and weight were analyzed in the students in high and middle socio-economic class of each area, the results were similar to the mean values obtained from the students in high and middle socio-economic class of two areas combined together.

Middle Eastern students in high socio-economic class had a larger mean value of height (171.55 centimeters) and a smaller mean value of weight (71.40 kilograms) than the students in the middle socio-economic class (170.83 centimeters and 80.60 kilograms).

Similar results were obtained from Eastern and South Eastern students, the students in a high socio-economic class had larger mean values of height and weight (169.98 centimeters and 61.45 kilograms) than the students in the middle socio-economic class (164.30 centimeters and 62.45 kilograms).

Table XVIII lists the mean and standard deviation values of height and weight of Middle Eastern and Eastern and South Eastern students in high and middle socio-economic class.

TABLE XVIII

MEAN AND STANDARD DEVIATION VALUES OF HEIGHT AND WEIGHT OF MIDDLE EASTERN AND EASTERN AND SOUTHEASTERN ASIAN STUDENTS IN HIGH AND MIDDLE SOCIO-ECONOMIC CLASS

	N	Height	Weight
MIDDLE EAST			
High socio-economic class	34	171.55 ± 5.00	71.40 ± 8.79
Middle socio-economic class	6	170.83 ± 11.85	80.60 ± 15.39
EAST AND SOUTHEAST			
High socio-economic class	35	169.48 ± 5.68	61.46 ± 7.22
Middle socio-economic class	4	164.30 ± 5.57	62.45 ± 12.52

The results of the students in high and middle socio-economic class of each area were not significantly different at the .05 confidence level. However, the similar obtained mean values of height and weight of the students in both classes may indicate there is a trend for the students in high socio-economic class to be taller and weigh less than the students in middle socio-economic class.

The weight residual in the subjects of each area was also studied. The results were obtained by subtracting the actual weight from the ideal weight. The results showed that 36 students from Middle East

(90%) and 28 students from East and South East Asia (70%) had weight residual. The mean value of the weight residual of the students from the Middle East and East and Southeast Asia were 3.78 kilograms and 2.98 kilograms, respectively. The results are shown in Table XIX.

TABLE XIX

MEAN VALUES OF WEIGHT RESIDUAL OF MIDDLE EASTERN AND EAST AND SOUTHEAST ASIAN STUDENTS

Area	N	Weight Residual (kg.)
Middle East	36	3.78
East and Southeast	28	2.98

Even though the mean value of the weight residual of the students from Middle East was greater than those of the students from East and Southeast Asia, there was not a significant difference between the groups. Middle Eastern students who had been in the United States longer than three years had smaller mean value of weight residual than those who had been in the the United States less than one year (2.47 Kg. < 2.51 Kg.). However, East and Southeast Asian students who had been in the United States longer than three years had higher mean value of weight residual than those who been in the United States less than one year (2.25 Kg. > 1.13 Kg.). The results are shown in Table XX.

TABLE XX

MEAN VALUE OF WEIGHT RESIDUAL OF MIDDLE EASTERN AND EAST AND SOUTHEAST ASIAN STUDENTS WHO HAD BEEN IN THE UNITED STATES FOR LESS THAN ONE YEAR AND MORE THAN THREE YEARS

	N	Weight Residual
MIDDLE EAST		
Group 1	7	2.51
Group 3	13	2.47
EAST AND SOUTHEAST		
Group 1	10	1.33
Group 3	11	2.55

Group 1: The students who had been in the United States less than one year.
Group 3: The students who had been in the United States more than three years.

Skinfold Thickness and Percentage of Body Fat

The mean values of the skinfold thickness of the students from Middle East and East and Southeast Asia are presented in Table XXI. The sites of skinfold thicknesses taken to be measured in Middle Eastern students and East and Southeast Asian students were bicep, tricep, iliac, subscapula, chest and abdomen. Each site of skinfold thicknesses and the sum of six sites were analyzed to make the comparison between the students from Middle East and East and Southeast Asia. To make the comparison between the students from these two areas with the United States population, only four sites of skinfold thicknesses (tricep, iliac, abdomen, and scapula) were made. Since as far as the researcher can find in the literature, only the values of four sites of skinfold thicknesses have been collected in the United States population.

TABLE XXI

MEAN AND STANDARD DEVIATION VALUES OF THE SKINFOLD THICKNESS OF THE STUDENTS FROM MIDDLE EAST AND EAST AND SOUTHEAST ASIA AND THE UNITED STATES POPULATION

	N	Bicep	Tricep	Iliac
Middle East	40	6.85 ± 4.092	12.25 ± 6.59	21.43 ± 11.75
East and Southeast	40	6.05 ± 3.021	11.85 ± 6.14	18.65 ± 8.56
United States(220)	53	-	13.1 ± 4.6	21.9 ± 9.4

	N	Scapula	Chest	Abdomen
Middle East	40	14.00 ± 5.32	15.53 ± 10.16	25.45 ± 14.09
East and Southeast	40	13.28 ± 4.10	12.68 ± 6.7	22.28 ± 11.82
United States(220)	53	13.6 ± 5.1	-	20.0 ± 9.6

	N	Sum of 4 Sites	Sum of 6 Sites
Middle East	40	73.13 ± 34.78	95.51 ± 52.19
East and Southeast	40	66.05 ± 26.91	87.78 ± 46.47
United States(220)	53	68.9 ± 28.7	-

The students from Middle East had the higher mean values of the skinfold thicknesses of bicep (6.85 millimeters) and chest (15.53 millimeters) than East and Southeast Asian students (6.05 millimeters and 12.675 millimeters). However, there were not significant differences in these two variables between the students from both areas at the .05 confidence level.

The United States subjects had the highest mean values of the skinfold thicknesses of tricep (13.1 millimeters) and iliac (21.7 millimeters). Middle Eastern students had the next highest mean values of the skinfold thicknesses of tricep and iliac with the mean values of 12.25 millimeters and 21.43 millimeters while East and Southeast Asian students had the lowest mean values of these variables (triceps - 11.85 millimeters, iliac - 18.65 millimeters). However, there were no significant differences in the skinfold thicknesses of tricep and iliac between Middle Eastern students and East and Southeast Asian students, Middle Eastern students and the United States population, and East and Southeast Asian students and the United States population at the confidence level of .05.

As far as the skinfold thicknesses of scapula and abdomen are concerned, Middle Eastern students had the highest mean values of 14.00 millimeters and 15.53 millimeters, respectively. For the skinfold thickness of scapula, the United States population followed with a mean value of 13.6 millimeters. For the skinfold thickness of abdomen, East and Southeast Asian students followed Middle Eastern students with a mean value of 22.28 millimeters, and the United States population had the lowest mean value of 20.00 millimeters. There were not any significant differences in the skinfold thicknesses of scapula and abdomen between Middle Eastern students and East and Southeast Asian students, Middle Eastern students and the United States population, East and Southeast Asian students and the United States population.

When the skinfold thicknesses of four sites (tricep, iliac, scapula and abdomen) were summed, the results showed that Middle Eastern students had the highest mean values of 73.13 millimeters followed by the United States population and East and Southeast Asian students with the mean values of 68.40 millimeters and 66.05 millimeters, respectively. However, there were no significant differences between Middle Eastern students and East and Southeast Asian students, Middle Eastern students and the United States population, and East and Southeast Asian students and the United States population at the confidence level of .05.

When the skinfold thicknesses of six sites (bicep, tricep, iliac, chest, scapula and abdomen) were summed, the results showed that Middle Eastern students had higher mean values than East and Southeast Asian students (95.51 millimeters > 87.78 millimeters). Also, there was a significant difference in the sum of six sites of skinfold thicknesses between the students from these two areas at the confidence level of .05. Duration of stay in the United States did not make any significant differences in the skinfold thicknesses of each sites (bicep, tricep, iliac, chest, scapula, and abdomen) and the sum of six sites of the students from both areas at the .05 confidence level. Table XXII shows the mean values of the skinfold thicknesses of the students from Middle East and East and Southeast Asia who had been in the United States less than one year and more than three years.

TABLE XXII

MEAN AND STANDARD DEVIATION VALUES OF THE SKINFOLD THICKNESSES OF MIDDLE EASTERN AND EAST AND SOUTHEAST ASIAN STUDENTS WHO HAD BEEN IN THE UNITED STATES LESS THAN ONE YEAR AND MORE THAN THREE YEARS

	N	Bicep	Tricep	Iliac	Scapula
			MIDDLE EAST		
Group 1	7	6.71 ± 3.11	10.57 ± 5.48	20.29 ± 8.95	14.29 ± 4.35
Group 3	13	6.00 ± 3.92	10.84 ± 6.75	16.15 ± 8.85	12.69 ± 6.55

	N	Chest	Abdomen	Sum of 6 Units
Group 1	7	11.71 ± 4.6	26.14 ± 12.69	89.71 ± 39.18
Group 3	13	13.31 ± 10.05	20.53 ± 12.40	79.52 ± 47.52

	N	Bicep	Tricep	Iliac	Scapula
			EAST AND SOUTHEAST		
Group 1	10	6.00 ± 1.34	11.00 ± 4.02	18.5 ± 5.33	13.8 ± 3.12
Group 3	11	6.45 ± 4.84	11.27 ± 9.45	20.45 ± 11.39	13.4 ± 5.11

	N	Chest	Abdomen	Sum of 6 Units
Group 1	10	11.4 ± 4.25	21.8 ± 7.9	82.5 ± 33.13
Group 3	11	11.64 ± 7.84	23.0 ± 14.85	86.2 ± 53.48

Group 1 = The students who had been in the United States less than one year.
Group 3 = The students who had been in the United States more than three years.

For the Middle East area, the students who had been in the United States had greater mean values of bicep (6.71 millimeters) iliac (10.29 millimeters), scapula (14.29 millimeters), and abdomen (26.14 millimeters) than those students who had been in the United States more than three years (bicep = 6.00 millimeters, iliac = 16.15 millimeters, scapula = 12.69 millimeters and abdomem = 20.53 millimeters). However, the students who had been in the United States more than three years had greater mean values of tricep and chest than those who had been in the United States less than one year (10.84 millimeters > 10.57 millimeters, and 13.31 millimeters > 11.71 millimeters). When the skinfold thicknesses of six sites were summed, the students who had been in the United States more than three years had greater mean values than those who had been in the United States less than one year (89.71 millimeters > 79.52 millimeters).

For East and Southeast Asia area, the students who had been in the United States more than three years had greater mean values of bicep, tricep, iliac, chest, and abdomen than the students who had been in the United States less than one year (6.45 millimeters > 6.00 millimeters, 11.27 millimenters> 11.00 millimeters, 20.45 millimeters > 18.5 millimeters, 11.64 millimeters > 11.4 millimeters, and 23.00 millimeters > 21.8 millimeters, respectively). Only the scapula skinfold thickness of the students who had been in the United States less than one year had a greater mean value than that of those who had been in the United States more than three years (13.8 millimeters > 13.36 millimeters).

When the skinfold thicknesses were analyzed in term of the relationship with exercise, exercise seemed to have the effect on the skinfold thicknesses of the subjects. The results showed that the students from both areas who exercised at their home countries, but not in the United States, had more skinfold thicknesses than the students who exercised at their home countries and in the United States.

For the Middle East area, the majority (9 students, 69.23%) of the students who had been in the United States more than three years and exercised at their home countries and in the United States had the mean value of the sum of six sites of skinfold thicknesses of 58.55 millimeters. Two students (15.38%) who exercised only in their home countries but not in the United States had the mean values of 126.5 millimeters, and one student (7.69%) who did not exercise at all had a value of 170 millimeters. These results were similar to the mean value derived from the students who had been in the United States less than one year. Two students (28.57%) who exercised in their home countries and in the United States had the lowest mean value of 62.00 millimenters. Three students (42.86%) who exercised in their home countries but not in the United States had the mean value of 89 millimeters. Two students (28.57%) who did not exercise at all had the highest mean value of 118.5 millimeters.

For the East and Southeast Asia area, three students (27.71%) who had been in the United States less than one year and exercised in their home countries and the United States had the lowest mean value of the sum of six sites of skinfold thicknesses of 72 millimeters, while seven students (63.64%) who exercised in their home countries but not in the United States had the mean value of 96.57 millimeters. One student (9.0%) who did not exercise at all had the mean value of 82.5 millimeters. Ten students (100%) from East and Southeast Asia who had been in the United States more than three years and exercised in their home countries but not in the United States had a mean value of 82.5 millimeters. Table XXIII lists mean value of skinfold thicknesses of exercisers and non-exercisers.

Socio-economic class did not make any significant difference in the sum of six sites of skinfold thicknesses (bicep, tricep, iliac, back, chest, and abdomen) between the students in high and middle socio-economic class. However, the students in high socio-economic class showed the greater mean value of the skinfold thicknesses than those in middle socio-economic class (108.4 millimeters > 88.84 millimeters). The results are shown in Table XXIV.

Skinfold thicknesses were also compared between the students who ate meat and who did not eat meat (vegetarians). Even though there were only three students from the Middle East who reported that they were vegetarians, it is interesting to make the comparison between the students in these two groups. The results showed that the mean value of sum of six sites of skinfold thicknesses (bicep, tricep, chest, iliac, back, and abdomen) of the vegetarians were 80.17 millimeters. Seventy-seven students who were meat-eaters had higher mean value of 113.64 millimeters. However, there was no significant difference in the sum of six sites of skinfold thicknesses between these two groups of students. Table XXV lists mean and standard deviation values of the sum of six sites of skinfold thicknesses of the vegetarians and non-vegetarians.

This study also investigated the effect of consuming the different kind of foods on the skinfold thicknesses. Foods to be analyzed were egg, poultry, fish, pork, and beef. The period of consuming these foods was not under the direct control of the researcher; therefore the

TABLE XXIII

MEAN VALUE OF SKINFOLD THICKNESS OF EXERCISERS AND NON-EXERCISERS

Middle East	Students in U.S. Less Than One Year N	Sum of Six Sites
Group 1	3	89 millimeters
Group 2	2	62 millimeters
Group 3	2	118.5 millimeters

Middle East	Students in U.S. More Than Three Years N	Sum of Six Sites
Group 1	2	126.5 millimeters
Group 2	9	58.55 millimeters
Group 3	1	170.00 millimeters

East and Southeast	Students in U.S. Less Than One Year N	Sum of Six Sites
Group 1	7	96.57 millimeters
Group 2	3	72.00 millimeters
Group 3	1	82.50 millimeters

TABLE XXIII (Continued)

East and Southeast	Students in U.S. More Than Three Years N	Sum of Six Sites
Group 1	10	82.5 millimeters

Group 1 = The students who exercised in their home countries but not in the United States.
Group 2 = The students who exercised in their home countries and the United States.
Group 3 = The students who did not exercise in their home countries and the United States.

TABLE XXIV

MEAN AND STANDARD DEVIATION VALUES OF THE SKINFOLD THICKNESSES OF THE STUDENTS IN HIGH AND MIDDLE SOCIO-ECONOMIC CLASS

Soci-economic Class	N	Sum of Six Sites
High	10	108.4 $\pm$ 48.57
Middle	69	88.84 $\pm$ 41.25

results might not reflect the real values. However, it is interesting to report these values.

TABLE XXV

MEAN AND STANDARD DEVIATION VALUES OF SUM OR SIX SITES OF SKINFOLD THICKNESSES OF THE VEGETARIANS AND NON-VEGETARIANS

	N	Skinfold Thicknesses
Vegetarians	3	80.17 ± 21.96
Non-Vegetarains	69	113.64 ± 40.76

The t-test analysis showed no significant differences in the sum of six sites of skinfold thicknesses between the students who ate egg, fish, pork, beef, and poultry and those who did not.

The students who ate egg, fish, pork, beef, and poultry had a mean value of 112.24 millimeters, 109.51 millimeters, 108.57 millimeters, 114.62 millimeters, and 112.89 millimeters, respectively. The students who did not eat egg, fish, pork, beef, and poultry had a mean value of 112.73 millimeters, 114.02 millimeters, 114.93 millimeters, 94.80 millimeters, and 112.89 millimeters, respectively. Table XXVI lists the mean and standard deviation value of the sum of six sites of skinfold thicknesses between the students who ate egg, fish, pork, beef and poultry and those who did not.

TABLE XXVI

MEAN AND STANDARD DEVIATION VALUES OF THE SUM OF SIX SITES OF SKINFOLD THICKNESSES BETWEEN THE STUDENTS WHO ATE EGGS, PORK, FISH, BEEF, AND POULTRY AND THOSE WHO DID NOT

Foods	N	Students Who Did Not Eat	N	Students Who Ate
Egg	24	112.73 ± 40.12	56	112.24 ± 41.21
Pork	48	114.93 ± 41.82	32	108.57 ± 39.12
Fish	51	114.02 ± 43.64	29	109.51 ± 35.27
Beef	9	94.80 ± 19.81	71	114.62 ± 42.12
Poultry	27	111.41 ± 45.80	53	112.89 ± 38.20

There was no significant difference in the sum of six sites of skinfold thickness between the students who ate cake and sweets and those who do not. However, the students who ate cakes and sweets showed a higher mean value of the sum of six sites of skinfold thicknesses than those who did not (120.30 millimeters > 103.19 millimeters). Table XXVII lists mean and standard deviation value of the sum of six sites of skinfold thicknesses of the students who ate cake and sweets and those who did not.

TABLE XXVII

MEAN AND STANDARD DEVIATION VALUES OF THE SUM OF SIX SITES OF SKINFOLD THICKNESSES OF THE STUDENTS WHO ATE CAKE AND SWEETS AND THOSE WHO DID NOT

	N	Skinfold Thicknesses
Students who ate cake and sweets	43	120.30 ± 45.87
Students who did not eat cake and sweets	37	103.19 ± 31.73

Percentage of body fat was analyzed from the figures obtained from the skinfold thicknesses. Tricep, chest and abdominal measurements were used to figure out the percentage of body fat in the nomogram by Best (223). The readings obtained from tricep, bicep, iliac and back were used in the sum of fours chart by Durnin and Wormsley (224).

Since the mean value of the percentage of body fat of the United States college male population available from the literature has been figured out by the underwater measurement technique, it would not be appropriate to compare these with the students from Middle East, East and Southeast Asia. However, the mean value of the percentage of body fat of the United States population was reported, and the comparison was made only between Middle Eastern and East and Southeast Asian student.

The United States students had a mean value of 15.3% body fat from underwater weighing. Middle Eastern students had a mean value of 13.15% body fat from the nomogram and 19.91% body fat from the sum of fours chart. Eastern and South Eastern students had a mean value of 11.88%

body fat from the nomogram and 18.92% body fat from the sum of fours chart. The mean values of the percentage of body fat from both nomogram and sum of fours chart were higher in Middle Eastern students, but, there were not any significant differences in both mean values between the students from both areas at the confidence level of .05.

It is the opinion of the researcher that the validity of the conversion of the skinfold thickness to percent body fat is somewhat questionable since the formulas used in the conversion are population specific. The nomogram was developed for young men in the United States, and the sum of fours was developed for adult men in England. The mean values of the percentage of body fat in this study which were obtained by nomogram and sum of fours showed quite a bit differences; however, the differences of the values were quite consistent. Therefore, the comparisons were made only on the basis of detecting the significant differences of the percentage of body fat which was figured out from each formula. Table XXVIII lists the mean and standard deviation values of the percentage of body fat of Middle Eastern, East and Southeast Asian students and the United States population.

The length of stay resulted in no significant difference in the percentage of body fat at the confidence level of .05. Middle Eastern students who had been in the United States less than one year had the mean values of 11.57% body fat from nomogram and 19.44% body fat from sum of fours chart while those who had been in the United States more than three years had the mean values of 10.84% body fat from nomogram and 17.85% body fat from sum of fours chart.

TABLE XXVIII

MEAN AND STANDARD DEVIATION VALUES OF BODY FAT OF THE STUDENTS FROM MIDDLE EAST AND EAST AND SOUTHEAST ASIA AND THE UNITED STATES POPULATION

Area	N	Nonogram	Sum of Fours	Underwater Technique
Middle East	40	13.15 ± 7.57	19.91 ± 7.60	-
East and Southeast	40	11.88 ± 2.0	18.92 ± 4.70	-
United States(220)	53	-	-	19.3 ± 15.3

New students from East and Southeast Asia had the mean values of 11.1% body fat from nomogram and 19.45% body fat from sum of fours chart while the other group had the mean values of 11.64% body fat from nomogram and 18.21% body fat from sum of fours chart. Table XXIX lists mean and standard deviation values of the percentage of body fat of the students who had been in the United States less than one year and more than three years.

The students who were the exercisers had the mean values of 11.21% body fat from nomogram and 18.48% body fat from sum of fours chart, while the non-exercisers had the higher mean values of 13.95% body fat from nomogram and 20.45% body fat from sum of fours chart. These were not statistically significant differences in both mean values of the percentage of body fat between the exercisers and non-exercises at the confidence level of .05. Table XXX lists the mean and standard

TABLE XXIX

MEAN AND STANDARD DEVIATION VALUES OF THE PERCENTAGE OF BODY FAT OF THE STUDENTS WHO HAD BEEN IN THE UNITED STATES LESS THAN ONE YEAR AND MORE THAN THREE YEARS

	N	Nomogram	Sum of Fours
MIDDLE EAST			
Group 1	7	11.57 ± 5.74	19.44 ± 4.18
Group 3	13	10.84 ± 8.25	17.85 ± 5.29
EAST AND SOUTHEAST			
Group 1	10	11.1 ± 3.07	19.45 ± 2.22
Group 3	11	11.64 ± 9.05	18.21 ± 7.19

Group 1 = The students who had been in the United States less than one year.
Group 3 = The students who had been in the United States more than three years.

deviation values of the percentage of body fat for the exercisers and non-exercisers.

TABLE XXX

MEAN AND STANDARD DEVIATION VALUES OF THE PERCENTAGE OF BODY FAT FOR EXERCISERS AND NON-EXERCISERS

	N	Nomogram	Sum of Fours
Exercisers	42	11.21 ± 5.92	18.48 ± 4.32
Non-Exercisers	13	13.95 ± 7.56	20.45 ± 5.86

The analysis of t-test showed no significant difference in the mean values of the percentage of body fat between the students in high and middle socio-economic class at the confidence level of .05. The students in high socio-economic class had higher mean values (nomogram = 15.8% body fat, sum of fours chart = 20.41% body fat) than the students in the middle socio-economic class (nomogram - 12.04% body fat, sum of fourt chart - 19.27%) body fat). The results are summarized in Table XXXI.

TABLE XXXI

MEAN AND STANDARD DEVIATION VALUES OF THE PERCENTAGE OF BODY FAT FOR THE STUDENTS IN HIGH AND MIDDLE SOCIO-ECONOMIC CLASS

Socio-economic Class	N	Nomogram	Sum of Fours
High	10	15.80 ± 9.2	20.41 ± 6.32
Middle	70	12.04 ± 6.38	19.27 ± 5.03

The students who were the vegetarians had lower mean values of percentage of body fat (nomogram = 7.33% body fat, sum of fours chart = 15.23% body fat), than those who were not (nomogram = 12.71% body fat, sum of fours chart = 19.45% body fat). However, there were no significant differences between these two groups of students. The results are listed in Table XXXII.

The study also showed that there were no significant differences in the percentage of body fat between the students who ate egg, fish, pork, beef, and poultry and those who did not. The students who ate such foods had the mean values of the percentage of body fat as follows: egg = 12.68% body fat (nomogram), 18.94% body fat (sum of fours); fish = 12.07% body fat (nomogram), 19.21% body fat (sum of fours); pork = 12.06% body fat (nomogram), 19.16% body fat (sum of fours); beef = 12.93% body fat (nomogram), 19.22% body fat (sum of fours). For those who did not eat such foods, the results showed as follows: egg = 12.68% body fat (nomogram), 18.52% body fat (sum of fours); fish = 12.76% body fat (nomogram), 19.95% body fat (sum of fours); pork = 12.81% body fat (nomogram), 19.56% body fat (sum of fours); beef = 9.22% body fat (nomogram), 17.7% body fat (sum of fours); and poultry = 12.22% body fat (nomogram), 19.29% body fat (sum of fours). Table XXXIII lists the mean and standard deviation values of the percentage of body fat between the students who ate egg, fish, pork, beef, and poultry and those who did not.

TABLE XXXII

MEAN AND STANDARD DEVIATION VALUES OF THE PERCENTAGE OF BODY FAT OF THE VEGETARIANS AND NON-VEGETARIANS

	N	Nomogram	Sum of Fours
Vegetarians	77	15.23 ± 3.53	7.33 ± 2.52
Non-Vegetarians	3	19.45 ± 5.59	12.71 ± 6.88

The students who ate cake and sweets showed higher mean values of the percentage of body fat (nomogram = 13.42% body fat, sum of fours = 20.27% body fat) than those who did not (nomogram = 11.46% body fat, sum of fours = 18.41% body fat). Table XXXIV lists the mean and standard deviation values of the percentage of body fat for the students who ate cake and sweets and those who did not.

TABLE XXXIII

MEAN AND STANDARD DEVIATION VALUES OF THE PERCENTAGE OF BODY FAT FOR THE STUDENTS WHO ATE EGGS, PORK, FISH, BEEF, AND POULTRY AND THOSE WHO DID NOT

Foods	N	Nomogram	Sum of Fours	N	Nomogram	Sum of Fours
Egg	24	12.68 ± 5.64	18.52 ± 4.63	24	12.68 ± 7.34	18.94 ± 6.90
Fish	29	12.81 ± 6.93	19.56 ± 4.08	51	12.06 ± 6.79	19.16 ± 5.48
Pork	32	12.76 ± 9.36	19.95 ± 4.12	48	12.07 ± 5.92	19.21 ± 5.20
Beef	71	9.22 ± 2.82	17.7 ± 2.29	9	12.93 ± 7.10	19.24 ± 7.89
Poultry	53	12.22 ± 2.68	19.29 ± 5.56	27	12.66 ± 3.10	18.96 ± 4.56

TABLE XXXIV

MEAN AND STANDARD DEVIATION VALUES OF THE PERCENTAGE OF BODY FAT FOR THE STUDENTS WHO ATE CAKE AND SWEETS AND THOSE WHO DID NOT

	N	Nomogram	Sum of Fours
The students who ate cake and sweets	43	13.42 ± 7.53	20.27 ± 5.13
The students who did not eat	37	11.46 ± 5.87	18.41 ± 1.94

Body Circumference

Mean and standard deviation values of 11 body circumferences (chest, shoulder, abdomen, buttock, bicep, forearm, wrist, thigh, knee, calf, and ankle) of the students from Middle East and East and Southeast Asia, and the United States population are presented in Table XXXV.

TABLE XXXV

MEAN AND STANDARD DEVIATION VALUES OF THE BODY CIRCUMFERENCES OF THE STUDENTS FROM MIDDLE EAST AND EAST AND SOUTHEAST ASIA AND THE UNITED STATES POPULATION

Body Circumference	Middle East Asia (N=40)	East and South East Asia (N=40)	United States (N=53)
Shoulder	111.83 ± 5.13	105.35 ± 6.02	101.7 ± 17.3
Chest	92.39 ± 6.0	86.51 ± 5.41	92.0 ± 5.0
Abdomen	81.91 ± 8.72	75.43 ± 7.48	80.4 ± 7.4
Buttock	94.47 ± 6.6	87.59 ± 4.74	94.1 ± 6.1
Thigh	56.28 ± 4.86	52.46 ± 4.19	55.4 ± 4.1
Bicep	29.89 ± 2.95	27.51 ± 2.55	27.7 ± 2.3
Forearm	26.47 ± 1.72	24.78 ± 1.63	26.0 ± 1.3
Wrist	17.06 ± 1.11	16.09 ± 2.67	16.1 ± 0.7
Knee	36.52 ± 2.32	35.02 ± 2.03	36.5 ± 1.9
Calf	36.65 ± 2.66	35.19 ± 2.47	37.1 ± 4.3
Ankle	23.14 ± 1.75	21.26 ± 1.12	21.9 ± 1.6

NOTE: Data for the United States population is as reported in Reference 230.

The results showed that Middle Eastern students had greater mean values of all of the body circumferences than East and Southeast Asian students (shoulder = 111.83 centimeters > 105.35 centimeters, chest = 92.39 centimeters > 86.51 centimeters, abdomen = 81.91 centimeters > 75.43 centimeters, buttock = 94.47 centimeters > 87.59 centimeters, thigh = 56.28 centimeters > 53.46 centimeters, bicep = 29.89 centimeters > 27.51 centimeters, forearm = 26.47 centimeters > 24.78 centimeters, wrist = 17.06 centimeters > 16.09 centimeters, knee = 36.52 centimeters > 35.02 centimeters, calf = 36.65 centimeters > 35.19 centimeters, ankle = 23.14 centimeters > 21.26 centimeters). There were significant differences in shoulder, chest, buttock, thigh, forearm, and ankle between Middle Eastern students and East and Southeast Asian students at the confidence level of .05. However, there were no significant differences in abdomen, bicep, wrist, knee, and calf between the students from these two areas.

When body circumferences of Middle Eastern students were compared with those of the United States population, the results showed that except for the calf circumference, Middle Eastern students had greater mean values of the rest of the body circumferences than the United States population (shoulders = 111.83 centimeters > 101.7 centimeters, chest = 92.39 centimeters > 92.0 centimeters, abdomen = 81.91 centimeters > 80.4 centimeters, buttock = 94.47 centimeters > 94.1 centimeters, thigh = 56.26 centimeters > 55.4 centimeters, bicep = 29.89 centimeters > 27.7 centimeters, forearm = 26.47 centimeters > 26.0 centimeters, wrist = 17.06 centimeters > 16.1 centimeters, knee = 36.52 centimeters > 36.50 centimeters, calf = 36.65 centimeters < 37.1 centimeters). There were statistically significant differences in shoulder circumference, bicep circumference, wrist circumference, and ankle circumference between the students from Middle East and the United States population, but there were not statistically significant differences in chest circumference, abdomen circumference, buttock circumference, thigh circumference, forearm circumference, knee circumference, and calf circumference between these two groups of students at the confidence level of .05.

The United States population had greater mean values of wrist circumference, chest circumference, abdomen circumference, buttock circumference, thigh circumference bicep circumference, forearm circumference, knee circumference, calf circumference, and ankle cirumference than East and Southeast Asian students (16.1 centimeters > 16.0 centimeters, 92.0 centimeters > 86.51 centimeters, 80.4 centimeters > 75.43 centimeters, 94.1 centimeters > 97.59 centimeters, 55.4 centimeters > 52.46 centimeters, 27.7 centimeters > 27.51 centimeters, 26.0 centimeters > 24.78 centimeters, 36.5 centimeters > 35.02 centimeters, 37.1 centimeters > 27.51 centimeters, and 21.9 centimeters > 21.26 centimeters). However, East and Southeast Asian students had greater mean values of shoulder circumference than the United States population (105.35 centimeters > 101.7 centimeters). There were statistically significant differences in shoulder circumference, chest circumference, abdomen circumference, buttock circumference, forearm circumference, thigh circumference, knee circumference, and calf circumference between East and Southeast Asian students and the United States population. However, there were no statistically significant differences in bicep circumference, wrist circumference and ankle circumference between the students from East and Southeast Asia and the United States population at the .05 confidence level.

The overall results showed that with the exception of calf circumference, Middle Eastern students had the highest mean values of the body circumferences among the students from three areas. These differences, might be caused by, presumably, the effect of racial differences.

Duration of stay did not make any statistically significant differences in all of 11 body circumferences between the students who had been in the United States less than one year and more than three years. Table XXXVI and XXXVII list the mean and standard deviation values of the body circumferences of the students from Middle East and East and Southeast Asia.

Middle Eastern students who had been in the United States less than one year had higher mean values of wrist circumference (17.00 centimeters), chest circumference (91.34 centimeters), thigh circumference (55.06 centimeters), knee circumference (36.66 centimeters), calf circumference (35.96 centimeters), and ankle circumference (22.80 centimeters), and lower mean values of shoulder circumference (109.83 centimeters), abdomen circumference (79.07 centimeters), buttock circumference (92.00 centimeters), and bicep circumference (28.47 centimeters) than those students who had been in the United States more than three years (wrist circumference = 16.98 centimeters, chest circumference = 90.5 centimeters, thigh circumference = 54.86 centimeters, knee circumference = 35.6 centimeters, calf circumference = 35.53 centimeters, ankle circumference = 22.72 centimeters, shoulder circumference = 110.93 centimeters, abdomen circumference = 79.37 centimeters,

TABLE XXXVI

MEAN AND STANDARD DEVIATION VALUES OF THE BODY CIRCUMFERENCES OF MIDDLE EASTERN STUDENTS WHO HAD BEEN IN THE UNITED STATES FOR LESS THAN ONE YEAR AND MORE THAN THREE YEARS

Body Circumference	Group 1 (N=7)	Group 3 (N=13)
Shoulder	109.83 ± 5.6	110.92 ± 5.68
Chest	91.34 ± 5.73	90.51 ± 5.48
Abdomen	79.07 ± 7.99	79.37 ± 7.12
Buttock	92.0 ± 6.05	92.71 ± 5.85
Thigh	55.06 ± 3.64	54.86 ± 4.64
Bicep	28.47 ± 2.66	29.58 ± 3.34
Forearm	26.36 ± 2.31	26.36 ± 1.74
Wrist	17.00 ± 1.85	16.98 ± 0.88
Knee	36.65 ± 2.77	35.6 ± 1.89
Calf	35.96 ± 3.80	35.53 ± 2.16
Ankle	22.80 ± 2.84	22.72 ± 1.59

Group 1 = The students who had been in the United States for less than one year.
Group 3 = The students who had been in the United States for more than three years.

TABLE XXXVII

MEAN AND STANDARD DEVIATION VALUES OF THE BODY CIRCUMFERENCES OF EAST AND SOUTHEAST ASIAN STUDENTS WHO HAD BEEN IN THE UNITED STATES FOR LESS THAN ONE YEAR AND MORE THAN THREE YEARS

Body Circumference	Group 1 (N=10)	Group 3 (N=11)
Shoulder	106.5 ± 3.03	107.98 ± 6.94
Chest	87.15 ± 4.24	88.94 ± 5.32
Abdomen	75.29 ± 5.97	75.71 ± 8.31
Buttock	88.17 ± 3.56	87.58 ± 5.85
Thigh	54.26 ± 5.09	52.26 ± 4.05
Bicep	27.92 ± 1.63	27.79 ± 2.87
Forearm	25.21 ± 0.86	24.93 ± 1.53
Wrist	17.66 ± 4.79	15.85 ± 0.88
Knee	34.71 ± 1.98	35.79 ± 2.44
Calf	36.07 ± 1.89	34.90 ± 2.89
Ankle	21.78 ± 1.02	20.73 ± 1.15

Group 1 = The students who had been in the United States for less than one year.
Group 3 = The students who had been in the United States for more than three years.

buttock = 92.71 centimeters, and bicep circumference = 29.57 centimeters). The students from both groups had equal mean value of forearm circumference (26.36 centimeters).

East and Southeast Asian students who had been in the United States less than one year had higher mean values of thigh circumference (54.26 centimeters), bicep circumference (27.92 centimeters), forearm circumference (25.21 centimeters), wrist circumference (17.66 centimeters), buttock circumference (88.17 centimeters), calf circumference (36.07 centimeters), and ankle circumference (21.78 centimeters), and lower mean values of shoulder circumference (106.5 centimeters), chest circumference (87.15 centimeters), abdomen circumference (75.29 centimeters), and knee circumference (34.71 centimeters) than those students who had been in the United States more than three years (thigh = 52.26 centimeters, bicep = 27.79 centimeters, forearm circumference = 24.93 centimeters, wrist circumference = 15.85 centimeters, calf circumference = 35.79 centimeters, buttock circumference = 87.58 centimeters, ankle circumference = 20.73 centimeters, should circumference = 109.98 centimeters, chest circumference = 88.94 centimeters, abdomen circumference = 75.71 centimeters, and knee circumference = 35.79 centimeters).

The relationship between exercise and body circumferences were also analyzed to see the effect of the physical activities on the various body circumferences. The results showed no statistically significant differences in 11 body circumferences between exercisers and non-exercisers at the confidence level of .05. The students who exercised regularly had higher mean values of shoulder circumference (109.60 centimeters), chest circumference (90.12 centimeters), buttock circumference (91.21 centimeters), bicep circumference (28.96 centimeters), forearm circumference (25.82 centimeters), wrist circumference (16.71 centimeters), thigh circumference (54.75 centimeters), calf circumference (36.05 centimeters), and ankle circumference (22.27 centimeters); and had lower mean values of knee circumference (35.63 centimeters) and abdominal circumference (77.74 centimeters) than the students who did not exercise (shoulder circumference = 107.47 centimeters , chest circumference = 88.71 centimeters , abdominal circumference = 79.69 centimeters, buttock = 90.83 circumference = 25.41 centimeters, wrist circumference = 16.42 centimeters, thigh circumference = 53.94 centimeters, knee circumferenece = 35.91 centimeters, calf circumference = 35.76 centimeters, and ankle circumference = 22.11 centimeters). Table XXXVIII lists the mean and standard deviation values of the relationship between exercise and the body circumferences.

When the results were analyzed in terms of the socio-economic class, the results showed there were not any statistically significant differences in these variables at the confidence level of .05 but interestingly, the mean values of 11 body circumferences of the students in high socio-economic class were higher than the students in low socio-economic class (shoulder circumference = 112.60 centimeters > 108.08 centimeters, chest circumference = 93.10 centimeters > 89.00 centimeters, abdominal circumference = 82.83 centimeters > 78.16 centimeters, buttock circumference = 94.52 centimeters > 90.61 centimeters, bicep circumference = 30.22 centimeters > 28.48 centimeters, forearm circumference = 26.75 centimeters > 25.48 centimeters, wrist circumference = 17.24 centimeters > 16.49 centimeters, thigh circumference = 56.12 centimeters > 54.13 centimeters, knee circumference = 37.16

centimeters > 35.57 centimeters, calf circumference = 37.63 centimeters > 35.67 centimeters, ankle circumference = 23.06 centimeters > 22.08 centimeters). Table XXXIX list mean values of the body circumferences of the students in middle and high socio-economic class.

TABLE XXXVIII

MEAN AND STANDARD DEVIATION VALUES OF THE BODY CIRCUMFERENCES OF EXERCISERS AND NON-EXERCISERS

Body Circumference	Non-Exercisers (N=38)	Exercisers (N=42)
Shoulder	107.47 ± 4.9	109.60 ± 5.22
Chest	88.71 ± 7.27	90.12 ± 5.50
Abdomen	79.69 ± 9.47	77.74 ± 9.95
Buttock	90.83 ± 7.66	91.21 ± 5.73
Bicep	28.41 ± 3.26	28.97 ± 2.74
Forearm	25.41 ± 2.13	25.82 ± 1.60
Wrist	16.42 ± 1.49	16.71 ± 2.52
Thigh	53.94 ± 5.28	54.75 ± 4.56
Knee	36.91 ± 2.51	35.64 ± 2.10
Calf	35.76 ± 3.00	36.05 ± 2.32
Ankle	22.11 ± 1.97	22.27 ± 1.52

TABLE XXXIX

MEAN AND STANDARD DEVIATION VALUES OF THE BODY CIRCUMFERENCES OF THE STUDENTS IN MIDDLE AND HIGH SOCIO-ECONOMIC CLASS

Body Circumference	Middle Class N = 69	High Class N = 10
Shoulder	108.08 ± 6.06	112.60 ± 8.01
Chest	89.00 ± 5.93	93.10 ± 8.61
Abdomen	78.16 ± 7.96	82.83 ± 12.67
Buttock	90.61 ± 6.64	94.52 ± 6.24
Bicep	28.48 ± 2.85	30.22 ± 3.73
Forearm	25.48 ± 1.71	26.75 ± 2.65
Wrist	16.49 ± 2.10	17.24 ± 2.05
Thigh	54.13 ± 4.80	56.12 ± 5.73
Knee	35.57 ± 2.02	37.16 ± 3.60
Calf	35.67 ± 2.53	37.63 ± 3.11
Ankle	22.08 ± 1.61	23.06 ± 2.44

Grip Strength

The mean and standard deviation values of grip strength of Middle Eastern and East and Southeastern Asia students and the United States population are summarized in Table XL.

The United States population had the highest mean values of both right and left grip strength (49.40 kilograms and 46.19 kilograms). Middle Eastern students had the next high mean values of both right and left grip strength (41.75 kilograms and 41.31 kilograms) and East and Southeast Asian students had the lowest mean values of these variables (right grip strength = 39.88 kilograms and left grip strength = 35.91

kilograms). There were no statistically significant differences in both right and left grip strength between Middle Eastern and the United States population and between East and Southeast Asian students and the United States population at the .05 confidence level.

TABLE XL

MEAN AND STANDARD DEVIATION VALUES OF GRIP STRENGTH OF THE STUDENTS FROM MIDDLE EAST AND EAST AND SOUTHEAST ASIA AND THE UNITED STATES POPULATION

Area	N	Right Grip	Left Grip
Middle East	40	41.75 ± 7.10	41.31 ± 6.72
East and Southeast	40	39.88 ± 8.96	41.31 ± 6.72
United States(229)	1717	49.40 ± 9.38	46.19 ± 9.04

Duration of stay in the United States did not make any significant differences in both right and left grip strength between the students from Middle East and East and Southeast Asia who had been in the United States less than one year and those who had been in the United States more than three years at the confidence level of .05. Middle Eastern students who had been in the United States more than three years had higher mean values of right and left grip strength (43.96 kilograms and 44.35 kilograms) than those who had been in the United States less than one year (40.64 kilograms and 40.0 kilograms). Similar results obtained from East and Southeast Asian students, the students who had been in the United States more than three years had higher mean values of right and left grip strength (45.0 kilograms and 40.77 kilograms) than those who had been in the United States less than one year (40.25 kilograms and 35.35 kilograms). The results are summarized in Table XLI.

TABLE XLI

MEAN AND STANDARD DEVIATION VALUES OF RIGHT AND LEFT GRIP STRENGTH OF THE STUDENTS WHO HAD BEEN IN THE UNITED STATES LESS THAN ONE YEAR AND MORE THAN THREE YEARS

	N	Right Grip Strength	Left Grip Strength
MIDDLE EAST			
Group 1	7	40.64 ± 8.57	43.96 ± 7.17
Group 3	13	40.00 ± 7.78	44.35 ± 5.68
EAST AND SOUTH EAST			
Group 1	10	40.25 ± 7.97	45.00 ± 7.95
Group 3	11	35.35 ± 7.16	40.77 ± 6.02

Group 1 = The students who had been in the United States less than one year.
Group 3 = The students who had been in the United States more than three years.

The relationship between exercise and the grip strength was also analyzed. The results showed that the students who reported to be the exercisers had the higher mean values of both right and left grip strength (42.49 kilograms and 39.68 kilograms) than the non-exercisers (39.18 kilograms and 37.43 kilograms). However, there was no statistically significant differences in both right and left grip strength between the exercisers and non-exercisers at the .05 confidence level. Table XLII lists the mean and standard deviation values of both right and left grip strength between exercisers and non-exercisers.

TABLE XLII

MEAN AND STANDARD DEVIATION VALUES OF RIGHT AND LEFT GRIP STRENGTH OF EXERCISERS AND NON-EXERCISERS

	N	Right Grip	Left Grip
Exercisers	42	42.29	39.68
Non-Exercisers	38	39.18	37.43

Students who were in the high socio-economic class had higher mean and standard deviation values of both right and left grip strength than those who belonged to the middle socio-economic class (40.69 kilograms and 38.32 kilograms). There were no statistically significant differences in these variables between the students in high and middle socio-economic class at the confidence level of .05. Table XLIII lists the mean and standard deviation values of both right and left grip strength between the students in high and middle socio-economic class.

TABLE XLIII

MEAN AND STANDARD DEVIATION VALUES OF RIGHT AND LEFT GRIP STRENGTH BETWEEN THE STUDENTS IN IN HIGH AND MIDDLE SOCIO-ECONOMIC CLASS

Socio-economic Class	N	Right Grip	Left Grip
High	10	42.04 ± 10.08	40.85 ± 12.01
Middle	69	40.69 ± 7.88	38.32 ± 7.46

Flexibility

Flexibility in this study was measured by the Sit and Reach Test. The United States population had the highest mean value of flexibility (13.38 inches). Middle Eastern students had the next high mean value of 12.03 inches and East and Southeast Asian students had the lowest mean value of 11.29 inches. The results showed there were no significant differences in flexibility between Middle Eastern students and East and Southeast Asian students, Middle Eastern students and the United States population, and East and Southeast Asian students and the United States population. Table XLIV lists the mean and standard devaition value of flexibility of Middle Eastern students, Eastern and Southeast Asian students, and the United States population.

TABLE XLIV

MEAN AND STANDARD DEVIATION VALUES OF FLEXIBILITY (SIT AND REACH TEST) OF MIDDLE EASTERN STUDENTS, EAST AND SOUTHEAST ASIAN STUDENTS, AND THE UNITED STATES POPULATION

Area	N	Flexibility
Middle Eastern	40	12.03 ± 4.06
East and Southeast Asia	40	11.29 ± 3.99
United States(330) -	100	13.28 ± 1.69

Duration of stay in the United States did not make any significant difference in flexibility in the students from both areas who had been in the United States less than one year and those who had been in the United States more than three years. However, the students from both areas who had been in the United States more than three years had higher mean values of flexibility (Middle Eastern = 12.81 inches, East and Southeast Asian students = 12.82 inches) than those students who had been in the United States less than one year (Middle Eastern = 9.43 inches, East and Southeast Asian students = 11.6 inches). Table XLV lists the mean and standard deviation values of Middle Eastern and East and Southeast Asian students who had been in the United States less than one year and more than three years.

TABLE XLV

MEAN AND STANDARD DEVIATION VALUES OF FLEXIBILITY OF MIDDLE EASTERN AND EAST AND SOUTHEAST ASIAN STUDENTS WHO HAD BEEN IN THE UNITED STATES LESS THAN ONE YEAR AND MORE THAN THREE YEARS

Area	Group 1	Group 3
Middle East	9.43 ± 4.36	12.81 ± 4.39
East and Southeast -	11.6 ± 4.20	12.82 ± 3.97

Group 1 = The students who had been in the United States less than one year.
Group 3 = The students who had been in the United States more than three years.

Exercise did not make statistically significant differences in flexibility between exercisers and non-exercisers. Exercisers showed higher mean value of flexibility than non-exercisers (11.70 inches > 11.61 inches). The results are shown in Table XLVI.

It is the opinion of the author that flexibility between the exercisers and non-exercisers showed no significant difference because the students who reported to be the exercisers participated in the kinds of physical activities which did not improve flexibility.

TABLE XLVI

MEAN AND STANDARD DEVIATION VALUE OF FLEXIBILITY OF THE EXERCISERS AND NON-EXERCISERS

	N	Flexibility
Exercisers	42	11.70 ± 4.12
Non-Exercisers	38	11.61 ± 3.96

When the flexibility was analyzed in terms of the socio-economic class, the results showed no statistically significant difference in flexibility between the students in high and middle socio-economic class. The students in middle socio-economic class had higher mean value of flexibility than the students in high socio-economic class (11.62 inches > 11.25 inches). Table XLVII lists the mean and standard deviation value of flexibility of these two groups of students.

Reaction Time

Table XLVIII shows the mean value of reaction time of Middle

Eastern students, East and Southeast Asian students, and the United States population.

TABLE XLVII

MEAN AND STANDARD DEVIATION VALUE OF FLEXIBILITY OF THE STUDENTS IN HIGH AND MIDDLE SOCIO-ECONOMIC CLASS

Socio-economic Class	N	Flexibility
High	10	11.25 ± 3.53
Middle	69	11.62 ± 4.05

TABLE XLVIII

MEAN AND STANDARD DEVIATION VALUE OF REACTION TIME OF MIDDLE EASTERN, EAST AND SOUTHEAST ASIAN STUDENTS, AND THE UNITED STATES POPULATION

Area	N	Reaction Time
Middle East	40	.175 ± .046
East and Southeast Asia	40	.165 ± .027
United States(231)	20	.163 ± .018

The results showed that the United States population had the fastest mean value of reaction time (.163 seconds). Middle Eastern students had the slowest mean value of .175 second with East and Southeast Asian students had the next high mean value of .165 second. There were no significant differences in the mean value of reaction time between Middle Eastern students and East and Southeast Asian students, Middle Eastern students and the United States population, and East and Southeast Asian students and the United States population.

Duration of stay in the United States did not make any significant differences in the reaction time of the students in both areas. The new students from Middle East had lower mean value of reaction time than those who had been in the United States more than three years (.172 second < .184 second). The new students from East and Southeast Asia had lower mean value of raction time than those who had been in the United States more than three years (.159 second < .164 second). Table XLIX lists the mean and standard deviation value of reaction time of the students in both areas who had been in the United States less than one year and more than three years.

Socio-economic class did not make any significant differences in reaction time at the confidence level of .05. However, the students in the high socio-economic class had the lower mean value of reaction time than those in the middle socio-economic class (.168 second < .171 second). Table L lists the mean and standard deviation values of reaction time of the students in high and middle socio-economic class.

Exercise also did not make any significant difference in reaction time between the exercisers and non-exercisers. The students who did

TABLE XLIX

MEAN AND STANDARD DEVIATION VALUE OF REACTION TIME OF THE STUDENTS FROM MIDDLE EAST AND EAST AND SOUTHEAST ASIA WHO HAD BEEN IN THE UNITED STATES LESS THAN ONE YEAR AND MORE THAN THREE YEARS

	N	Reaction Time
MIDDLE EAST		
Group 1	7	.172 ± .046
Group 3	13	.184 ± .068
EAST AND SOUTHEAST ASIA		
Group 1	10	.159 ± .024
Group 3	11	.164 ± .035

Group 1 = The students who had been in the United States less than one year.
Group 3 = The students who had been in the United States more than three years.

TABLE L

MEAN AND STANDARD DEVIATION VALUE OF REACTION TIME OF THE STUDENTS IN HIGH AND MIDDLE SOCIO-ECONOMIC CLASS

Socio-economic Class		Reaction Time
High	N = 10	.168 ± .024
Middle	N = 70	.171 ± .039

not exercise had slower mean value of reaction time than those who exercised (0.173 second > 0.166 second).

Table LI lists the mean and standard deviation value of reaction time of the students who exercised and those who did not.

TABLE LI

MEAN AND STANDARD DEVIATION VALUE OF REACTION TIME OF THE STUDENTS WHO EXERCISED AND THOSE WHO DID NOT

	N	Reaction Time
Exercisers	42	.167 ± .024
Non-Exercisers	38	.173 ± .047

When the reaction time was analyzed in terms of alcohol consumption and cigarette smoking, the results showed that there was no significant difference between the students who were drinkers and smokers and those who were not. The drinkers had slower mean value of reaction time than non-drinkers (.181 second > .165 second) and the smokers had faster mean value of reaction time than the non-smokers (.157 second < .174 second). Table LII lists the mean and standard deviation value of reaction time of drinkers, non-drinkers, smokers, and non-smokers.

TABLE LII

MEAN AND STANDARD DEVIATION VALUE OF REACTION TIME OF DRINKERS, NON-DRINKERS, SMOKERS AND NON-SMOKERS

	N	Reaction Time
Smokers	18	.157 ± .012
Non-smokers	62	.174 ± .032
Drinkers	24	.181 ± .049
Non-drinkers	56	.165 ± .030

Electrocardiogram

The characteristics of the resting electrocardiogram to be investigated in this study were heart rate, R wave amplitude, T wave amplitude, P-R interval, Rest/work ratio and QRS axis.

The results showed that East and Southeast Asian students had the highest mean values of heart rate (68.38 beats per minute), R wave (13.55 millimeters), and QRS axis (71.75 degrees). Middle Eastern students had the next high mean values of heart rate (64.5 beats per minute), and the United States population had the next high mean values of R wave amplitude and QRS axis (13.19 millimeters and 64.6 degrees). Middle Eastern students had the lowest mean values of R wave amplitude and QRS axis (13.03 millimeters and 58.08 degrees), and the United States population had the lowest mean value of heart rate (64.5 beats per minute).

The United States had the highest mean values of T wave amplitude, P-R interval and rest/work ratio (4.20 milliliters, .172 second, and the ratio of 2.6). East and Southeast Asian students had the next high mean values of T wave amplitude and P-R interval (3.8 millimeters and .165 second), while Middle Eastern students had the next high mean values of rest/work ratio (1.96) and also had the lowest mean values of T wave amplitude and P-R interval (3.8 millimeters and .159 second). East and Southeast Asian students had the lowest mean value of rest/work ratio (1.94).

There were no significant differences in the mean values of heart rate, T wave amplitude, R wave amplitude, P-R interval, rest/work ratio, and QRS axis between the students from Middle East and East and Southeast Asia, Middle East and the United States, East and Southeast Asia and the United States. However, there were significant differences in the mean values of T wave amplitude and rest/work ratio between Middle Eastern students and the United States population. Also, there was a significant difference in the mean value of rest/work ratio between East and Southeast Asian students and the United States population. Mean and standard deviation values of the characteristics of the electrocardiogram of Middle Eastern, East and Southeast Asian students, and the United States population are shown in Table LIII.

The researcher also examined and found some abnormalities in the ECG tracing of the students in this study. For the students from Middle East Asia, left axis deviation and right axis deviation were found in two students and one student (5.0% and 2.5%), respectively. Left venticular hypertrophy were seen in 11 students (27.6%). For the students from East and Southeast Asia, left axis deviation and right axis deviation were found in one student and eight students (2.5% and 20%), respectively. Left ventricular hypertrophy were seen in 12 students (30%). ST elevation of 2 mm. in lead II was present is two students (5%) and ST elevation of 3 mm. in lead III was presented in two students (5%). Incomplete right bundle branch block was seen in one student (2.5%) and complete right bundle branch block was seen in one student (2.5%). Sinus arrhythmia was seen in one student (2.5%).

TABLE LIII

MEAN AND STANDARD DEVIATION VALUES OF THE CHARACTERISTICS OF THE RESTING ELECTROCARDIOGRAM OF MIDDLE EASTERN, EAST AND SOUTHEAST ASIAN STUDENTS AND THE UNITED STATES POPULATION

Characteristic	Middle East	East and South East	United States
Heart Rate	68.13 ± 10.78	68.38 ± 8.87	64.5 ± 8.58
T Wave Amplitude	3.33 ± 1.31	3.8 ± 1.99	4.2 ± 1.5
R Wave Amplitude	13.03 ± 5.18	13.55 ± 6.16	13.19 ± 3.94
P-R Interval	.159 ± .021	.165 ± .024	.172 ± .019
Rest/Work	1.96 ± .47	1.95 ± .37	2.6 ± .46
QRS Axis	58.05 ± 26.42	71.75 ± 23.89	64.6 ± 24.7

NOTE: United States population data reported in Reference 33.

Duration of stay in the United States did not make any significant differences in heart rate, T wave amplitude, R wave amplitude, P-R interval, rest/work ratio, and QRS axis between the students from both areas who had been in the United States less than one year and more than three years at the confidence level of .05.

For the Middle East area, the students who had been in the United States less than one year had the mean values of heart rate, R wave amplitude, T wave amplitude, P-R interval, rest/work ratio, and QRS axis as follows: 73.28 beats per minute, 10 millimeters, 3.14 millimeters, .16 seconds, the ratio of 1.68, and 67.14 degrees. The students who had been in the United States more than three years had the mean values of the variables as follows: heart rate - 65.85 beats per minute, R wave amplitude - 13.38 millimeters, T wave amplitude - 3.61 millimeters, P-R interval - .16 seconds, rest/work ratio - 2.09, and Q R S axis - 63.54 degrees.

For East and Southeast Asia area, the students who had been in the United States less than one year had the mean values of heart rate, R wave amplitude, T wave amplitude, P-R interval, rest/work ratio, and QRS axis as follow: 66.9 beats per minute, 14.3 millimeters, 3.6 millimeters, .164 seconds, the ratio of 1.99, 75.4 degrees. The students who had been in the United States more than three years had the mean values of these variables as follow: heart rate - 68 beats per minute, R wave amplitude - 11. 00 millimeters, T wave amplitude - 3.18 millimeters, P-R interval - .164 second, rest/work ratio - 1.86, and QRS axis - 61.27 degrees. Mean and standard deviation values of the characteristics of the resting electrocardiogram of the students from both areas who had been in the United States less than one year and more than three years are presented in Table LIV.

Exercise did not have any effect on these variables, and the results showed no significant difference in these variables between the

TABLE LIV

MEAN AND STANDARD DEVIATION VALUES OF THE RESTING ELECTROCARDIOGRAM CHARACTERISTICS OF MIDDLE EASTERN AND EAST AND SOUTHEAST ASIAN STUDENTS WHO HAD BEEN IN THE UNITED STATES LESS THAN ONE YEAR AND MORE THAN THREE YEARS

	N	Heart Rate	R Wave Amplitude	T Wave Amplitude	P-R Interval	Rest/Work Ratio	Q R S Axis
MIDDLE EAST							
Group 1	7	73.28 ± 11.77	10.00 ± 4.55	3.14 ± 1.07	.16 ± .00	1.68 ± .38	67.14 ± 22.10
Group 3	13	65.85 ± 8.73	13.38 ± 5.77	3.61 ± 1.26	.16 ± .02	2.09 ± .40	63.54 ± 23.37
EAST AND SOUTH EAST							
Group 1	10	66.9 ± 11.49	14.3 ± 6.5	3.6 ± 1.35	.16 ± .04	1.99 ± .44	75.4 ± 20.99
Group 3	11	68.0 ± 8.83	11.0 ± 6.93	3.2 ± 1.47	.16 ± .01	1.86 ± .44	61.3 ± 3.03

Group 1 = The students who had been in the United States less than one year.
Group 3 = The students who had been in the United States more than three years.

subjects who exercised and those who did not. The exercisers showed the mean values of these variables as follow: heart rate = 66.95 beats per minute, T wave amplitude = 3.52 millimeters, R wave amplitude = 13.48 millimeters, P-R interval = .163 second, rest/work ratio = 1.92, and QRS axis = 67.71 degrees. Table LV lists the mean and standard deviation values of the characteristics of the resting electrocardiogram of the exercisers and non-exercisers.

TABLE LV

MEAN AND STANDARD DEVIATION VALUES OF THE CHARACTERISTICES OF RESTING ELECTROCARDIOGRAM OF THE EXERCISERS AND NON-EXERCISERS

	N	Heart Rate	R Wave Amplitude	T Wave Amplitude
Exercisers	38	69.68 ± 8.86	13.08 ± 6.22	3.61 ± 1.99
Non-Exercisers	42	66.95 ± 10.53	13.48 ± 5.10	3.52 ± 1.38
	N	P-R Interval	Rest/Work Ratio	Q R S Axis
Exercisers	38	.16 ± .00	1.92 ± .39	67.71 ± 19.59
Non-Exercisers	42	.16 ± .024	1.97 ± .46	62.36 ± 30.63

Socio-economic class did not have any significant affect in most of the ECG items of the students who belonged to high and middle socio-economic class. The results showed that the students who belonged to the middle socio-economic class had higher mean values of heart rate, T wave amplitude, R wave amplitude and lower mean values of P-R interval, rest/work, and QRS axis than the students who belonged to high socio-economic class (68.59 beats > 65.90 beats, 3.63 millimeters > 3.1 millimeters, 13.31 millimeters > 13.10 millimeters, .16 second < .17 second, the ratio of 1.94 < the ratio of 2.03, and 64.83 degrees < 65.4 degrees). Table LVI lists the mean and standard deviation values of the characteristics of the resting electrocardiogram of the students who belonged to high and middle socio-economic class.

The researcher also analyzed the effect of smoking on heart rate, T wave amplitude, R wave amplitude, P-R interval, and rest/work ratio. The results showed that there were no significant differences in these ECG items between the smokers and non-smokers at the confidence level of .05. However, non-smokers had higher mean values of T wave amplitude, R wave amplitude, P-R interval than the smokers (3.65 millimeters > 3.28 millimeters, 13.37 millimeters > 13.00 millimeters, and 0.163 second > 0.158 second). The smokers had higher mean values of heart rate and rest/work ratio than non-smokers (68.39 beats > 68.20 beats, the ratio of 2.03 > the ratio of 1.92). The results are summarized in Table LVII.

The researcher chose seven tested physical fitness variables to develop the physical fitness index in this study. The values of the physical fitness index score in this study were combined with the values of the physical fitness index score obtained from another study done by Tamer (229). The subjects in his study were the same with those in this

TABLE LVI

MEAN AND STANDARD DEVIATION VALUES OF THE CHARACTERISTICS OF RESTING ELECTROCARDIOGRAM OF THE STUDENTS WHO BELONGED TO HIGH AND MIDDLE SOCIO-ECONOMIC CLASS

Socio-Economic Class	N	Heart Rate	R Wave Amplitude	T Wave Amplitude
Middle	70	68.59 ± 5.9	13.31 ± 5.64	3.63 ± 1.77
High	10	65.90 ± 7.3	13.10 ± 6.08	3.1 ± 0.88

Socio-Economic Class	N	P-R Interval	Rest/Work Ratio	Q R S Axis
Middle	70	.16 ± .02	1.94 ± .43	64.83 ± 26.47
High	10	.17 ± .03	2.03 ± .36	65.4 ± 23.27

study but they were tested with different physical fitness tests. Those tests were Vo_2 mean, respiratory function (VC, FVC, FEV/FVC, MVV), systolic and diastolic blood pressure, and blood chemistry analysis (TC, HDL, and TC/HDL).

TABLE LVII

MEAN AND STANDARD DEVIATION VALUES OF THE CHARACTERISTICS OF THE RESTING ELECTROCARDIOGRAM OF THE SMOKERS AND NON-SMOKERS

	Heart Rate	R Wave Amplitude	T Wave Amplitude
Non-smokers	68.20 ± 9.94	13.37 ± 5.98	3.65 ± 1.79
Smokers	63.39 ± 9.27	13.00 ± 4.50	3.28 ± 1.27
	P-R Interval		**Rest/Work Ratio**
Nonsmokers	.163 ± .016		1.92 ± 0.42
Smoker	.158 ± .018		2.04 ± 0.49

There were three physical fitness indexes developed by the researcher. The procedures used to develop the physical fitness index in this study were done as follows:

1. The first physical fitness index was done similar to that of the Tamer study. The total scores showed the overall physical fitness of the three groups of subjects. Each group was given a value of 1, 2, or 3 for each physical fitness variable. The best result for each 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. 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 (see Table LVIII).

2. The second physical fitness index was done almost similar to the first physical fitness index but there was a small difference. The researcher chose the three most important physical fitness variables and each variable was weighed and rated according to its importance. These variables were: (a) maximum oxygen uptake, (b) strength, and (c) flexibility. Arbitrarily, maximum oxygen uptake was rated to be four times more important than any variables in this study. From this rating, the value of maximum oxygen uptake was then multiplied by 4, and the values of strength and flexibility were multiplied by 2. The rest of the physical fitness variables were scored as in the first physical fitness index. The values of the most important three physical fitness variables and the rest of the physical fitness vairables were combined and showed the overall physical fitness level. The lowest total score indicates the best overall physical fitness level of the group,

and the highest total score indicates worst overall physical fitness level of the group for this study (see Table LIX).

3. The third physical fitness index was done totally different from the other two physical fitness indexes. Only the physical fitness variables that had been found to be significantly different among the three groups were chosen to be included in the physical fitness index. Groups were rated only on those variables where a significant difference was found between two or more groups. In these cases, the group or groups being significantly better were given a rating of 1. If all three groups were significantly different, the rating would be 1, 2, 3. In cases where any two groups were not significantly different from each other, they were both assigned the same rating. The lowest total score indicates the best overall physical fitness level of the group, and the highest total score indicates worst overall physical fitness level of the group for this study (see Table LX).

From Table LVIII, 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, while the Middle Eastern and the East and Southeast Asian students had the same overall physical fitness level.

From Table LIX and Table LX, the total physical fitness index scores showed the United States to be at a better overall physical fitness level than the Middle Eastern and the East and Southeast Asian students. The scores from these two tables also showed that the Middle

Eastern students were at better overall physical fitness level than the East and Southeast Asian students.

TABLE LVIII

OVERALL PHYSICAL FITNESS INDEX SCORES (METHOD 1)

Variables	Middle East	East and Southeast	United States
Vo_2 max	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
Grip Strength	2	3	1
Flexibility (Sit and Reach Test)	2	3	1
Reaction Time	3	2	1
T wave	3	2	1
Rest/Work Ratio	3	2	1
Heart Rate	2	3	1
TOTAL	36	36	24

TABLE LIX

OVERALL PHYSICAL FITNESS INDEX SCORES (METHOD 2)

Variables	Middle East	East and Southeast	United States
Vo_2 max	(1 X 4) 4	(2 x 4) 8	(3 x 4) 12
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
Grip Strength	(2 x 2) 4	(3 X 2) 6	(1 X 2) 2
Flexibility (Sit and Reach Test)	(2 x 2) 4	(3 X 2) 6	(1 X 2) 2
Reaction Time	3	2	1
T wave	3	2	1
Rest/Work Ratio	3	2	1
Heart Rate	2	3	1
TOTAL	43	48	35

TABLE LX

OVERALL PHYSICAL FITNESS INDEX SCORES (METHOD 3)

Variables	Middle East	East and Southeast	United States
Vo_2 max	1	1	3
VC	1	3	1
FVC	2	3	1
FEV_1/FVC	1	1	3
MVV	2	3	1
Systolic B.P.	1	1	3
Diastolic B.P.	2	2	1
TC/HDL	2	2	1
T wave	3	2*	1
Rest/Work Ratio	2	3	1
TOTAL	17	21	16

*Not significant difference from other two groups

The results of some tested variables in this study were also compared with the results of some populations in Middle East Asia and East and Southeast Asia reported in the literature. The tested variables chosen to make the comparison were height, weight, body circumference, grip strength, and Sit and Reach Test.

Height and weight of the studied groups were compared with Malaysian (67), Japanese (68), and Thai (69). The results showed that all the three studied groups had higher mean values of height and weight than Malaysian, Japanese, and Thai. (United States - 177.04 cm. and 74.84 kg.; Middle East - 171.44 cm. and 72.98 kg.; East and Southeast - 168.81 cm. and 62.50 kg. > Malaysia - 166.0 cm., and 55.63 kg.; Japanese - 167.2 cm. and 58.9 kg.; and Thai - 165.0 cm. and 55.0 kg).

Body circumferences of the studied groups were compared with Japanese (68) and Chinese (84). The results showed that Japanese had higher mean values of chest circumference (96.33 cm.) than all of the studied groups (Middle East - 81.91 cm., East and Southeast - 86.51 cm., and United States - 92.0 cm.). Chinese had the equal mean value of chest circumference with Middle Eastern students (81.91 cm.), but they had less mean value of chest circumference than the Untied States population (92.0 cm.) and East and Southeast Asia (86.51 cm.). The studied groups had higher mean values of upper arm circumference, thigh circumference, and calf circumference than Japanese and Chinese. (United States - upper arm circumference = 27.7 cm., thigh circumference = 55.4 cm., calf circumference = 37.1 cm.; Middle Eastern students - upper arm circumference = 29.88 cm., thigh circumference = 56.28 cm., calf circumference = 36.65 cm.; and East and Southeast Asia - upper arm circumference = 27.52 cm., thigh circumference 52.46 cm., calf circumference = 35.19 cm. > Japanese - upper arm circumference = 26.20 cm., thigh circumference = 50.34 cm., and calf circumference = 34.79 cm.; Chinese - upper arm circumference = 23.38 cm., thigh circumference = 45.65 cm., and calf circumference = 32.69 cm.)

The Japanese had higher mean value of forearm circumference than East and Southeast Asian students (24.99 cm. > 24.78 cm.) and had a smaller mean value than Middle Eastern students (24.99 cm. < 26.47 cm.) and the United States population (24.99 cm. < 26.0 cm.).

The Chinese had equal mean value of forearm circumference with Eastern and Southeastern students (24.68 cm. = 24.68 cm.) and had a smaller mean value than Middle Eastern students and the United States population (24.68 cm. < 26.47 cm. < 26.00 cm.).

The Chinese had a smaller mean value of abdominal circumference than any of the three groups (Chinese - 65.59 cm., Middle Eastern - 75.4 cm., Eastern and Southeastern students - 75.4 cm. and the United States population - 80.4 cm.).

The values of left and right grip strength of the studied groups were compared with the values of the populations from Hong Kong (212), Japan (213), Korea (213), Indonesia (213), Taiwan (213) and Thailand (213).

The results showed that Hong Kong, Japanese, Korean and Taiwanese had higher mean values of the dominant grip strength than the mean values of left and right grip strength of Middle Eastern and Eastern and Southeastern students. (Hong Kong = 45.6 kg., Japanese = 49.4 kg., Korean = 44.5 kg., and Taiwanese 46.2 kg. > Middle Eastern - left grip strength = 41.31 kg. and right grip strength = 41.75 kg.; Eastern and Southeastern - left grip strength = 35.91 kg.; right grip strength = 39.88 kg.) Indonesian and Thai had the lower mean value of dominant grip strength than the mean values of left and right grip strength of Middle and Eastern and Eastern and Southeastern (Indonesian - 29.6 kg., and Thai - 38.5 kg. < Middle Eastern - left grip strength = 41.31 kg. and right grip strength = 41.75 kg.; Eastern and Southeastern - left grip strength = 35.91 kg. and right grip strength = 39.88 kg.).

Japanese had equal mean value of the dominant grip strength with right grip strength of the United States but had higher mean value than left grip strength of the United States (Japanese = 49.4 kg., the United States - right grip strength = 49.4 kg. and left grip strength = 46.19 kg.). Taiwanese had the lower mean value of dominant grip strength than right grip strength of the United States but had greater mean value than left grip strength of the United States (Taiwanese = 46.2 kg., the United States - left grip strength = 46.19 kg., and right grip strength = 49.90 kg.)

Hong Kong (45.6 kg), Korean (44.5 kg.), Indonesian (29.5 kg.), and Thai (38.5 kg.), had lower mean values of the dominant grip strength than the mean values of left and right grip strength of the United States population (left grip strength = 46.19 kg. and right grip strength = 19.40 kg.).

The three studied groups had higher mean value of flexibility than Indonesian (202) (Middle Eastern = 12.03 inches, Eastern and Southeastern students = 11.29 inches, and the United States population = 13.58 inches > Indonesian = 10.9 inches).

Summary of Results

The primary purpose of this study was to compare height, weight, skinfold thickness, the percentage of body fat, body circumferences, grip strength, flexibility (Sit and Reach Test) and the characteristics of the resting electrocardiogram between 40 students from Middle East Asia and 40 students from East and Southeast Asia. The results of these two groups were also compared with the selectred norms of the United States. A secondary purpose was to compare the anthropometrical and physical fitness variables of those foreign students who had been in the United States less than one year with those who had been in the United States longer than three years. In addition, the researcher attempted to analyze these variables in terms of exercise, smoking, alcohol consumption, diet habits, and socio-economic classes of the foreign students.

The United States population had the highest mean values of height and weight. The students from Middle East Asia had the next high mean values of height and weight and the students from East and Southeast Asia had the lowest mean values of height and weight. There was no significant difference in weight between the students from Middle East and East and Southeast Asia. Middle Eastern students also had higher mean value of the weight residual than East and Southeast Asian students but there was not any significant difference. There was a significant difference in height between Middle Eastern students and the United States population, but there was no significant difference in weight between the students from both areas. There were significant differences in height and weight between Eastern and Southeast Asian students and the United States population.

Middle Eastern students had higher mean values of the skinfold thicknesses of bicep and chest than East and Southeast Asian students, but they were not significant. The United States population had the highest mean values of the skinfold thicknesses of tricep and iliac. Middle Eastern students had the next high mean values of the skinfold thicknesses of tricep and iliac, while East and Southeast Asian students had the lowest mean values of the variables. However, there were no significant differences between Middle Eastern students and East and

Southeast Asian students, Middle Eastern students and the United States population, and East and Southeast Asian students and the United States population at the confidence level of .05.

Middle Eastern students had the highest mean values of the skinfold thicknesses of scapula and abdomen. The United States population had the next high mean value of the skinfold thickness of scapula, while East and Southeast Asian students had the lowest mean value of this variable. East and Southeast Asian students had the next high mean value of the skinfold thickness of abdomen, while the United States population had the lowest mean value of this variable. There were not any significant differences in the skinfold thicknesses of scapula and abdomen between Middle Eastern students and East and Southeast Asian students, Middle Eastern students and the United States population, East and Southeast Asian students and the United States population.

Middle Eastern students had the highest mean value of the sum of four sites of skinfold thicknesses (tricep, iliac, scapula, and abdomen) while the United States population had the next high mean value and East and Southeast Asian students had the lowest mean value of this variable. There were no significant differences between Middle Eastern students and the United States population, and East and Southeast Asian students and the United States population.

Middle Eastern students had higher mean value of the sum of the skinfold thicknesses of six sites (bicep, tricep, chest, iliac, scapula, and abdomen) than East and Southeast Asian students. There was a significant difference between the students from these two areas.

Even though the United States population had the highest mean value of the percentage of body fat, the result was not compared with Middle

Eastern and East and Southeast Asian students. Since the available mean value of the percentage of body fat of the United States population obtained from the underwater technique and those of Middle Eastern and East and Southeast Asian students obtained from the nomogram and sum of fours chart. Therefore, the comparison was made only between Middle Eastern students and East and Southeast Asian students. Middle Eastern students had higher mean value of the percentage of body fat than East and Southeast Asian students, but there was not any statistically significant difference. The conversion of the skinfold thicknesses to percent body fat is questionable on the foreign group because the formula for the conversion was constructed for the population specific (nomogram - young men in the United States, sum of fours - adult men in England).

Middle Eastern students had greater mean values of all of the body circumference than East and Southeast Asian students. There were significant differences in shoulder circumference, chest circumference, buttock circumference, thigh circumference, forearm circumference, and ankle circumference; however, there were no significant differences in abdomen circumference, bicep circumference, wrist circumference, knee circumference, and calf circumference between the students from these two areas at the .05 confidence level.

With the exception of calf circumference, Middle Eastern students had greater mean values of the rest of the body circumferences than the United States population. There were significant differences in shoulder circumference, bicep circumference, wrist circumference, and ankle circumference, but there were no significant differences in chest circumference, abdomen circumference, buttock circumference, thigh circumference, forearm circumference, knee circumference, and calf circumference.

The United States population had greater mean values of wrist circumference, chest circumference, abdomen circumference, buttock circumference, thigh circumference, bicep circumference, forearm circumference, knee circumference, calf circumference, and ankle circumference than East and Southeast Asian students. However, East and Southeast Asian students had greater mean values of shoulder circumference than the United States population. There were statistically significant differences in shoulder circumference, chest circumference, abdomen circumference, buttock circumference, forearm circumference, thigh circumference, knee circumference, and calf circumference but there were no significant differences in bicep circumference, wrist circumference, and ankle circumference.

The overall results indicated that Middle Eastern students had the highest mean values of almost all of the body circumferences, with the exception of calf circumference. These differences might be caused by, presumably, the racial differences.

The United States population had the highest mean values of both right and left grip strength followed by Middle Eastern students and East and Southeast Asian students, respectively. There were no significant differences in either right and left grip strength between Middle Eastern and East and Southeast Asian students. However, there were significant differences in both right and left grip strength between Middle Eastern and the United States population and between East and Southeast Asian students and the United States population.

The United States population had the highest mean values of flexibility. Middle Eastern students had the next high mean value while East and Southeast Asian students had the lowest mean value of this variable. There were no statistically significant differences between any of the groups.

The United States population had the lowest mean value of reaction time while Middle Eastern students had the highest mean value and East and Southeast Asian students had the next high mean value of this variable. There was no significant difference in this variable between any of the groups.

As far as the electrocardiogram was concerned, East and Southeast Asian students had the highest mean values of heart rate, R wave and QRS axis. Middle Eastern students had the next high mean value of heart rate and had the lowest mean values of R wave, and QRS axis. The United States population had the next high mean values of R wave amplitude and QRS axis and had the lowest mean value of heart rate.

The United States population had the highest mean values of T wave amplitude, P-R interval, and rest/work ratio. East and Southeast Asian students had the next high mean values of T wave amplitude and P-R interval and had the lowest mean values of rest/work ratio. Middle Eastern students had the next high mean value of rest/work ratio and had the lowest mean value of T wave amplitude and P-R interval.

There were no significant differences in the mean values of heart rate, T wave amplitude, R wave amplitude, P-R interval, rest/work ratio, and QRS axis between Middle Eastern and East and Southeast Asian students. However, there were significant differences in the mean values of T wave amplitude and rest/work ratio between Middle Eastern students and the United States population. Also, there was a significant difference in rest/work ratio between East and Southeast Asian students and the United States population.

The lower heart rate, the higher values of T wave amplitude and rest/work ratio have been considered to be an indicator of being a more cardiovascularly fit person. This study showed that the United States population had the best cardiovascular fitness because they had the highest mean values of heart rate and also had the highest mean values of T wave amplitude and rest/work ratio.

The results showed some slight differences in almost all of the tested anthropometrical and fitness variables between the foreign students who had been in the United States less than one year and more than three years. However, there were no significant differences at the .05 confidence level.

The students who ate meat had higher mean value of the sum of six sites of skinfold thicknesses (bicep, tricep, iliac, chest, back and abdomen) and the percentage of body fat than the students who were vegetarians but there was no statistically significant differences. There were some slight differences between the students who ate egg, fish, pork, beef, poultry, and sweets, but also there were not any significant differences at the .05 confidence level.

Exercise habits had positive effects on the skinfold thicknesses. The students who exercised in their home countries but not in the United States had more skinfold thicknesses than those who exercised in their home countries and in the United States. However, there were not any statistically significant differences.

The students who were the exercisers also had lower mean value of the percentage of body fat (nomogram and sum of fours chart), abdomen and knee circumference, and reaction time. However, the exercisers had higher mean values of right and left grip strength, shoulder circumference, chest circumference, buttock circumference, bicep circumference, forearm circumference, wrist circumference, thigh circumference, calf circumference, and ankle circumference than non-exercisers; however, none of these variables were significant differences between these two groups of students at the confidence level of .05.

Exercise habits did not show any effect on the flexibility and all of the resting electrocardiogram characteristics.

The students who were drinkers and smokers had higher mean values of reaction time than those who were not. There were no statistically significant differences at the .05 confidence level.

Non-smokers had higher mean values of T wave amplitude, R wave amplitude, and P-R interval. They also had lower mean values of heart rate and rest/work ratio than smokers. There were not any statistically significant differences.

Students in high socio-economic class had higher mean values of heigth, skinfold thicknesses, the percentage of body fat (nomogram and sum of fours chart), all of the body circumferences, right and left grip strength, and P-R interval and had lower mean values of weight, reaction time, heart rate, T wave amplitude, R wave amplitude, rest/work ration and QRS axis than the students in middle socio-econmic class. However, none of these variables were significant differences at the .05 confidence level.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

Physical activity and the capacity for work are the fundamental determinants of human survival. Many physiologists and physical educators have tried to investigate the factors which influence the level of physical capacity and the anthropometrical characteristics of mankind. Their studies have focused on many factors which are considered to have the potential impact on such variables. These factors include race, sex, age, nutritional status, climate, season, the different geographical regions, and the socio-economic environment. The results and conclusions have varied depending upon the evaluative instruments and the ethnic group studied.

With the current interest in racial and ethnic population studies, the purpose of this study was to measure and compare height, weight, skinfold thickness, the percentage of body fat, the body circumference, strength, flexibility, reaction time and the characteristiecs of the resting electrocardiogram of Middle Eastern students, East and South East Asian students, and the United States population. A secondary purpose was to compare the physical fitness variables of those foreign students who had been in the United States less than one year with those who had been in the Untied States longer than three years. An attempt was also made to analyze those tested variables in terms of exercise, smoking and diet habits, and socio-economic classes of the foreign students.

A total number of 80 subjects from Middle East, and East and South East Asian countries participated in this study. These foreign students at Oklahoma State University may not represent the whole population in their respective countries or regions since they may only represent the Middle Eastern, East, and South East 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:

1. the differences on each physical fitness variable between Middle East, East and Southeast Asia, and the United States;
2. the differences in each variable among the foreign students according to their length of stay in the United States; and,
3. the effects of exercise, smoking, drinking, diet habits, and the socio-economic classes of students on these physical fitness vairables.

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-hypothesis statements, the following conclusions were made:

1. The difference in the mean value of height 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.

2. The Middle Eastern students had a significantly higher mean value of weight than the East and Southeast Asian students at the .05 confidence level. The null-hypothesis was rejected.

3. The difference in the mean value of the weight residual 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.

4. The United States population had significantly higher mean value of height than the Middle Eastern students at the .05 confidence level. The null-hypothesis was rejected.

5. The difference in the mean value of weight was not statistically significant between the United States population and the Middle Eastern students at the .05 confidence level. The null-hypothesis was accepted.

6. THe United States population had significantly higher mean values of height and weight than the East and Southeast Asian students at the .05 confidence level. The null-hypotheses were rejected.

7. The differences in the mean values of the skinfold thicknesses of bicep, tricep, chest, iliac, abdomen and scapula 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.

8. The differences in the mean values of the skinfold thicknesses of tricep, iliac, scapula, and abdomen were not statistically

significant between the Middle Eastern students and the East and Southeast Asian students, the Middle Eastern students and the United States population, and the East and Southeast Asian and the United States population at the .05 confidence level. The null hypotheses were accepted.

10. The Middle Eastern students had significantly higher mean value of the sum of six sites of the skinfold thicknesses than the East and Southeast Asian students at the .05 confidence level. The null-hypotheses were rejected.
11. The difference in the percentage of body fat between the Middle Eastern students and the East and southeast Asian students was not statistically significant at the .05 confidence level. The null-hypothesis was accepted.
12. The Middle Eastern students had significantly higher mean values of shoulder circumference, chest circumference, buttock circumference, thigh circumference, forearm circumference, and ankle circumference than the East and Southeast Asian students at the .05 confidence level. The null-hypotheses were rejected.
13. The differences in the mean values of abdomen circumference, bicep circumference, wrist circumference, knee circumference, and calf circumference 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.
14. The differences in the mean values of chest circumference, abdomen circumference, buttock circumference, thigh

circumference, forearm circumference, knee circumference, and calf circumference were not statistically significant between the Middle Eastern students and the United States population at the .05 confidence level. The null-hypotheses were accepted.

15. The East and Southeast Asian students had significantly higher mean value of shoulder circumference than the United States population at the .05 confidence level. The null-hypothesis was rejected.

16. The United States population had significantly higher mean values of chest circumference, abdomen circumference, buttock circumference, thigh circumference, forearm circumference, knee circumference, and calf circumference than the East and Southeast Asian students at the .05 confidence level. The null-hypotheses were rejected.

17. The differences in the mean values of bicep circumference, wrist circumference, and ankle circumference were not statistically significant between the United States population and the East and Southeast Asian at the .05 confidence level. The null-hypotheses were accepted.

18. The differences in the mean values of right and left grip strength were not statistically significant between the Middle Eastern and the East and Southeast Asian students at the .05 confidence level. The null-hypotheses were accepted.

19. The United States had significantly higher mean values of right and left grip strength than the Middle Eastern and the East and Southeast Asian students at the .05 confidence level.

The null-hypotheses were rejected.

20. The differences in the mean value of Sit and Reach Test were not statistically significant between the Middle Eastern and the East and Southeast Asian students, the Middle Eastern students and the United States population, and the East and Southeast Asian students and the United States population at the .05 confidence level. The null-hypotheses were accepted.

21. The differences in the mean values of heart rate, T wave amplitude, R wave amplitude, P-R interval, rest/work ratio, and QRS axis were not statistically significant between the Middle Eastern and the East and Southeast Asian students at the .05 confidence level. The null-hypotheses were accepted.

22. The United States population had significantly higher mean values of T wave amplitude and rest/work ratio than the Middle Eastern students at the .05 confidence level. The null-hypotheses were rejected.

23. The difference in the mean values of heart rate, R wave amplitude, P-R interval and QRS axis were not statistically significant between the United States population and the Middle Eastern students at the .05 confidence level. The null-hypothesis was accepted.

24. The United States population had significantly higher mean values of rest/work ratio than the East and Southeast Asian students at the .05 confidence level. The null-hypothesis was rejected.

25. The differences in the mean values of heart rate, T wave amplitude, R wave amplitude, P-R interval, and QRS axis were

not statistically significant between the United States population and the East and Southeast Asian students at the .05 confidence level. THe null-hypotheses were accepted.

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

a) height

b) weight

c) weight residual

d) skinfold thicknesses of bicep, tricep, iliac, chest, abdomen, and scapula

e) sum of six sites of skinfold thicknesses (bicep, tricep, iliac, back, abdomen, and scapula)

f) shoulder circumference

g) chest circumference

h) abdomen circumference

i) buttock circumference

j) bicep circumference

k) forearm circumference

l) wrist circumference

m) thigh circumference

n) knee circumference

o) calf circumference

p) ankle circumference

q) right and left grip strength

r) Sit and Reach Test

s) reaction time

t) heart rate

u) T wave amplitude

v) R wave amplitude

w) P-R interval

x) rest/work ration

y) QRS axis

Recommendations

In order to obtain valid results and make the accurate comparison of the physical fitness and anthropometrical variables of the people from different ethnic groups, several recommendations could be made with regard to further study. These recommendations are as follows:

1. Research should be done on a large number of subjects whose results can be applied to the whole population. In this aspect, correct sampling is of particular importance when it is intended to describe the characteristics of an entire population. Data should be collected from people of every race in the various geographical regions living in a wide variety of environments - urban and rural society, primitive and civilized, hot and cold temperatures, and high altitude.
2. The validity of results can be affected by the different methodology from one laboratory to one another; therefore, it is strongly recommeded that further study in any laboratories

should be done by using the same standardized test under the same test conditions.

3. The nomogram or equation for the conversion of skinfold thicknesses to percent body fat and the constant values in the body circumference chart that are used in calculating the predicted weight should be analyzed and constructed for the population in the specific race or country.
4. To obtain the valid results of the relationship between the exercise habits, diet habits, cigarette smoking, and alcohol consumption and the physical fitness or the anthropometrical characteristics, longitudinal studies should be employed and conducted under the direct control of the researcher.

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APPENDIXES

APPENDIX A

LABORATORY SOFTWARE

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, jog 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 _________

ANALYSIS OF BODY BUILD

Name______________________________Wt._______lbs.________kg. Ht.______in.______dm.

(1) Body Segment	(2) Circumference			(3) Male K Value	(4) Female K Value	(5) d Value	(6) Equiv Wt(kg) d^2 X H
	L.	R	Av.				
1 Shoulder				55.4	52.0		
2 Chest				45.9	44.5		
3 Abdomen				40.6	38.7		
4 Buttocks				46.7	50.8		
5 Thighs				27.4	30.1		
6 Biceps				15.4	14.4		
7 Forearm				13.4	13.0		
8 Wrist				8.2	8.2		
9 Knee				18.3	18.8		
10 Calf				17.9	18.4		
11 Ankle				10.8	11.1		
Σ							
M							

Predicted Wt. as Mean of Equiv. Wts. (col. 6)____________________

Predicted Wt. as $\frac{C}{K} = \frac{\text{Sum (col. 2)}}{300}$ ____________________

Data Collection for Estimation of Body Composition from Skinfold Measurement

Name ____________ Age ________ Ht ____ in ____ cm ____ Wt _____ lbs ______ kg.

Date ____

Skinfold	Observer 1			Observer 2		
	First	Second	Mean	First	Second	Mean
1. Chest						
2. Abdominal						
3. Arm						

Specific Gravity ____________________ Specific Gravity ____________

Percent Body fat ____________________ Percent Body fat ____________

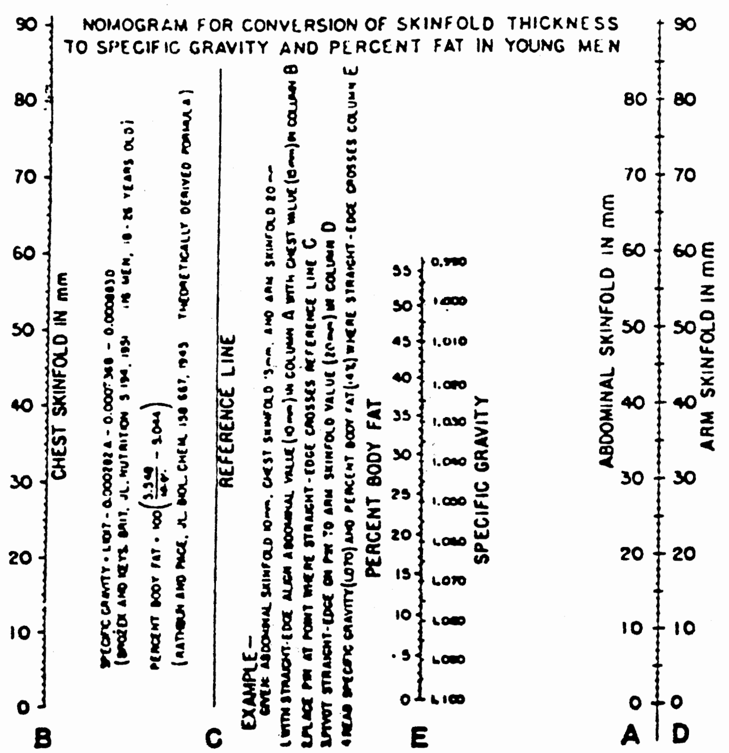

Figure 19-2. Nomogram for conversion of skinfold thickness to specific gravity and percent fat in young men. (From W.R. Best USAMRNL Report no. 113. August, 1953.).

OKLAHOMA STATE UNIVERSITY

HEALTH AND FITNESS CENTER

Name ____

Date ____

GRIP STRENGTH RT. 1.______ LT. 1.______

2.______ 2.______

PUSH TRIAL 1.______ PULL TRIAL 1.______

2.______ 2.______

FLEXIBILITY__________ OXYGEN SATURATION__________

LEG STRENGTH RT. 1.______ LT. 1.______

2.______ 2.______

SINGLE REACTION TIME

TRIAL 1.__________

2.__________

3.__________

4.__________

5.__________

6.__________

7.__________

8.__________

9.__________

10.__________

VERTICAL JUMP REACTION TIME

TRIAL 1.__________

2.__________

3.__________

4.__________

5.__________

6.__________

7.__________

8.__________

9.__________

10.__________

HEIGHT__________ WEIGHT__________ VITAL CAPACITY__________

____

MAXIMAL BREATHING CAPACITY__________

____

APPENDIX B

RAW DATA

TABLE LXI

PHYSICAL FITNESS COMPONENTS OF MIDDLE EASTERN STUDENTS

No	Age	Group	Country	Right Grip Strength (Kg.)	Left Grip Strength (Kg.)	Reaction Time (1/100 sec)	Height (cm.)	Weight (Kg.)	%Body Fat (Monogram)	%Body Fat (Sum of Fours)
1	28	1	Iran	38.0	32.0	.145	161.9	68.18	17.0	23.4
2	22	1	Jordan	37.0	36.0	.161	171.5	66.93	8.0	15.5
3	21	1	Kuwait	34.0	39.0	.148	174.6	64.20	10.0	18.0
4	20	1	Lebanon	40.0	45.0	.155	175.8	67.95	9.0	17.7
5	22	1	Saudi-Arabia	27.5	26.0	.173	167.0	62.27	10.0	19.6
6	20	1	Syria	53.0	50.0	.141	184.8	92.73	23.0	27.0
7	20	1	Turkey	40.0	39.0	.275	179.1	61.04	6.0	15.5
8	23	2	Iran	41.5	39.5	.142	177.2	84.09	26.0	29.7
9	24	2	Iran	50.0	42.0	.205	170.2	69.14	11.0	19.5
10	25	2	Iran	49.5	45.0	.147	173.4	71.59	9.0	14.8
11	20	2	Iran	43.0	40.0	.175	180.3	87.45	17.0	25.0
12	26	2	Iran	42.0	39.0	.143	166.4	85.45	27.0	27.8
13	22	2	Iran	35.0	30.0	.212	174.0	70.00	15.0	21.6
14	25	2	Iran	47.0	41.0	.137	170.8	68.18	6.0	13.2
15	30	2	Iran	51.0	55.0	.202	184.2	100.00	31.0	25.8
16	26	2	Iran	40.0	38.0	.178	174.0	73.36	12.0	20.0
17	21	2	Iraq	34.0	34.0	.151	163.8	68.27	16.0	23.0
18	21	2	Jordan	37.0	37.0	.152	172.1	73.52	12.0	22.9
19	29	2	Jordan	43.0	48.0	.161	171.5	77.95	13.0	22.9
20	23	2	Jordan	50.0	49.0	.163	165.1	68.27	3.0	7.6

TABLE LXI (Continued)

No	Age	Group	Country	Right Grip Strength (Kg.)	Left Grip Strength (Kg.)	Reaction Time (1/100 sec)	Height (cm.)	Weight (Kg.)	%Body Fat (Monogram)	%Body Fat (Sum of Fours)
21	23	2	Jordan	36.0	44.0	.201	177.8	98.86	26.0	31.2
22	22	2	Kuwait	27.0	24.0	.192	166.0	69.72	14.0	20.3
23	24	2	Lebanon	35.0	39.0	.186	159.0	57.91	13.0	20.0
24	21	2	Lebanon	37.0	39.5	.168	165.1	65.11	7.0	18.0
25	20	2	Lebanon	36.0	31.0	.158	163.0	72.72	20.0	24.5
26	23	2	Saudi-Arabia	44.0	42.0	.189	174.0	73.64	14.0	19.8
27	20	2	Syria	36.0	39.0	.130	173.4	73.75	12.0	22.0
28	24	3	Iran	40.5	44.5	.149	160.0	86.39	25.0	25.9
29	24	3	Iran	49.0	45.0	.159	173.4	54.09	13.0	14.0
30	24	3	Iran	43.0	43.0	.147	172.1	67.27	10.0	18.2
31	22	3	Iran	43.0	45.0	.146	161.9	61.60	11.0	16.5
32	27	3	Iran	28.0	36.0	.202	160.0	68.18	30.0	28.3
33	26	3	Iraq	41.0	38.0	.214	165.7	61.27	9.0	19.8
34	24	3	Jordan	50.0	49.0	.144	170.8	71.00	6.0	16.5
35	20	3	Kuwait	39.0	39.0	.140	177.1	75.00	15.0	21.4
36	27	3	Lebanon	55.0	49.5	.135	173.9	75.00	4.0	14.4
37	24	3	Lebanon	44.0	46.0	.272	174.6	64.00	5.0	11.0
38	27	3	Saudi-Arabia	55.0	54.5	.147	175.9	79.55	4.0	10.5
39	29	3	Saudi-Arabia	41.0	41.0	.181	174.0	80.82	12.0	20.5
40	24	3	Syria	43.0	46.0	.368	174.6	69.27	7.0	15.1

TABLE LXI (Continued)

No	Age	Group	Country	Flexibility (inch)	Optimal Weight (Kg.)	Weight Residual (Kg.)	Bicep (mm.)	Tricep (mm.)	Iliac (mm.)	Subscapula (mm.)	Chest (mm.)
1	28	1	Iran	16.0	68.56	4.96	10.0	16.0	26.0	12.0	12.0
2	22	1	Jordan	11.0	65.15	1.78	3.0	5.0	14.0	13.0	9.0
3	21	1	Kuwait	10.0	63.71	0.49	7.0	11.0	15.0	10.0	9.0
4	20	1	Lebanon	8.0	66.80	1.15	4.0	8.0	18.0	12.0	10.0
5	22	1	Saudi-Arabia	11.0	61.89	0.38	7.0	7.0	15.0	20.0	15.0
6	20	1	Syria	8.5	84.35	8.38	12.0	21.0	40.0	22.0	21.0
7	20	1	Turkey	1.5	60.66	0.43	4.0	6.0	14.0	11.0	6.0
8	23	2	Iran	10.0	74.29	9.80	14.0	21.0	53.0	22.0	35.0
9	24	2	Iran	13.5	65.25	3.89	3.0	16.0	13.0	13.0	9.0
10	25	2	Iran	10.0	72.96	-1.37	2.0	5.0	16.0	10.0	12.0
11	20	2	Iran	12.0	84.45	3.00	11.0	16.0	32.0	17.0	16.0
12	26	2	Iran	16.0	75.63	9.82	19.0	20.0	36.0	17.0	16.0
13	22	2	Irann	12.0	66.88	3.12	9.0	15.0	21.0	14.0	16.0
14	25	2	Iran	16.5	64.20	3.98	3.0	7.0	10.0	9.0	15.0
15	30	2	Iran	10.0	94.80	5.20	11.0	20.0	28.0	22.0	44.0
16	26	2	Iran	14.0	73.21	0.15	5.0	12.0	20.0	14.0	17.0
17	21	2	Iraq	15.0	66.81	1.46	6.0	18.0	30.0	11.0	15.0
18	21	2	Jordan	15.0	69.60	3.92	5.0	15.0	27.0	18.0	6.0
19	29	2	Jordan	13.0	73.95	4.02	10.0	13.0	18.0	17.0	13.0
20	29	2	Jordan	10.0	66.38	1.89	2.0	4.0	5.0	7.0	3.0

TABLE XLI (Continued)

No	Age	Group	Country	Flexibility (inch)	Optimal Weight (Kg.)	Weight Residual (Kg.)	Bicep (mm.)	Tricep (mm.)	Iliac (mm.)	Subscapula (mm.)	Chest (mm.)
21	23	2	Jordan	2.0	77.57	21.29	12.0	25.0	61.0	26.0	35.0
22	22	2	Kuwait	12.5	64.99	4.73	6.0	9.0	17.0	17.0	19.0
23	24	2	Lebanon	12.0	57.32	0.59	7.0	9.0	23.0	12.0	19.0
24	21	2	Lebanon	16.5	64.89	0.22	4.0	9.0	20.0	10.0	9.0
25	20	2	Lebanon	18.0	70.10	2.62	9.0	19.0	28.0	17.0	22.0
26	23	2	Saudi-Arabia	9.0	69.00	4.64	6.0	11.0	20.0	13.0	16.0
27	20	2	Syria	11.5	75.07	-1.32	5.0	17.0	27.0	11.0	10.0
28	24	3	Iran	13.5	78.54	8.05	10.0	22.0	33.0	17.0	28.0
29	24	3	Iran	10.0	54.47	-0.38	2.0	3.0	3.0	6.0	4.0
30	24	3	Iran	18.5	64.86	2.41	5.0	8.0	22.0	9.0	11.0
31	22	3	Iran	13.0	58.28	3.32	9.0	10.0	10.0	11.0	15.0
32	27	3	Iran	16.5	64.76	3.42	17.0	30.0	20.0	32.0	40.0
33	26	3	Iraq	11.0	60.18	1.09	7.0	6.0	22.0	15.0	13.0
34	24	3	Jordan	15.0	69.28	1.92	3.0	6.0	19.0	10.0	6.0
35	20	3	Kuwait	11.0	75.06	-0.06	8.0	14.0	21.0	14.0	18.0
36	27	3	Lebanon	10.0	73.09	1.91	4.0	5.0	15.0	8.0	4.0
37	24	3	Lenanon	17.5	61.93	2.07	3.0	7.0	5.0	9.0	6.0
38	27	3	Saudi-Arabia	11.5	76.70	2.85	5.0	13.0	18.0	17.0	12.0
39	29	3	Saudi-Arabia	2.0	77.15	3.67	5.0	13.0	18.0	17.0	12.0
40	24	3	Syria	17.0	67.28	1.99	5.0	7.0	13.0	9.0	11.0

TABLE LXI (Continued)

No	Age	Group	Country	Abdomen	Sum of 4 Sites (mm.) Tricep + Iliac + Subscapula + Abdomen	Sum of 6 Sites (mm.) Bicep + Tricep + Iliac + Subscapula + Chest + Abdomen	Shoulder (cm.)	Chest (cm.)
1	28	1	Iran	36.0	90.0	112.0	108.0	96.0
2	22	1	Jordan	27.0	59.0	71.0	108.0	88.6
3	21	1	Kuwait	17.0	53.0	69.0	108.6	85.0
4	20	1	Lebanon	18.0	56.0	70.0	109.7	88.3
5	22	1	Suadi-Arabia	20.0	62.0	84.0	104.5	90.0
6	20	1	Syria	52.0	135.0	168.0	122.0	102.0
7	20	1	Turkey	13.0	44.0	54.0	108.0	89.5
8	23	2	Iran	36.0	132.0	181.0	113.5	98.0
9	24	2	Iran	12.0	54.0	66.0	111.5	91.5
10	25	2	Iran	26.0	57.0	71.0	114.0	94.0
11	20	2	Iran	39.0	104.0	131.0	119.0	96.0
12	26	2	Iran	45.0	121.0	175.0	118.0	102.0
13	22	2	Iran	30.0	80.0	105.0	111.0	88.5
14	25	2	Iran	7.0	33.0	51.0	110.5	89.5
15	30	2	Iran	50.0	120.0	175.0	123.0	108.0
16	26	2	Iran	22.0	68.0	90.0	111.0	94.0
17	21	2	Iraq	30.0	89.0	110.0	107.2	85.0
18	21	2	Jordan	28.0	83.0	94.0	112.5	93.0
19	29	2	Jordan	25.0	73.0	96.0	117.0	96.0
20	23	2	Jordan	5.0	21.0	26.0	115.0	94.5

TABLE LXI (Continued)

No	Age	Group	Country	Abdomen	Sum of 4 Sites (mm.) Tricep + Iliac + Subscapula + Abdomen	Sum of 6 Sites (mm.) Bicep + Tricep + Iliac + Subscapula + Chest + Abdomen	Shoulder (cm.)	Chest (cm.)
21	23	2	Jordan	65.0	177.0	224.0	118.7	107.0
22	22	2	Kuwait	26.0	69.0	94.0	110.0	92.0
23	24	2	Lebanon	29.0	73.0	99.0	105.0	83.5
24	21	2	Lebanon	8.0	47.0	60.0	111.7	91.8
25	20	2	Lebanon	35.0	99.0	130.0	113.0	95.0
26	23	2	Suadi-Arabia	30.0	74.0	96.0	113.5	89.5
27	20	2	Syria	20.0	75.0	90.0	106.3	91.0
28	24	3	Iran	50.0	122.0	160.0	122.0	100.0
29	24	3	Iran	7.0	19.0	25.0	102.5	80.5
30	24	3	Iran	24.0	63.0	71.0	110.0	86.0
31	22	3	Iran	22.0	53.0	75.0	105.5	84.0
32	28	3	Iran	35.0	117.0	174.0	110.0	91.0
33	26	3	Iraq	25.0	68.0	88.0	107.0	89.0
34	24	3	Jordan	18.0	53.0	62.0	108.5	92.0
35	20	3	Kuwait	29.0	78.0	104.0	117.0	95.0
36	27	3	Lebanon	9.0	28.0	37.0	118.0	96.0
37	24	3	Lebanon	9.0	28.0	37.0	109.0	86.5
38	27	3	Saudi-Arabia	7.0	28.0	37.0	115.0	96.0
39	29	3	Saudi-Arabia	24.0	72.0	89.0	118.0	92.0
40	26	3	Thailand	10.0	39.0	55.0	113.0	88.5

TABLE LXI (Continued)

No	Age	Group	Country	Abdomen (cm.)	Buttock (cm.)	Bicep (cm.)	Forearm (cm.)	Wrist (cm.)	Thigh (cm.)	Knee (cm.)	Calf (cm.)	Ankle (cm.)	Heart Rate (beats/min.)
1	28	1	Iran	84.0	98.0	28.5	25.5	16.3	56.8	35.8	37.8	22.8	60
2	22	1	Jordan	76.4	87.0	28.8	26.2	17.3	55.1	35.6	34.3	22.0	71
3	21	1	Kuwait	74.5	89.0	26.8	25.9	16.5	53.2	35.3	34.6	22.5	79
4	20	1	Lebanon	79.1	91.0	29.7	26.6	16.4	55.8	35.9	33.0	20.3	79
5	22	1	Saudi-Arabia	76.5	94.0	26.5	24.3	15.5	54.5	35.8	35.5	22.3	94
6	20	1	Syria	94.0	101.0	33.5	31.3	21.0	61.0	42.0	43.7	28.9	62
7	20	1	Turkey	69.0	84.0	25.5	24.8	16.0	49.0	33.5	32.8	20.8	68
8	23	2	Iran	94.9	97.4	32.5	28.2	18.3	61.4	38.1	39.5	24.6	75
9	24	2	Iran	75.0	91.0	25.9	25.0	15.5	52.8	36.8	39.4	23.0	79
10	25	2	Iran	85.0	93.0	32.0	28.3	17.3	56.5	35.3	35.5	22.9	68
11	20	2	Iran	95.5	103.5	32.0	27.5	18.3	57.8	39.0	38.3	24.5	79
12	26	2	Iran	96.5	102.0	37.0	29.7	19.4	61.3	39.3	39.5	24.5	88
13	22	2	Iran	73.0	96.0	27.4	24.3	16.5	56.5	36.1	35.8	22.9	60
14	25	2	Iran	75.0	89.0	28.0	25.5	16.0	51.5	35.3	36.5	22.5	58
15	30	2	Iran	99.0	102.5	34.3	29.4	18.3	64.0	42.5	40.3	23.8	58
16	26	2	Iran	80.5	96.5	29.3	26.8	17.0	58.0	36.3	37.0	25.0	75
17	21	2	Iraq	82.4	92.0	31.1	26.3	16.9	55.1	35.6	38.4	24.4	78
18	21	2	Jordan	82.0	96.0	30.8	26.2	16.0	56.0	36.0	37.0	21.8	79
19	29	2	Jordan	91.0	100.0	30.0	36.0	17.0	53.4	36.6	36.0	23.8	46
20	23	2	Jordan	74.0	89.0	31.5	27.0	16.4	54.0	33.8	39.7	22.5	48

TABLE LXI (Continued)

No	Age	Group	Country	Abdomen (cm.)	Buttock (cm.)	Bicep (cm.)	Forearm (cm.)	Wrist (cm.)	Thigh (cm.)	Knee (cm.)	Calf (cm.)	Ankle (cm.)	Heart Rate (beats/min.)
21	23	2	Jordan	105.0	118.7	34.3	28.1	17.8	73.5	41.9	41.3	24.8	72
22	22	2	Kuwait	83.0	90.0	30.0	25.0	16.8	54.5	35.0	35.8	22.0	78
23	24	2	Lebanon	74.0	98.5	27.3	24.0	16.4	51.3	34.5	33.5	21.4	71
24	21	2	Lebanon	82.5	90.0	29.5	26.5	17.4	54.8	35.0	34.3	26.5	62
25	20	2	Lebanon	85.5	94.0	30.9	26.3	18.0	58.5	36.7	39.0	23.8	54
26	23	2	Saudi-Arabia	76.3	93.0	28.3	25.6	16.3	59.0	38.3	36.3	21.4	68
27	20	2	Syria	81.0	97.5	29.6	25.9	16.8	62.6	39.0	41.2	24.5	60
28	24	3	Iran	92.0	95.2	35.8	28.6	19.0	60.3	40.0	38.2	24.2	65
29	24	3	Iran	68.0	83.0	23.0	23.4	16.3	44.3	33.9	31.5	21.2	75
30	24	3	Iran	80.0	90.0	29.5	25.8	16.4	54.3	35.0	34.6	20.8	66
31	24	3	Iran	73.0	87.0	29.7	26.5	16.2	52.0	34.5	34.2	20.5	72
32	27	3	Iran	86.0	93.0	31.0	27.3	17.0	56.5	35.3	35.3	21.3	83
33	26	3	Iraq	82.3	89.5	26.5	24.0	16.2	49.5	33.5	33.5	22.3	75
34	24	3	Jordan	79.5	92.0	31.5	27.3	16.5	56.3	57.0	36.0	22.4	54
35	20	3	Kuwait	84.0	94.0	30.8	26.8	16.8	58.8	35.8	37.3	23.4	54
36	27	3	Lebanon	79.5	106.5	33.4	26.5	16.5	60.6	33.2	36.6	26.1	65
37	24	3	Lebanon	70.0	89.0	25.9	24.1	16.6	51.3	34.8	33.5	22.5	56
38	27	3	Saudi-Arabia	82.0	96.0	30.5	28.1	17.5	58.5	38.0	38.3	23.3	66
39	29	3	Saudi-Arabia	85.0	99.0	29.8	28.8	17.4	55.8	36.0	38.4	24.3	60
40	24	3	Syria	70.5	91.0	27.1	25.5	18.4	55.0	35.8	34.5	23.0	65

TABLE LXI (Continued)

No	Age	Group	Country	T Wave (mm.)	R Wave (mm.)	P-R Interval (sec.)	Rest/Work Ratio	QRS Axis Degree
1	28	1	Iran	4.0	7.0	.16	2.00	42.0
2	22	1	Jordan	5.0	10.0	.16	1.71	71.0
3	21	1	Kuwait	3.0	15.0	.16	1.50	79.0
4	20	1	Lebanon	3.0	16.0	.16	1.57	78.0
5	22	1	Saudi-Arabia	2.0	11.0	.16	1.00	83.0
6	20	1	Syria	3.0	3.0	.16	2.13	30.0
7	20	1	Turkey	2.0	8.0	.16	1.88	87.0
8	23	2	Iran	2.0	7.0	.16	1.86	48.0
9	24	2	Iran	4.0	10.0	.16	2.00	79.0
10	25	2	Iran	5.0	17.0	.16	2.00	49.0
11	20	2	Iran	2.0	10.0	.16	1.67	23.0
12	26	2	Iran	2.0	15.0	.20	1.43	64.0
13	22	2	Iran	6.0	12.0	.12	2.75	53.0
14	25	2	Iran	6.0	17.0	.16	2.00	74.0
15	30	2	Iran	2.0	7.0	.20	2.13	41.0

TABLE LXI (Continued)

No	Age	Group	Country	T Wave (mm.)	R Wave (mm.)	P-R Interval (sec.)	Rest/Work Ratio	QRS Axis Degrees
16	26	2	Iran	3.0	10.0	.16	1.33	-10.0
17	21	2	Iraq	1.0	11.0	.16	1.43	82.0
18	21	2	Jordan	3.0	14.0	.16	1.43	27.0
19	29	2	Jordan	2.0	11.0	.16	3.10	30.0
20	23	2	Jordan	5.0	19.0	.16	2.00	88.0
21	23	2	Jordan	3.0	18.0	.12	2.14	63.0
22	22	2	Kuwait	2.0	17.0	.12	1.43	-16.0
23	24	2	Lebanon	2.0	8.0	.16	1.55	61.0
24	21	2	Lebanon	3.0	26.0	.16	1.71	78.0
25	25	2	Lebanon	4.0	15.0	.12	2.75	51.0
26	23	2	Saudi-Arabia	3.0	19.0	.16	2.14	80.0
27	20	2	Syria	4.0	14.0	.20	2.75	61.0
28	24	3	Iran	4.0	10.0	.20	2.00	50.0
29	24	3	Iran	3.0	11.0	.16	2.28	100.0

TABLE LXI (Continued)

No	Age	Group	Country	T Wave (mm.)	R Wave (mm.)	P-R Interval (sec.)	Rest/Work Ratio	QRS Axis Degrees
30	24	3	Iran	4.0	12.0	.16	2.59	64.0
31	24	3	Iran	3.0	15.0	.16	1.71	74.0
32	27	3	Iran	2.0	14.0	.16	1.57	65.0
33	26	3	Iraq	2.0	17.0	.16	1.57	80.0
34	24	3	Jordan	3.0	19.0	.16	2.50	60.0
35	20	3	Kuwait	4.0	6.0	.12	2.75	69.0
36	27	3	Lebanon	4.0	17.0	.20	1.88	70.0
37	24	3	Lebanon	7.0	3.0	.16	2.25	30.0
38	27	3	Saudi-Arabia	4.0	10.0	.16	1.75	90.0
39	29	3	Saudi-Arabia	4.0	13.0	.16	2.38	68.0
40	24	3	Syria	3.0	7.0	.12	1.88	11.0

TABLE LXII

PHYSICAL FITNESS COMPONENTS OF EAST AND SOUTHEAST ASIAN STUDENTS

No	Age	Group	Country	Left Grip Strength (Kg.)	Right Grip Strength (Kg.)	Reaction Time (1/100 sec)	Height (cm.)	Weight (Kg.)	%Body Fat (Monogram)	%Body Fat (Sum of Fours)
1	24	1	Indonesia	38.0	32.0	.145	161.9	68.18	17.0	23.4
2	25	1	Japan	35.5	28.0	.177	170.8	65.45	10.0	22.0
3	20	1	Japan	53.5	49.5	.176	171.4	69.09	0.8	18.8
4	29	1	Korea	50.0	39.0	.134	170.8	63.86	12.0	18.8
5	20	1	Malaysia	43.0	43.0	.139	180.3	71.14	8.0	16.2
6	20	1	Malaysia	26.0	27.0	.160	165.5	56.36	13.0	20.0
7	22	1	Malaysia	42.5	38.0	.162	168.9	63.41	10.0	18.2
8	22	1	Singapore	34.0	31.0	.146	167.0	57.72	9.0	18.0
9	29	1	Thailand	37.0	30.0	.214	165.1	66.48	15.0	21.4
10	23	1	Thailand	43.0	36.0	.135	177.8	59.09	9.0	17.7
11	30	2	China	49.0	43.5	.188	175.3	70.00	15.0	24.1
12	22	2	Indonesia	46.0	29.0	.150	162.0	50.90	7.0	15.1
13	26	2	Japan	52.0	53.0	.125	167.6	75.40	17.0	22.3
14	22	2	Japan	53.0	49.0	.178	165.1	65.45	6.0	15.1
15	30	2	Korea	36.0	36.5	.152	163.2	71.59	18.0	22.3
16	20	2	Malaysia	32.0	32.0	.155	167.0	57.05	17.0	22.3
17	20	2	Malaysia	36.0	32.5	.168	172.7	65.57	13.0	19.1
18	20	2	Malaysia	37.0	36.5	.145	163.2	61.36	14.0	20.0
19	20	2	Malaysia	26.0	33.5	.210	161.3	47.73	12.0	20.8
20	22	2	Singapore	37.0	29.5	.160	164.5	64.66	13.0	20.3

TABLE LXII (Continued)

No	Age	Group	Country	Left Grip Strength (Kg.)	Right Grip Strength (Kg.)	Reaction Time (1/100 sec)	Height (cm.)	Weight (Kg.)	%Body Fat (Monogram)	%Body Fat (Sum of Fours)
21	29	2	Taiwan	31.0	35.5	.142	171.5	58.09	8.0	14.0
22	26	2	Taiwan	28.0	21.5	.164	174.0	55.45	4.0	11.9
23	22	2	Taiwan	40.5	37.0	.198	167.6	62.18	19.0	24.3
24	27	2	Taiwan	45.0	43.5	.211	165.1	58.41	19.0	24.3
25	20	2	Taiwan	35.0	30.0	.166	174.0	60.90	14.0	18.8
26	22	2	Thailand	30.0	20.0	.179	156.2	45.45	2.0	6.3
27	25	2	Thailand	36.0	30.0	.167	162.6	62.77	12.0	22.5
28	20	2	Thailand	26.0	25.0	.168	168.3	59.55	7.0	17.4
29	24	2	Thailand	22.0	17.0	.193	168.3	63.63	19.0	21.2
30	22	3	China	41.0	42.0	.181	177.2	59.54	6.0	16.2
31	23	3	Japan	57.0	52.5	.239	164.5	65.18	4.0	12.8
32	28	3	Indonesia	46.0	41.5	.142	170.1	55.68	6.0	14.0
33	30	3	Korea	48.0	44.0	.184	173.4	69.73	21.0	21.8
34	24	3	Malaysia	49.0	43.0	.144	180.9	65.45	8.0	19.6
35	25	3	Singapore	36.5	36.5	.115	172.0	64.55	13.0	21.4
36	25	3	Taiwan	54.0	43.0	.202	177.8	64.77	9.0	19.6
37	28	3	Taiwan	45.0	42.5	.136	174.0	82.27	32.0	31.1
38	30	3	Taiwan	40.5	37.5	.156	169.5	53.64	4.0	4.7
39	28	3	Thailand	49.0	38.0	.151	163.8	73.18	20.0	26.2
40	26	3	Thailand	29.0	28.0	.149	160.0	49.09	5.0	13.0

TABLE LXII (Continued)

No	Age	Group	Country	Flexibility (inch)	Optimal Weight (Kg.)	Weight Residual (Kg.)	Bicep (mm.)	Tricep (mm.)	Iliac (mm.)	Subscapula (mm.)	Chest (mm.)
1	24	1	Indonesia	5.0	66.51	1.67	6.0	12.0	13.0	17.0	20.0
2	25	1	Japan	8.0	62.73	2.72	9.0	11.0	23.0	17.0	10.0
3	20	1	Japan	15.0	69.97	-0.88	6.0	7.0	17.0	16.0	7.0
4	29	1	Korea	14.5	64.90	-1.04	6.0	11.0	16.0	13.0	12.0
5	20	1	Malaysia	12.5	71.15	0.01	5.0	7.0	15.0	10.0	10.0
6	20	1	Malaysia	16.0	57.3	-1.02	5.0	16.0	19.0	11.0	10.0
7	22	1	Malaysia	12.0	62.50	0.91	5.0	12.0	16.0	11.0	9.0
8	22	1	Singapore	16.5	55.91	1.81	5.0	10.0	18.0	10.8	8.0
9	29	1	Thailand	5.5	58.10	8.38	8.0	12.0	18.0	19.0	19.0
10	23	1	Thailand	11.0	60.30	0.91	5.0	12.0	11.0	14.0	9.0
11	30	2	China	10.0	67.89	2.11	8.0	17.0	26.0	20.0	17.0
12	22	2	Indonesia	7.0	61.24	-0.34	5.0	11.0	8.0	10.0	6.0
13	26	2	Japan	11.0	74.19	1.21	7.0	12.0	22.0	20.0	22.0
14	22	2	Japan	14.0	64.11	1.34	4.0	7.0	12.0	11.0	7.0
15	30	2	Korea	14.5	71.87	-0.28	10.0	11.0	24.0	16.0	20.0
16	20	2	Malaysia	10.0	56.77	0.28	6.0	20.0	24.0	11.0	16.0
17	20	2	Malaysia	13.0	64.79	0.78	8.0	13.0	15.0	11.0	14.0
18	20	2	Malaysia	18.5	57.96	3.40	4.0	17.0	21.0	12.0	11.0
19	20	2	Malaysia	13.0	44.08	3.65	6.0	16.0	21.0	11.0	9.0
20	22	2	Singapore	9.0	60.86	3.80	14.0	24.0	10.0	13.0	22.0

TABLE XLII (Continued)

No	Age	Group	Country	Flexibility (inch)	Optimal Weight (Kg.)	Weight Residual (Kg.)	Bicep (mm.)	Tricep (mm.)	Iliac (mm.)	Subscapula (mm.)	Chest (mm.)
21	29	2	Taiwan	10.0	55.71	2.38	5.0	8.0	9.0	9.0	9.0
22	26	2	Taiwan	6.0	55.33	0.12	3.0	6.0	6.0	11.0	5.0
23	22	2	Taiwan	9.0	60.95	1.23	9.0	16.0	31.0	16.0	22.0
24	27	2	Taiwan	11.0	55.78	2.63	7.0	16.0	27.0	20.0	25.0
25	20	2	Taiwan	9.0	61.10	-0.20	6.0	13.0	13.0	14.0	18.0
26	22	2	Thailand	5.0	45.20	0.25	2.0	4.0	4.0	6.0	3.0
27	25	2	Thailand	11.5	60.17	2.60	7.0	9.0	17.0	13.0	18.0
28	20	2	Thailand	11.5	57.10	2.45	4.0	9.0	16.0	12.0	7.0
29	24	2	Thailand	1.5	58.80	4.83	6.0	21.0	14.0	15.0	23.0
30	22	3	China	15.5	58.09	1.45	4.0	7.0	11.0	15.0	7.0
31	23	3	Japan	17.5	61.23	3.95	4.0	5.0	9.0	10.0	5.0
32	28	3	Indonesia	9.5	56.66	-0.98	4.0	7.0	9.0	11.0	6.0
33	30	3	Korea	14.0	66.01	3.72	13.0	8.0	20.0	18.0	24.0
34	24	3	Malaysia	10.0	65.85	-0.40	5.0	8.0	24.0	12.0	7.0
35	25	3	Singapore	15.0	61.46	3.09	5.0	12.0	30.0	10.0	16.0
36	25	3	Taiwan	16.5	64.53	0.24	5.0	9.0	19.0	16.0	8.0
37	28	3	Taiwan	10.0	72.34	9.83	19.0	36.0	43.0	25.0	27.0
38	30	3	Taiwan	11.0	52.90	0.74	2.0	4.0	8.0	6.0	3.0
39	28	3	Thailand	17.0	69.44	3.74	7.0	24.0	37.0	16.0	18.0
40	26	3	Thailand	5.0	49.67	-0.58	3.0	4.0	15.0	8.0	8.0

TABLE LXII (Continued)

No	Age	Group	Country	Abdomen	Sum of 4 Sites (mm.) Tricep + Iliac + Subscapula + Abdomen	Sum of 6 Sites (mm.) Bicep + Tricep + Iliac + Subscapula + Chest + Abdomen	Shoulder (cm.)	Chest (cm.)
1	24	1	Indonesia	38.0	69.0	93	111.0	91.8
2	25	1	Japan	19.0	60.0	79	104.5	89.0
3	20	1	Japan	22.0	46.0	59	109.5	94.6
4	29	1	Korea	28.0	36.0	54	107.4	86.5
5	20	1	Malaysia	17.0	37.0	52	109.6	89.5
6	20	1	Malaysia	17.0	51.0	66	106.5	81.0
7	22	1	Malaysia	16.0	44.0	58	102.0	84.3
8	22	1	Singapore	18.0	43.0	56	102.6	82.0
9	29	1	Thailand	32.0	57.0	84	102.5	87.3
10	23	1	Thailand	11.0	42.0	56	107.0	87.3
11	30	2	China	21.0	71.0	96	98.5	89.0
12	22	2	Indonesia	9.0	34.0	45	99.5	78.0
13	26	2	Japan	35.0	61.0	90	112.0	96.0
14	22	2	Japan	11.0	34.0	45	111.5	90.5
15	30	2	Korea	49.0	61.0	90	115.0	93.0
16	20	2	Malaysia	26.0	61.0	83	94.0	77.0
17	20	2	Malaysia	27.0	47.0	69	109.0	86.5
18	20	2	Malaysia	22.0	54.0	69	103.4	84.2
19	20	2	Malaysia	18.0	54.0	69	93.5	74.0
20	22	2	Singapore	22.0	52.0	69	108.0	91.7

TABLE LXI (Continued)

No	Age	Group	Country	Abdomen	Sum of 4 Sites (mm.) Tricep + Iliac + Subscapula + Abdomen	Sum of 6 Sites (mm.) Bicep + Tricep + Iliac + Subscapula + Chest + Abdomen	Shoulder (cm.)	Chest (cm.)
21	29	2	Taiwan	15.0	31.0	45	102.0	83.5
22	26	2	Taiwan	6.0	26.0	34	102.0	83.0
23	22	2	Taiwan	40.0	72.0	103	108.5	86.0
24	27	2	Taiwan	30.0	70.0	102	103.2	84.5
25	20	2	Taiwan	19.0	46.0	70	102.0	86.0
26	22	2	Thailand	4.0	16.0	21	100.0	82.5
27	25	2	Thailand	21.0	46.0	71	95.0	81.0
28	20	2	Thailand	15.0	41.0	52	104.0	84.0
29	24	2	Thailand	30.0	56.0	85	99.6	80.1
30	22	3	China	12.0	37.0	48	107.2	87.0
31	23	3	Japan	9.0	28.0	37	114.5	92.0
32	28	3	Indonesia	12.0	31.0	41	105.0	84.5
33	30	3	Korea	50.0	51.0	86	113.5	92.5
34	24	3	Malaysia	20.0	49.0	61	107.4	90.0
35	25	3	Singapore	25.0	57.0	78	105.7	91.5
36	25	3	Taiwan	20.0	49.0	62	113.3	86.9
37	28	3	Taiwan	51.0	123,0	169	121.2	99.9
38	30	3	Taiwan	6.0	14.0	190	100.0	82.0
39	28	3	Thailand	18.0	33.0	119	100.0	90.5
40	26	3	Thailand	7.0	15.0	40	100.0	81.5

TABLE LXI (Continued)

No	Age	Group	Country	Abdomen (cm.)	Buttock (cm.)	Bicep (cm.)	Forearm (cm.)	Wrist (cm.)	Thigh (cm.)	Knee (cm.)	Calf (cm.)	Ankle (cm.)	Heart Rate (beats/min.)
1	24	1	Indonesia	89.5	93.0	30.9	25.7	31.0	65.3	35.8	37.2	21.8	60
2	25	1	Japan	77.0	87.0	28.3	24.8	15.9	52.8	35.3	35.2	22.0	71
3	20	1	Japan	75.5	93.0	29.6	27.0	17.8	56.0	29.6	38.3	22.8	48
4	29	1	Korea	78.0	89.5	29.0	25.8	17.6	54.3	34.5	35.3	21.9	60
5	20	1	Malaysia	94.2	90.0	28.1	24.7	16.4	60.3	37.0	37.8	23.2	60
6	20	1	Malaysia	71.0	88.0	27.5	25.3	16.0	50.5	34.3	33.5	21.0	60
7	22	1	Malaysia	71.2	81.7	27.2	25.4	16.6	54.8	36.0	38.6	23.1	72
8	22	1	Singapore	69.0	87.0	25.3	24.8	15.5	50.3	35.3	33.3	20.3	88
9	29	1	Thailand	77.3	88.5	26.5	24.8	14.5	51.5	35.0	36.3	20.8	72
10	23	1	Thailand	70.0	84.0	26.8	23.8	15.3	48.8	34.3	35.0	20.9	78
11	30	2	China	79.0	91.8	30.4	35.8	16.3	56.0	37.0	35.5	21.1	71
12	22	2	Indonesia	65.5	83.0	25.4	23.5	14.3	50.0	33.9	31.0	21.8	60
13	26	2	Japan	97.5	98.0	30.3	28.0	17.8	57.3	36.0	39.0	21.8	68
14	22	2	Japan	76.0	87.0	30.0	26.5	15.8	54.0	35.0	37.5	22.3	79
15	30	2	Korea	90.0	94.0	31.0	27.8	18.0	57.0	36.9	39.4	23.5	62
16	20	2	Malaysia	73.5	84.0	27.0	24.7	15.0	55.0	34.9	34.5	21.6	78
17	20	2	Malaysia	75.5	90.0	29.2	25.5	15.4	53.8	35.5	36.3	22.0	62
18	20	2	Malaysia	72.4	84.9	28.5	24.8	15.6	53.0	35.3	35.5	21.5	83
19	20	2	Malaysia	66.8	79.8	21.8	20.1	13.2	46.5	32.9	31.3	18.9	72
20	22	2	Singapore	75.5	85.0	29.1	24.4	15.2	54.8	36.5	35.6	21.7	60

TABLE LXI (Continued)

No	Age	Group	Country	Abdomen (cm.)	Buttock (cm.)	Bicep (cm.)	Forearm (cm.)	Wrist (cm.)	Thigh (cm.)	Knee (cm.)	Calf (cm.)	Ankle (cm.)	Heart Rate (beats/min.)
21	29	2	Taiwan	74.0	87.0	25.5	23.0	15.1	47.5	34.0	32.0	20.5	65
22	26	2	Taiwan	75.0	81.0	23.1	22.8	24.5	47.0	33.5	35.0	20.3	71
23	22	2	Taiwan	80.0	91.0	27.5	25.3	16.2	52.7	33.9	33.5	20.6	83
24	27	2	Taiwan	73.0	86.5	27.1	24.0	25.4	49.5	33.6	33.2	21.0	72
25	20	2	Taiwan	72.0	87.0	29.0	25.3	15.8	49.0	34.8	34.6	21.0	58
26	22	2	Thailand	60.5	82.0	23.0	22.3	13.4	45.3	30.8	33.0	20.0	62
27	25	2	Thailand	74.8	86.0	24.3	22.0	13.5	49.5	32.0	31.8	20.8	68
28	20	2	Thailand	73.5	94.0	28.8	25.5	16.3	50.5	35.8	37.8	23.0	72
29	24	2	Thailand	77.1	86.6	24.6	23.6	15.9	52.4	37.6	36.3	21.1	72
30	22	3	China	68.5	85.5	25.5	22.8	15.1	48.5	36.0	32.2	19.8	88
31	23	3	Japan	73.0	89.3	29.0	26.5	16.5	52.4	35.4	35.8	20.0	60
32	28	3	Indonesia	69.9	79.5	26.8	23.7	15.3	49.4	34.8	34.6	20.6	62
33	30	3	Korea	80.5	88.0	27.8	24.8	16.9	54.0	35.3	34.5	21.7	68
34	24	3	Malaysia	74.0	84.5	29.0	24.8	15.6	54.0	36.3	34.0	21.1	68
35	25	3	Singapore	75.7	86.6	28.1	24.7	15.2	52.8	34.8	35.4	19.9	60
36	25	3	Taiwan	71.7	90.0	26.5	25.6	16.0	53.2	34.5	35.5	20.6	66
37	28	3	Taiwan	95.0	97.0	33.3	27.6	17.6	59.3	38.8	39.2	22.9	72
38	30	3	Taiwan	65.0	84.0	24.3	24.5	14.9	46.6	34.5	32.8	19.8	65
39	28	3	Thailand	84.0	98.0	31.5	26.5	16.3	57.5	41.3	40.0	22.3	60
40	26	3	Thailand	75.5	81.0	23.9	22.8	15.0	47.3	32.0	29.9	19.3	79

TABLE LXII (Continued)

No	Age	Group	Country	T Wave (mm.)	R Wave (mm.)	P-R Interval (sec.)	Rest/Work Ratio	QRS Axis Degrees
1	24	1	Indonesia	4.0	10.0	.12	2.00	30
2	25	1	Japan	4.0	5.0	.20	2.00	80
3	20	1	Japan	6.0	4.0	.16	3.00	80
4	29	1	Korea	4.0	15.0	.16	2.00	68
5	20	1	Malaysia	4.0	18.0	.20	1.75	90
6	20	1	Malaysia	5.0	20.0	.20	2.43	99
7	22	1	Malaysia	2.0	23.0	.12	1.75	51
8	22	1	Singapore	2.0	21.0	.16	1.66	79
9	29	1	Thailand	2.0	14.0	.12	1.88	95
10	23	1	Thailand	3.0	13.0	.20	1.43	82
11	30	2	China	5.0	10.0	.16	2.33	100
12	22	2	Indonesia	5.0	10.0	.16	1.75	104
13	26	2	Japan	4.0	17.0	.16	2.13	62
14	22	2	Japan	4.0	12.0	.20	1.57	98
15	30	2	Korea	2.0	12.0	.16	2.29	66

TABLE LXI (Continued)

No	Age	Group	Country	T Wave (mm.)	R Wave (mm.)	P-R Interval (sec.)	Rest/Work Ratio	QRS Axis Degrees
16	20	2	Malaysia	2.0	8.0	.16	2.00	61
17	20	2	Malaysia	5.0	23.0	.16	2.00	69
18	20	2	Malaysia	2.0	16.0	.20	1.57	65
19	20	2	Malaysia	5.0	10.0	.16	1.86	87
20	22	2	Singapore	6.0	19.0	.20	2.50	68
21	29	2	Taiwan	5.0	13.0	.16	2.29	74
22	26	2	Taiwan	4.0	9.0	.20	1.63	96
23	22	2	Taiwan	4.0	7.0	.16	1.57	17
24	27	2	Taiwan	3.0	13.0	.12	1.71	66
25	20	2	Taiwan	4.0	17.0	.16	2.38	90
26	22	2	Thailand	3.0	18.0	.16	1.63	88
27	25	2	Thailand	3.0	16.0	.16	2.14	72
28	20	2	Thailand	2.0	22.0	.20	2.00	93
29	24	2	Thailand	13.0	26.0	.12	1.71	66
30	22	3	China	3.0	6.0	.16	1.43	81

TABLE LXI (Continued)

No	Age	Group	Country	T Wave (mm.)	R Wave (mm.)	P-R Interval (sec.)	Rest/Work Ratio	QRS Axis Degrees
31	23	3	Japan	3.0	12.0	.16	1.75	79
32	28	3	Indonesia	4.0	17.0	.16	2.57	82
33	30	3	Korea	3.0	4.0	.16	1.88	30
34	24	3	Malaysia	4.0	18.0	.16	1.67	81
35	25	3	Singapore	2.0	3.0	.16	1.78	- 08
36	25	3	Taiwan	1.0	2.0	.16	2.00	65
37	28	3	Taiwan	1.0	13.0	.16	1.29	30
38	30	3	Taiwan	4.0	10.0	.20	1.86	73
39	28	3	Thailand	6.0	12.0	.16	2.71	78
40	26	3	Thailand	4.0	24.0	.16	1.57	83

TABLE LXIII

SMOKING, ALCOHOL, EXERCISE AND DIET HABITS, AND SOCIOECONOMIC CLASS OF MIDDLE EAST 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 ane Sweets	C'ass
			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	H-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

TABLE LXIV

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	Clas
			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

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VITA 2

Vijit Kanungsukkasem

Candidate for the Degree of

Doctor of Education

Thesis: A MEASUREMENT AND COMPARISON OF SELECTED PHYSICAL FITNESS COMPONENTS AND ANTHROPOMETRICAL CHARACTERISTICS 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 Bangkok, Thailand, September 30, 1952, the son of Sin and Noi Kanungsukkasem.

Education: Attended pre-elementary school, elementary school, secondary school, and high school at Assumption College, in Bangkok, Thailand. Graduated from Assumption College in 1972; received the Bachelor of Education Degree from Chulalongkorn University, Bangkok, Thailand, in 1977; received the Master of Science degree in HPELS from Oklahoma State University in 1980; and completed requirements for Doctor of Education degree in May, 1983.

Professional Experience: Taught Physical Education at Assumption College, Bangkok, Thailand, 1977-1978. Member of Health, Physical Education, and Recreation Association of Thailand and Kappa Delta Pi, an honor society in education.