A COMPARISON OF THE PHYSICAL FITNESS LEVELS OF SELECTED OKLAHOMA STATE UNIVERSITY FACULTY AND SELECTED COMMERCIAL PEOPLE OF THE STATE OF OKLAHOMA

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CHAPTER I

INTRODUCTION

It is becoming increasingly evident that regular exercise can be an essential part of one's life-style for maintaining and improving health, performance and appearance. At this time, interest in this area is high. Intensive study of the interaction between physical activity and obesity has been conducted for a number of years.[1] The lack of physical activity appears to be a significant contributing factor to obesity. Lack of exercise, high blood pressure and overweight have been statistically related to the incidence of coronary heart disease (CHD).[2]

Controversy continues to surround interpretation of the relationship of physical activity to obesity and CHD. Some authors have claimed that exercise is not an important factor in weight control, the cholesterol problem, or the problem of atherosclerosis.[3] Paffenbarger stated that the more active person has a lower risk of developing coronary heart disease, and has a lower risk of dying from it

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[1] L. B. Oscal, "The Role of Exercise in Weight Control," Exercise and Sport Sciences Reviews, I (1973), p. 273.

[2] S. M. Fox, Relationship of Activity Habits to Coronary Disease: Exercise Testing and Exercise Training in Coronary Heart Disease (New York, 1973), p. 143.

[3] P. J. Steincrohn, Don't Die Before Your Time (New York, 1971), p. 27.

in a given time span.[4] World famous exercise physiologist and physician, Per-Olof Astrand, has managed to resolve this apparent dilemma to his own satisfaction. He stated that: "It will take 100 years to determine the exact relationship between physical activity and premature death from coronary heart disease. Personally, I can't afford to wait that long to find out so I elect to exercise."[5]

With the importance of exercise becoming more clear, physical fitness evaluation programs for adults are being initiated throughout the United States. At Oklahoma State University, the physical fitness evaluation program began in 1972 under the direction of A. B. Harrison. For several years, his studies on physical fitness focused only on selected male members of the Oklahoma State University faculty. The measurements used to assess the physical condition of the subjects were the Balke Treadmill test for functional capacity, electrocardiogram, blood pressure, pulmonary function, and body composition.

This program attracted many business and professional people from all over the state of Oklahoma. In 1979, the Mobile Fitness Laboratory which contains the latest exercise testing equipment became available for use in giving physical fitness evaluations and exercise prescriptions. From June 1979 to July 1980, 308 subjects from 17 different communities were tested for a fee in the Mobile Lab. These subjects included both males and females. The measurements to assess the physical condition of these subjects were the same ones which are used for

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[4]A. J. Ryan, "Exercise and the Cardiovascular System (Round Table) Physician and Sports Medicine, VII (1979), p. 53.

[5]E. A. Amsterdam, J. H. Wilmore, and A. N. DeMaria, Exercise in Cardiovascular Health and Disease (New York, 1977), p. 267.

the Oklahoma State University plus grip strength, leg strength, push and pull strength, reaction time, vertical jump reaction time, flexibility, and O_2 saturation.

Statement of the Problem

The purpose of this study was to compare the physical fitness levels of the Oklahoma State University Faculty Group (N = 62) with those of the Commercial Group (N = 308) which were tested in the Mobile Lab program. Comparison will be made on the following: Aerobic Points, Lying Blood Pressure, Lying Pulse Rate, Percent Body Fat, Respiratory Functions, EKG, and Predicted maximum VO_2 from Treadmill Test. All comparisons and analysis of the data were on data collected during the academic year of 1979-1980.

Subproblems

1. To compare the physical fitness levels of subjects from different communities.

2. To compare the physical fitness levels between the Oklahoma State University Faculty and the commercial subjects.

3. To compare the physical fitness levels of all tested males in various age groups.

4. To compare the physical fitness levels between females and males who were tested in the Mobile Lab Program.

5. To compare the physical fitness levels of various professional groups. (Bankers, merchants, lawyers, realtors, attorneys, physicians, construction workers, professors, administrators, and etc.)

6. To compare the test and retest of physical fitness results on

64 Mobile Lab subjects who were re-evaluated during the year of this study (1979-1980).

Hypotheses

1. There is no significant difference in the results of the physiological variables between males of the Oklahoma State University Faculty and males of the Commercial Group.

2. There is no significant mean change with mean age increased one year of the physiological variables among all males tested.

3. There is no significant difference in the results of the physiological measures between males and females of the Commercial Group.

4. There is no significant mean change with mean age increased one year of the physiological variables among males and females of the Commerical Group.

5. There is no significant difference in the results of the physiological measures between females of three different communities in the Commercial Group.

6. There is no significant difference in the results of the physiological measures between males of eight different communities in the Commercial Group.

7. There is no significant difference in the results of the physiological measures between males of nine different professional groups.

8. There is no significant difference between test and retest scores of 64 subjects who were re-evaluated during the year of 1979-1980.

Limitations

1. The subjects were all volunteers. Since there was no random selection, none of the groups can be said to represent a larger group.

2. There were no controls of subjects' personal factors such as diet, sleep, and other health routines.

Delimitations

1. The subjects being used in this study were voluntary male faculty, and males and females from various Oklahoma communities who paid a fee for evaluation in the Mobile Laboratory.

Assumption

1. The tests selected were valid predictors of physical fitness.

2. Those giving the tests were skilled and capable of taking valid measures.

Selection of Measurements

The measurements used to assess the physical condition of the subjects were Balke Treadmill Test, body circumferences, skin fold fat measurements, resting blood pressure, resting pulse rate, pulmonary functions, electrocardiogram, grip and leg strength, push and pull strength, reaction time, vertical jump reaction time, flexibility, and O_2 saturation.

Balke Treadmill Test

Treadmill stress testing currently is the accepted tool for assessing cardiopulmonary function and for determining the subsequent exercise prescription.[6] It is also used as a screening device for potential heart problems, to determine fitness level and functional capacity. Stress tests are used clinically to show the presence of blocked coronary arteries. It is a noninvasive test and not as expensive as some other medical tests. The treadmill test does not depend upon skill or efficiency. Walking is familiar to people so most people can take the test without being limited by skill.

The Balke Treadmill test was used to assess the physical condition of the subjects. The test can be used for a wide range of ages and physical fitness levels. The test requires only walking skill and utilizes a gradually increasing work load.

Body Circumferences

Behnke[7] developed a method to estimate ideal body weight which employed eleven body circumference measurements. This method used only a flexible metal anthropometric tape and can be done in a short amount of time.

Skin Fold Fat Measurement

The technique of skinfold fat measurements which was developed by Brozek and Keys was employed.[8] It utilized a skinfold fat caliper

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[6]H. L. Taylor, W. Haskell, S. W. Fox and H. Blackburn, *Exercise Test: A Summary of Procedures and Concepts of Stress Testing for Cardiovascular Diagnosis and Function Evaluation: Measurement in Exercise Electrocardiography* (Illinois, 1969), pp. 259-305.

[7]A. R. Behnke and W. L. Taylor, "Anthropometric Comparison of Mascular and Obese Men," *Journal of Applied Physiology*, XVI (1961), p. 955.

[8]Brozek and A. Keys, "The Evaluation of Leanness-Fatness in Men: Norms and Interrelationships," *British Journal of Nutrition*, V (1951), p. 194.

which measures skinfold fat thicknesses in centimeters.

Resting Blood Pressure

In this study, an indirect method commonly used in hospitals and in doctors' offices was used to measure blood pressure. It required the use of a sphygmomanometer (Blood pressure cuff and pressure gauge) and a stethoscope.[9]

Resting Pulse Rate

Some confusion exists in terms of heart rate and pulse rate. The heart rate is the actual number of times the heart beats per minute. When the heart contracts, a wave of force passes down the elastic aorta and the arteries. The heart rate and pulse rate will be the same. For this study, the resting pulse rate was taken by a physiography recorder or an electrocardiograph machine. The resting pulse rate was recorded for 10 seconds and multiplied by 6 in order to get resting pulse per minute.

Pulmonary Function

There have been several studies concerned with the pulmonary function test.[10] Pulmonary function testing has become increasingly important in the diagnosis and management of pulmonary disease. Function testing would seem to date from the work of Baldwin, Cournand,

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[9] D. K. Mathews, R. W. Stacy and G. N. Hoover, *Physiology of Muscular Activity and Exercise* (New York, 1964), p. 184.

[10] N. G. Hepper, G. Fowler, and H. F. Helmholz, "Relationship of Height to Lung Volume in Healthy Men," *Diseases of the Chest*, XXXVII (1960), p. 314.

and Richards[11] which included the quantitative assessment of maximal breathing capacity, vital capacity, timed vital capacity, and O_2 intake. These pulmonary function tests were done for this study on a Collins 9 liters Respirometer.

Electrocardiogram

The electrocardiograph (EKG) is an instrument for recording the electrical signal originating from the heart and received by electrodes attached to the surface of the skin. Each heart beat produces a characteristic electrical wave form. The EKG is an excellent tool for detecting abnormalities of the heart. The exercise EKG is a valuable tool for detecting individuals with potential cardiac problems. A Birtcher EKG machine was used to record a 12 lead resting EKG.

Grip and Leg Strength

Hand dynamometers and cable tensionmeters were used to measure grip and leg strength respectively. Two trials were given to both right hand and left hand and right leg and left leg. Both strong and weak trials were recorded in pounds (lbs).

Push and Pull Strength

A push and pull strength device was used to measure push and pull strength. Two trials were given for both push and pull. Both strong and weak trials were recorded in pounds (lbs).

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[11] E. F. Baldwin, A. Cournand, and D. W. Richard, "Pulmonary Insufficiency: Physiological Classification, Clinical Methods of Analysis, Standard Values in Normal Subjects," Medicine, XXVII (1948), p. 276.

Reaction Time

The Dekan Timer (The Automatic Performance Analyzer) which records the time from the stimulus to the response to a sound was used to measure the reaction time. Ten trials were given to the subject.

Vertical Jump Reaction Time

The Dekan Timer (The Automatic Performance Analyzer) was used to measure the vertical jump reaction time. Ten trials were given to the subject.

Flexibility

Since flexibility is specific to each joint, no generalized flexibility test is available. Because this study is on physical fitness and related to health aspects, lower back flexibility was measured. To measure this area, a simple field test called the sit and reach test was used. The distance reached was recorded in inches.

O_2 Saturation

A Waters oximeters (Model 350) and an earpiece was used to measure the O_2 saturation of the subject. Since hemoglobin in the red blood cells carries oxygen, it is obvious that the number of red blood cells and the amount of hemoglobin in those cells are important in determining how much oxygen can be transported to the working muscles. DeVries[12] mentioned that during resting conditions at sea level, the hemoglobin leaving the lungs is at least 95 percent saturated with O_2.

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[12] H. A. DeVries, Physiology of Exercise (Iowa, 1974), p. 176.

Definition of Terms

ECG (Electrocardiogram): A graphic recording of the electrical change of the cardiac cycle.

Systolic Pressure: The maximal level of pressure in the arteries following the contraction of the ventricle.

Diastolic Pressure: The lowest level of pressure in the arteries at the time of relaxation of the ventricle.

P Wave: Depolarization of the atria on EKG.

QRS Interval: Depolarization of the ventricles on EKG.

T Wave: Repolarization of the ventricles on EKG.

Rest Time: Time from the end of T Wave to the next ST segment on EKG.

Work Time: Time of the ST interval EKG.

Rest/Work: Rest Time divided by Work Time.

Maximum Breathing Capacity: Maximal volume of air which a subject can breathe per minute. It is predicted from a 15 second test.

Vital Capacity: The maximal volume measured on expiration after the deepest inspiration.

Timed Vital Capacity: Volume of gas exhaled over a given time interval during a complete forced expiration (one second interval).

Instruments

The instruments which were used to obtain the physiological measurements of the subjects are listed along with names of the manufacturers.

Automatic Performance Analyzer: An apparatus which was used to measure the reaction time. (Dekan timing devices, Glen Ellyn, Illinois.)

Lange Skinfold Caliper: An apparatus which was used to measure the skinfold thickness. (Cambridge Scientific Industries, Inc., Cambridge, Maryland.)

Grip Strength Device: An apparatus which was used to measure the grip strength of both hands. (Harpenden, British Indicators, Ltd.)

Weight Measurement Device: An apparatus which was used to measure the weight. (Detecto-Medic, Detected Scales, Inc., Brooklyn, New York.)

CD 4 Respirometer: An apparatus which was used to measure the maximal breathing capacity. (Instrumentation Associates, Inc., 17 West 60th Street, New York, New York 10023.)

Nine Liter Respirometer: An apparatus which was used to measure various respiratory capacities. (Warren E. Collin, Incorporated, 220 Wood Road, Braintree, Massachusetts.)

Push and Pull Strength Device: An apparatus which was used to measure push and pull strength. (Narragansett.)

Anthropometric Tape: A tape which was used to measure the body part circumferences. (Preston Corporation, Fifth Avenue, New York, New York 10003.)

T5 Cable Tensionmeter: An apparatus which was used to measure the leg strength. (Pacific Scientific Company, Los Angeles.)

Tissot Tank: A large stainless steel tank which was used to measure the maximal breathing capacity. (Warren E. Collins, Incorporated, 555 Huntington Avenue, Boston, Massachusetts.)

Physiograph: An apparatus which was used to monitor and record the heart rate. (E & M Instrument Corporation, Inc., Houston, Texas.)

EKG Scope: An apparatus which was connected to the EKG machine and provided the EKG graph on the screen. (Hewlett-Packard Company.)

Bio Telemetry Receiver: A receiver which can receive radio waves from a small transmitter and send the signal back to the physiograph machine. (Narco Bio-Systems, Inc., Houston, Texas.)

Electrocardiograph: An apparatus which was used to record the electrical signal originating from the heart and received by electrodes attached to the surface of the skin. (Birtcher, 4501 North Adden Drive, El Monte, California.)

Biotachometer BT-1200: An apparatus which was used to monitor the heart rate. (Narco Bio Systems, Inc., Houston, Texas.)

Timer: An apparatus which was used for setting time during Treadmill Test and recovering time. (Meylan Stopwatch Corporation, 264 West 40th, New York, New York.)

Electrodes and Transmitter: Equipments which transmitted heart sounds by radio waves into the telemetry apparatus. (E & M Instrument Corporation, Inc., Houston Texas.)

Programmed Exercise Control: An apparatus which was used to control the treadmill speed and grade. (Model 642, Quinton Instruments, Seattle, Washington.)

Treadmill: An apparatus with a continuously moving belt which was used to run at various speed and grade. (Quinton Instruments, Seattle, Washington.)

EKG Paste: An electrolyte that emulifies skin oil and provides greater conductivity between skin and electrodes or electroplates.

Mercury Sphygmomanometer: An apparatus which was used to measure the blood pressure of the subject during resting, walking on the treadmill, and recovering. (Trimline, Py Mah Corporation, Somersville, New Jersey.)

Significance

1. The faculty group has been studied for eight years in the physical fitness research by A. B. Harrison. This group seems to exercise habitually more than the commercial group does. Does the first group have better physical fitness than the second one?

2. The matter of compliance with recommended exercise programs is of considerable interest today. It will be interesting to determine whether evaluation of the physical fitness followed by an exercise prescription can be effective in bringing some changes in physical fitness of the subject or not.

3. The population statistics indicate that aging is a factor of deterioration on most physical fitness variables. In the subjects of this study, is this factor still valid?

4. Is there more stress on those people in the business community as compared to university faculty and administrator members? If so, one would expect more stress disease such as hypertension and CHD among the business community as represented by the commercial group in this study.

CHAPTER II

REVIEW OF LITERATURE

Cardiovascular diseases have a worldwide distribution. Some disease entities, such as hypertensive heart disease, rheumatic heart disease, vascular lesions affecting the central nervous system (stroke) and certain congenital abnormalities are found in practically every part of the world. Others are distributed predominantly in certain geographic areas. Foremost among the latter group is coronary heart disease, which comprises the major portion of mortality due to cardiovascular diseases in the United States and most Western societies. According to the World Health Organization, analysis of vital statistics data from 29 technologically advanced countries (including the United States) shows that 39 percent of deaths in 25 to 64-year-old men were due to cardiovascular diseases in 1967; coronary artery diseases accounted for about 75 percent of these deaths.[1] In 50 countries that maintain vital statistics, cardiovascular diseases account for about 37 percent of all deaths each year. In the United States, these diseases account for approximately 54 percent of all deaths.[2]

Exercise conditioning programs have been widely recommended in

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[1]Myocardial Infarction Community Registers, Public Health in Europe, <u>World Health Organization</u> Report No. 5, 1976.

[2]T. Gordon and T. Tom, "The Recent Decrease in Coronary Heart Disease Mortality," <u>Preventive Medicine</u>, IV (1975), pp. 115-125.

both the medical literature and the lay press as the means of decreasing the incidence, prevalence, severity or mortality of coronary heart diseases. These claims were initially based on epidemiologic studies which suggested an inverse relationship between physical activity and coronary heart disease.[3] In the introduction to a recent Symposium on Exercise and the Heart, Adams stated that "Exercise as a therapeutic tool to improve cardiac and physical performance should be recommended in all age groups provided the subjects are thoroughly evaluated and the exercise program individualized."[4]

Blood Pressure Studies

DeVries stated that the blood pressure is a variable condition easily changed by things such as sex, age, ethnic origin, obesity, emotion, time of day, ingestion of food and posture.[5]

Mial and Level followed up the blood pressure of more than 1,000 persons for a period of 8 to 10 years. They found a positive correlation relating change in weight to blood pressure up to the age of 50.[6] Paffenbarger has shown a close correlation between weight and blood

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[3] W. J. Zukel, R. H. Lewis, and P. E. Enterline, "A Short-Term Community Study of the Epidemiology of Coronary Heart Disease: A Preliminary Report of the North Dakota Study," American Journal of Public Health, XLIX (1959), pp. 1630-1639.

[4] C. W. Adams, "Symposium on Exercise and the Heart," American Journal of Cardiology, XXX (1972), pp. 713-756.

[5] H. A. DeVries, Physiology of Exercise for Physical Education and Athletics (Iowa, 1974), p. 129.

[6] W. E. Mial and H. G. Lovel, "Relation Between Change of Blood Pressure and Age," British Medicine Journal, II (1967), p. 665.

pressure.[7]

Bartles reported that during isometric exercise, there was a greater increase in blood pressure. In isometric contraction, the tissue pressure on arteries can be very high, requiring a very high perfusion pressure which requires large increases in systolic pressure.[8] DeVries also stated that the isometric exercise should be avoided with older people and cardiac patients.[9] Astrand reported that when comparing the arterial blood pressure response to exercise in subjects of different ages, the older men had consistently higher systolic and diastolic pressures than the younger ones.[10]

Reduced blood pressure values as a result of a physical fitness program are reported by Pollock[11] and Wilmore.[12]

Respiratory Function Studies

Guyton stated than in normal persons the volume of air in the lungs depends primarily on body size and body build. The volumes and

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[7] R. S. Paffenbarger, "Chronic Disease in Former College Students," American Journal of Epidemiology, LXXXVII (1968), pp. 25-32.

[8] R. L. Bartles, E. L. Fox, R. W. Bowers, and E. P. Hiatt, "Effect of Isometric Work on Heart Rate, Blood Pressure, and Net Oxygen Cost," Research Quarterly, XXXIX (1960), p. 440.

[9] DeVries, 1974, p. 132.

[10] P. O. Astrand, Textbook of Work Physiology (New York, 1977), p. 191.

[11] M. L. Pollock, H. S. Miller, R. Janeway, A. C. Linnerud, B. Robertson, and R. Valentino, "Effect of Walking on Body Composition and Cardiovascular Function of Middle-Aged Men," Journal of Applied Physiology, XXX (1971), p. 126.

[12] J. H. Wilmore, R. N. Girandola, F. I. Katch, and V. L. Katch, "Physiological Alterations Resulting From a 10-Week Program of Jogging," Medicine and Science in Sports, II (1970), p. 7.

capacities tend to decrease when the person lies down.[13]

Edington and Edgerton state that the functional capacity of the respiratory system is impaired during aging as reflected in decreased maximal breathing capacity and vital capacity.[14]

Stuart and Collins found vital capacity and maximal breathing capacity of athletes to be significantly higher than the mean of the nonathlete.[15]

Wilmore stated that the static lung volumes change very little with training. There is a tendency for vital capacity to increase slightly and for residual volume to decrease by approximately the same amount.[16]

Heart Rate Studies

Wilmore indicated that the heart rate is the simplest and one of the most informative of the cardiovascular parameters that can be measured. In the very sedentary, deconditioned individuals, the resting heart rates can exceed 100 beats per minute and in highly conditioned endurance athletes, the resting heart rates have been reported

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[13] A. C. Guyton, Textbook of Medical Physiology (New York, 1966), pp. 551-552.

[14] D. W. Edington and V. R. Edgerton, The Biology of Physical Activity (Massachusetts, 1976), p. 338.

[15] D. G. Stuart and W. D. Collins, "Comparison of Vital Capacity and Maximum Breathing Capacity of Athletes and Nonathletes," Journal of Applied Physiology, XIV (1959), p. 507.

[16] J. H. Wilmore, Athlete Training and Physical Fitness: Physiological Principles and Practices of the Conditioning Process (Massachusetts, 1977), p. 58.

in the 28 to 40 beats per minute range.[17]

Raab considered heart rate as one of the most reliable of all physiological variables reflecting the efficiency of the bodily processes in response to exercise.[18]

Saltin reported physical training decreases the heart rate that occurs in the resting state and at each level of work.[19]

DeVries stated that the resting heart rate in adult females averages five to ten beats faster than adult males under any given set of conditions.[20]

Astrand, Astrand, and Rodahl indicated that a decrease in maximal heart rate with age would be expected to cause a reduction in the aerobic work capacity.[21]

Strength Studies

Wilmore stated that peak strength is usually attained by the age of 20 years in females and between 20 and 30 years in males. Strength remains relatively stable until the age of 35 to 45 years and

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[17] Wilmore, 1977, pp. 31-32.

[18] W. Raab, P. De Paula, E. Silva, and Y. K. Starcheska, "Adrenergie and Cholinergie Influences on the Dynamic Cycle of the Normal Heart," Cardiologia, XXXIII (1958), p. 350.

[19] B. Saltin, G. Blomquist, and J. H. Mitchell, "Response to Exercise After Bed Rest and After Training," Circulation, XXXVIII (1968), p. 74.

[20] DeVries, 1974, p. 104.

[21] I. Astrand, P. O. Astrand, and K. Rodahl, "Maximal Heart Rate During Work in Older Man," Journal of Applied Physiology, XIV (1955), p. 365.

then decreases gradually with increasing age.[22]

DeVries indicated that by 60 years of age, the male had lost not more than 10 to 20 percent of his maximum strength. The loss of strength with aging in the females appears to proceed at a slightly faster rate.[23]

Edington and Edgerton reported that the trainability of males and females appeared to differ. They also report that young adult males can improve their strength to a greater percent than young adult females.[24]

Flexibility Studies

McCue found that active individuals tended to be more flexible than inactive individuals did.[25]

Phillips agreed that among elementary school age children girls are superior to boys in flexibility. It is likely that this difference exists at all ages and throughout adult life.[26]

Buxton indicated 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.[27]

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[22] Wilmore, 1977, p. 192.

[23] DeVries, 1974, p. 379.

[24] Edington and Edgerton, 1976, p. 289.

[25] B. F. McCue, "Flexibility of College Women," Research Quarterly, XXIV (1953), p. 316.

[26] M. Phillips, "Analysis of Results From the Kraus-Weber Test of Minimum Muscular Fitness in Children," Research Quarterly, XXVI (1955), pp. 314-323.

[27] D. Buxton, "Extension of the Kraus-Weber Test," Research Quarterly, XXVIII (1957), pp. 210-217.

Treadmill Studies

Hermanson and Anderson investigated the endurance capacity of both sedentary and athletic college-age populations and found the athletic men and women to have the highest predicted maximum O_2 intake. While the athletic men were noticeably superior, the athletic women had values 25 percent greater than the sedentary man.[28]

Many studies have been published on the effect of physical training on maximal aerobic power. Wilmore reported that the maximal oxygen uptake increased six percent between the initial and final testing sessions.[29] Cureton and Phillips found an increase of 38 percent between the initial and final tests.[30]

Robinson tested a total of 79 male subjects, ranging in age from 6 to 75 years; for adults, there was a gradual decline in maximal O_2 consumption with age, the maximal values were found at mean age 17.4 years, and then declined to less than half those values of mean age 75.[31]

Skinfold and Circumference Measurement

Falls stated that the amount of fat in the body may well be the

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28 L. Hermanson and K. L. Anderson, "Aerobic Work Capacity in Young Norwegian Men and Women," Journal of Applied Physiology, XX (1965), pp. 425-437.

29 Wilmore, 1970, pp. 7-14.

30 T. K. Cureton and E. E. Phillips, "Physical Fitness Changes in Middle-Aged Men Attributable to Equal Eight-Week Periods of Training, Nontraining, and Re-Training," Journal of Sports Medicine, IV (1964), pp. 87-93.

31 S. Robinson, "Experimental Studies of Physical Fitness in Relation to Age," Arbeitsphysiologie, X (1938), pp. 251-323.

first consideration in evaluation of physical fitness.[33]

Myhre and Kessler indicated that the body weight and fatness increase with advancing age. Such an increase in fat was said to occur with a corresponding loss of active tissue cells which was accepted as a phenomenon of the physiological aging process.[34]

Wilmore reported that the 18 to 22-year-old female would average between 22 and 26 percent relative body fat, while the male of similar age would average between 12 and 16 percent. These differences were due to both a lower absolute lean weight and a higher absolute fat weight in the females.[35]

Moody, Kollias, and Buskirk reported that an exercise such as jog-walk combination was a feasible method for weight reduction in the obese even in the absence of any dietary restriction.[36]

Reaction Time Studies

Barbara stated that individual differences in speed of reaction is to a considerable extent dependent on neuromuscular co-ordination

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[33] H. F. Falls, Exercise Physiology (New York, 1968), p. 368.

[34] L. G. Myhre and W. V. Kessler, "Body Density and Potassium 40 Measurements of Body Composition as Related to Age," Journal of Applied Physiology, XXI (July, 1966), p. 1254.

[35] Wilmore, 1977, p. 181.

[36] D. L. Moody, J. Kollias, and E. R. Buskirk, "The Effect of a Moderate Exercise Program on Body Weight, and Skinfold Thickness in Overweight College Women," Medicine and Science in Sports, XVII (1969), pp. 74-80.

abilities.[37]

Philip and William reported that athletes possessed better reaction time than the non-athletes.[38]

Franklin reported that the average reaction time was slower in women than men and in younger subjects than adults.[39]

O_2 Saturation Studies

Lamb stated that the characteristics of blood are very important for aerobic endurance exercise. Since hemoglobin in the red blood cells carries oxygen, it is obvious that the number of red blood cells and the amount of hemoglobin in those cells are important in determining how much oxygen can be transported to the work muscles.[40]

Guyton found that normally about 97 percent of the oxygen transported from the lungs to the tissue was carried in chemical combination with hemoglobin in the red cells, and the remaining three percent carried in the dissolved state in the water of the plasma and cell.[41]

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[37] N. K. Barbara, "Simple Reaction Time of Selected Topclass Sportmen and Research Students," Research Quarterly, XXXII (1961) pp. 409-412

[38] J. R. Philip and R. P. William, "Reaction and Movement Time of Experienced Karataka," Research Quarterly, XXXIV (1963), pp. 242-243.

[39] H. M. Franklin, "Stimulus Complexity, Movement Complexity, Age, and Sex in Relation to Reaction Latency and Speed in Limb Movements," Research Quarterly, XXXII (1961), p. 365.

[40] D. R. Lamb, Physiology of Exercise-Responses and Adaptations (New York, 1978), pp. 215-219.

[41] Guyton, 1966, p. 518.

Electrocardiogram Studies

Pollock stated that it would be desirable for all persons to have a complete physical examination including a 12 lead resting and exercise ECG prior to their physical fitness evaluation.[42]

Tharp reported that athletes had higher amplitude of the R and T waves than ordinary subjects of the same age and environment. This indicates that the amplitude of R and T waves can be used to indicate circulatory fitness.[43]

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[42]M. L. Pollock, J. H. Wilmore, and S. M. Fox, Health and Fitness Through Physical Activity (New York, 1978), p. 76.

[43]G. Tharp, "Cardiac Function Tests as Indexes of Fitness," Research Quarterly, XL (1961), pp. 818-822.

CHAPTER III

METHODS AND PROCEDURE

The purpose of this study was to compare the physical fitness of males of the Oklahoma State University faculty and the commercial subjects in the state of Oklahoma. The methods and the procedure are listed as follows: (1) selection of subjects; (2) personal data collected; (3) administration of the test and treatment of data.

Selection of Subjects

Three hundred and eight males and females participated in this comparison. Sixty four males and females were retest subjects. Subjects were volunteers from the Oklahoma State University faculty and the commercial subjects from the state of Oklahoma.

The subjects' age ranged from 17 to 73 years. The physiological characteristics of subjects ranged widely. The subjects varied in age, weight, height, levels of physical fitness, and anthropometric measures.

Subjects from the Oklahoma State University faculty were involved in a longitudinal study which is being conducted by A. B. Harrison. The other subjects were the commercial subjects from around the state of Oklahoma. There were subjects from Blackwell, Duncan, Shawnee, Ponca City, Yale, Pawhuska, Cushing, Thomas, Guthrie, Altus, Broken Arrow, Cherokee, Chickasha, Cordell, Tulsa, Watonga, and Yukon.

The evaluation of physical fitness for the faculty took place in the physiology lab which is located in the Colvin Center. The evaluation of physical fitness for the commercial groups took place in the Mobile Laboratory in the local communities. Evaluations and collecting the data were done by A. B. Harrison and his staff. All the subjects' data were collected during the 1979-1980 school year.

Personal Data Collected

Each subject was asked to give information about age, medical history, and current physical activities (see Appendix A).

Administration of the Test

All testing instruments were prepared and checked before the arrival of the subjects. Subjects arrived dressed in shorts and sport shoes. An informed consent was signed by the subject (see Appendix E). The sequence of the evaluations for the faculty was as follows: (1) the body circumference, (2) the skinfold measurements, (3) the pulmonary function measurements, (4) recording of resting heart rate and blood pressure, (5) recording of resting electrocardiogram, and (6) the Balke Treadmill test. The sequence of the evaluations for the commercial subjects was as follows: (1) recording of resting heart rate blood pressure, (2) recording of resting electrocardiogram, (3) the body circumference measurements, (4) the skinfold measurements, (5) the pulmonary function measurements, (6) O_2 saturation, (7) reaction time and vertical jump reaction time tests, (8) grip and leg strength tests, (9) flexibility test, and (10) the Balke Treadmill test.

Recording of Resting Heart Rate

The subject lay down on a table and relaxed for about five minutes. The physiograph was used for recording the resting heart rate of the subject. Two telemetry electrodes and a transmitter were used to transfer the signal to the physiograph. The first electrode was placed over the subject's upper sternum. The second electrode was placed below and two inches to the left side of the left nipple. The subject's resting heart rate was recorded for 10 seconds. The result was multiplied by six to get a one minute heart rate.

Recording of Resting Blood Pressure

The subject's resting blood pressure was measured by a stethoscope and a mercury sphygmomanometer. The inflating rubber cuff was wrapped around the upper right arm, and the stethoscope was placed over the brachial artery below the cuff. The cuff pressure was inflated up to 180 mm. Hg. The cuff pressure was lowered slowly by the pressure release knob. The first sound which was heard was the systolic pressure. The last sound which was heard was the diastolic pressure. This procedure was done at least twice to acquire a stable value.

Resting Cardiogram

A Birtcher Electrocardiograph Model 344 was used to record the electrocardiogram. The electrode plates were put on the subject's right wrist, left wrist, right ankle, and left ankle. The electrode plates were indicated respectively as RA, LA, RL, and LL. The suction cups were put on the subject's chest from lead V1 to V6. The suction cups indicate the lead number 1 to 6. This study was concerned with the R and T wave and the rest/work ratio. An example of those measured is shown in Appendix I.

The Body Circumference Measurements

The body circumference was measured with a flexible metal anthropometric tape. The segments of the body measured were the shoulders, chest, abdomen, buttocks, right and left thights, right and left biceps, right and left forearms, right and left wrists, right and knees, right and left calves, and right and left ankles. Each measurement was recorded in centimeters and entered in ananalysis of body build sheet (see Appendix D). The results were calculated to determine the predicted weight of each subject. The weight residual was computed by determining the difference between actual weight with predicted weight.

The Skinfold Measurements

A Lange Skinfold Fat Caliper was used to measure skinfold thickness of both males and females. The chest, arm, and abdomen were used to obtain skinfold thickness for males and iliac and arm were used to obtain skinfold thickness for females. The technique for obtaining the skinfold thickness was as follows: the skinfold was grasped firmly by the thumb and index finger and the caliper was placed on the exact site one half to one inch from the thumb and finger. The chest skinfold was taken at the oblique fold halfway from nipple to anterior axillary fold on the line joining these. The triceps skinfold was taken at the vertical fold in the posterior midline of the arm halfway from acromion to olecranon processes. The abdominal skinfold was taken at the horizontal fold on the anterior abdominal wall just to the right of the unbilicus. The iliac skinfold was taken at the vertical fold over the iliac crest in midaxillary line. All of the measurements were taken on the right side of the body. The data was converted to specific gravity and percent of body fat (see Appendix B for male and Appendix C for female).

The Pulmonary Function Measurements

The Collins Nine-Liter Respirometer was used to measure the vital capacity and timed vital capacity. The respirometer was flushed and filled with pure oxygen. The ventilometer pen was set by pulling out on the ventilometer clutch and turning. The ventilometer pen (red) was set at $1\frac{1}{2}$-2 liters. The two pens were adjusted so that they were one vertical line apart on the Kymograph paper. The speed of the rotating drum was set at 32 mm/min. The subject was seated and relaxed while performing the test. The subject was instructed as how to breathe through the apparatus. The mouth piece was fitted so that the subject's lips covered the outer ring. A nose clip was placed on the subject. The subject breathed normally into the apparatus for three minutes. The O_2 intake of the subject was calculated from the Kymograph reading by subtracting the figure of the first minute from the third minute. This score was multiplied by a correction factor to express the volume in STPD (standard temperature, pressure and atmospheric humidity) and divided by three to obtain one minute.

Sample Calculation:

Third minute	=	3750
First minute	=	2850
Difference	=	900
900 x .9	=	810
810 - 3	=	270 or .27 L

At the end of three minutes, the subject was told to inhale and exhale as much as possible all in one breath. This was the vital capacity test. Each subject's record was calculated from the Kymograph reading by subtracting the figure of exhaling phase (bottom single breath) from the figure of inhaling phase (top single breath). This score was multiplied by a correction factor to express the volume in BTPS (body temperature, air pressure, and saturation with water). The figure of 1.085 (for 23 degree centigrade) was used as the temperature correction factor for the reading.

Sample Calculation:

Inhaling phase	=	4250
Exhaling phase	=	550
Difference	=	3700
3700 x 1.085	=	4014.5 or 4.02 L (BTPS)

The obtained vital capacity was then compared with the norms.

After the vital capacity test and after several normal breaths, the subject was asked to take a maximal inspiration and hold. The speed of the drum was set immediately to 1920 mm/min. and the subject was instructed to force out all the air as fast as possible. This was the timed vital capacity test. This score was also calculated and compared with the norms.

The Collins 100-Liter Tissot tank was used to measure maximum breathing capacity. Each subject was instructed to breathe forcefully and deeply into the mouthpiece at a rate of approximately one breath per second. The test was given in the standing position with a nose clip attached to the subject's nose. The subject was given two trials with one minute rest in between. The best effort was recorded as maximal breathing capacity.

The maximal breathing capacity was measured as liters per minute. Each subject's record was measured by subtracting the final reading from the initial reading on the kymograph drum. The score was multiplied by the constant factor of 1.332 for the Tissot tank and this score was then multiplied by 1.085 to obtain the corrected liters per minute (BTPS).

Sample Calculation:

Starting	=	720 mm.
Read out	=	450 mm.
Difference	=	270
Multiply	=	4
270 x 4	=	1080 mm/min.
1080 x 1.332	=	1438.56 mm/min.
1438.56 x 1.085	=	1560.84 mm/min.
		or 1.56 L/min. (BTPS)

The obtained maximal breathing capacity volume (BTPS) was then compared with the expected norm for individuals' height, weight, and age to determine the residual.

O_2 Saturation

A Waters X-350 Oximeter was utilized to measure the oxygen saturation in the subject. The subject sat on a chair in front of the oximeter. The control unit, earpiece, and power cord were connected. The master power switch was set to E position and the selector switch to amp balance. The system was allowed to stabilize for at least 15 minutes. The earpiece was placed on the subject's ear. The selector switch was turned to amp balance position and adjusted until the meter read 100. The pressure capsule was inflated to 200 mm Hg. The selector switch was turned to E gain position and adjusted until the meter read 40. With the pressure still up, the selector switch was turned to sat position and adjusted until the meter read 76 on the 0 to 100 percent scale. The selector switch was turned to operate and the oxygen saturation of the subject was read.

Reaction Time and Vertical Jump Reaction Time

The Dekan Timer (The Automatic Performance Analyzer) was used to measure the reaction time of the subject. Ten trials were given to the subject. The subject stood with his finger touching the response key and the stimulus unit was on the desk behind him. The instructions and demonstrations were made as simple as possible. The subject was permitted to hold the response key in any position he felt most comfortable for operation. Two practice trials were given, followed by 10 trials. The foreperiod time (the period of waiting for the sound stimulus) was varied to avoid anticipation on the part of the subject. This time was kept between one to four seconds. The equipment recorded the interval between the presentation of the stimuli and the push of the key (stop the time). Movement time was therefore excluded from this study and reaction time only was measured. The results were recorded in 1/100 of second. The mean of the final five trials was recorded as reaction time.

Vertical jump reaction time was administered the same as the reaction time except in the manner of stopping the time. The subject was asked to stand with both feet on a switch mat. At the sound of the buzzer, the subject jumped and lifted both feet off the mat. Then the clock was stopped. Ten trials were given and the final five were averaged to obtain vertical jump reaction time.

Hand Grip and Leg Strength Tests

A hand dynamometer was used to measure the grip strength of the subject. The dynamometer was adjusted as comfortably as possible according to the subject's hand size. The subject grasped and pressed the dynamometer as hard as possible. Two trials were given on both right and left hands of the subject. The results were recorded in pounds (lbs) from the best effort.

A cable tensiometer was used to measure the leg strength of the subject. The subject sat on the edge of a table with both hands placed flat on the table. A canvas loop attached to the tensiometer cable was put around the subject's ankle. The subject was told to push his leg forward as hard as possible and not to push against the table with the hands or jerk his leg while pushing forward. Two trials were given on both right and left legs of the subject. The results were recorded in pounds (lbs) from the best effort of the two trials.

Flexibility Test

The sit and reach test was used to determine flexibility at the hip joint. The subject sat with the legs extended directly in front of him and the knees pressed against the floor. The feet were placed against a box to which was attached a yardstick, with the 14-inch mark being placed at the point where the feet contacted the box. The subject placed the index fingers of both hands together and reached forward slowly as far as possible. The distance reached was noted on the yardstick and recorded. The knees were kept in contact with the floor and bouncing was discouraged. The results were recorded in inches. The smaller the number, the better the flexibility.

The Balke Treadmill Test

The treadmill was calibrated for exact speed before the subject started to walk. The subject was instructed to grasp the side rails of the treadmill and place his right foot on and off to get used to the moving belt. The subject was instructed to release his hand from the rails and walk at normal stride. The speed of the treadmill was set at 3.4 miles per hour for males (see Appendix F) and 3.0 miles per hour for females (see Appendix G). The treadmill was raised two percent after the first minute and one percent for each minute thereafter. The subject was asked to terminate the treadmill walk if any irregularities were produced in the EKG in the form of arrythmias or S-T depression. The subject could stop the test at any time they felt that they had reached their maximal work load or exhaustion point. The subject's heart rate was determined by the biotachometer attached to the EKG machine. At the termination, the length of time the subject walked and the grade of the treadmill were recorded together with the final heart rate.

The predicted maximal oxygen intake in ml/kg/min. was determined from the Balke's regression equation and the score was entered into Cooper's chart for age-adjusted fitness level (see Appendix H).

Treatment of Data

The program for the statistical analysis of the data in this study was run at the Oklahoma State University Computer Center.

The statistical treatment was organized to analyze the data, as presented in separate categories listed by steps.

Step one was to compare the means of the physiological variables between males of the Oklahoma State University faculty and males of the commercial group.

Step two was to compare the mean change with age increased one year of the physiological variables among all males tested.

Step three was to compare the means of the physiological variables between males and females of the commercial group.

Step four was to compare the mean change with age increased one year of the physiological variables among males and females of the commercial group.

In steps one through four, the Analysis of Variance were used to determine if there were any differences on the selected variables. The "F" test was used to determine if there were any significant differences at the .01 and .05 percent level on the selected variables.

Step five was to compare the means of the physiological variables between females of three different communities in the commercial group.

Step six was to compare the means of the physiological variables between males of eight different communities in the commercial group.

Step seven was to compare the means of the physiological variables between males of nine different professions in the commercial group.

In steps five through seven, the Analysis of Variance and Duncan's Multiple Range Test were used to determine if there were any differences on the selected variables. The "F" test was used to determine if there were any significant differences at the .01 and .05 percent level on the selected variables.

Step eight was to compare the means of a list of variables in the study contrasting the test and the retest in an attempt to ascertain if any changes had occurred among sixty-four subjects from the commercial group. A paired comparison test was used to analyze the change. The results of the "F" test were used to determine if there were any significant changes at the .01 and .05 percent level on the selected variables.

CHAPTER IV

ANALYSIS OF DATA AND DISCUSSION OF RESULTS

The purpose of this study was to compare the physical fitness levels of the Oklahoma State University faculty (N = 62) with those of the commercial group (N = 308) which were tested in the Mobile Lab program. The results of the study are recorded in this chapter.

The complete statistical analysis was undertaken at the Oklahoma State University Computer Center under the direction of Dr. Robert Morrison.

Since the names of all variables were abbreviated prior to being programmed into the computer, it is necessary to define all such abbreviated variables before explaining each statistical hypothesis.

Table I is a list of all abbreviated variables with a full explanation of those abbreviations.

The physiological variables which were used in step one and two were the weekly aerobic points total, the lying systolic blood pressure, the lying diastolic blood pressure, the resting O_2 intake, the timed vital capacity, the vital capacity, the maximum breathing capacity, the amplitude of the R wave, the amplitude of the T wave, the rest-work ratio, the weight residual, the predicted maximum O_2 intake, and the lying pulse rate.

TABLE I

EXPLANATION OF ABBREVIATION

Abbreviation	Definition
Aerobic	Aerobic points
BPLy-Sys	Lying systolic blood pressure, mm. Hg.
BPLy-Dia	Lying diastolic blood pressure, mm. Hg.
O_2 Intake	Resting O_2 intake, L/min.
TVC	Timed vital capacity, percent of norm
VC	Vital capacity, percent of norm
MBCpct	Maximum breathing capacity, percent of norm
AMp-R	Amplitude of the R wave as seen in the EKG, mm.
AMp-T	Amplitude of the T wave as seen in the EKG, mm.
Restwork	Rest-work ratio from the EKG, mm.
Wt-Res	Weight residual, lbs.
Ml-Kg	milliters per kilogram, ml. kg. min.
Lying	Lying pulse rate, bpm.
Gripstrg	Grip strength, lbs.
Legstrg	Leg strength, lbs.
Flex	Flexibility, inches
Pushstr	Push strength, lbs.
Pullstr	Pull strength, lbs.
SRTAudio	Reaction time to sound, sec.
VJRT	Vertical jump reaction time, sec.
O_2 Sat	Oxygen saturation, percent

Step one in the statistical analysis was to compare the means of the physiological variables in the study between males of the Oklahoma State University faculty, and males of the commercial group. Wilmore has shown that physical activity tends to decrease significantly with increasing age.[1] Since the commercial group has a mean age of 45 years and the faculty group has a mean age of 50 years, the commercial group might be expected to have better physical fitness than the faculty group. According to DeVries, regular exercise training will improve physical condition.[2] The faculty group seems to exercise more habitually than the commercial group probably because of the availability of exercise facilities on the campus. In addition, the faculty group has taken a part in an annual exercise testing program as a part of research which has been conducted by A. B. Harrison.

The analysis of variance procedure was used to test for the significance of differences between means. The results of the "F" test applied to each variable for step one are shown in Tables II through Table XIV.

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[1]Wilmore, 1977, p. 189-196.

[2]DeVries, 1974, p. 241.

TABLE II

COMPARISON OF WEEKLY AEROBIC POINTS TOTAL

Group	N	Mean	MS	df	F
Faculty Group	62	29.58			
Commercial Group	222	7.12			
			24446.01	1	18.12**

TABLE III

COMPARISON OF LYING SYSTOLIC BLOOD PRESSURE

Group	N	Mean (mm Hg)	MS	df	F
Faculty Group	62	123.69			
Commercial Group	222	130.95			
			2549.11	1	11.53**

TABLE IV

COMPARISON OF LYING DIASTOLIC BLOOD PRESSURE

Group	N	Mean (mm Hg)	MS	df	F
Faculty Group	62	72.32			
Commercial Group	222	83.32			
			1743.13	1	16.56**

*$P < .05$

**$P < .01$

TABLE V

COMPARISON OF RESTING O_2 INTAKE

Group	N	Mean (L/min.)	MS	df	F
Faculty Group	59	0.36			
Commercial Group	220	0.37			
			0.00	1	0.00^{NS}

TABLE VI

COMPARISON OF TIMED VITAL CAPACITY

Group	N	Mean (%)	MS	df	F
Faculty Group	60	81.62			
Commercial Group	218	80.73			
			36.66	1	0.27^{NS}

TABLE VII

COMPARISON OF VITAL CAPACITY

Group	N	Mean (%)	MS	df	F
Faculty Group	62	120.86			
Commercial Group	220	109.73			
			5984.26	1	19.49**

*$P < .05$

**$P < .01$

TABLE VIII

COMPARISON OF MAXIMUM BREATHING CAPACITY

Group	N	Mean (%)	MS	df	F
Faculty Group	62	133.45			
Commercial Group	218	103.37			
			43676.45	1	69.79**

TABLE IX

COMPARISON OF AMPLITUDE OF THE R WAVE

Group	N	Mean (mm)	MS	df	F
Faculty Group	62	10.56			
Commercial Group	222	8.79			
			152.06	1	12.70**

TABLE X

COMPARISON OF AMPLITUDE OF THE T WAVE

Group	N	Mean (mm)	MS	df	F
Faculty Group	62	2.71			
Commercial Group	222	2.12			
			16.59	1	21.27**

*$P < .05$

**$P < .01$

TABLE XI

COMPARISON OF REST-WORK RATIO

Group	N	Mean (mm)	MS	df	F
Faculty Group	62	1.89			
Commercial Group	222	1.74			
			1.11	1	9.25**

TABLE XII

COMPARISON OF WEIGHT RESIDUAL

Group	N	Mean (lbs)	MS	df	F
Faculty Group	58	8.95			
Commercial Group	219	15.46			
			1942.38	1	9.18**

TABLE XIII

COMPARISON OF PREDICTED MAXIMUM O_2 INTAKE

Group	N	Mean (ml/kg/min)	MS	df	F
Faculty Group	61	42.20			
Commercial Group	218	34.76			
			2638.21	1	72.44**

*$P < .05$

**$P < .01$

TABLE XIV

COMPARISON OF LYING PULSE RATE

Group	N	Mean (bpm)	MS	df	F
Faculty Group	62	64.68			
Commercial Group	222	71.23			
			2083.59	1	16.73**

*P < .05

**P < .01

Table II shows that there was a significant difference at the .01 level in the weekly aerobic points total between males of the faculty group and males of the commercial group. The mean weekly aerobic points total of the faculty group (29.58) was higher than the commercial group (7.12). This indicates that the faculty group did exercise more than the commercial group did and should have better physical fitness than the commercial group.

Tables III and IV show that there were significant differences at the .01 level in the lying systolic and diastolic blood pressure between males of the faculty group and males of the commercial group. The mean lying systolic and diastolic blood pressure of the faculty group (123.69 mm Hg. and 77.32 mm Hg. respectively) were lower than the commercial group (130.95 mm Hg. and 83.32 mm Hg. respectively). Pollock indicated that the blood pressure may be lowered by an exercise training program.[3]

Tables IX and X show that there were significant differences at the .01 level in the amplitude of the R and T waves between males of the faculty group and males of the commercial group. The means of the amplitude of the R and T waves of the faculty group (10.56 mm and 2.71 mm respectively) were higher than the commercial group (8.79 mm and 2.12 mm respectively). Wolf stated that the height of the R and T waves can also be increased by an exercise training program.[4]

Table XI shows that there was a significant difference at the .01 level in the rest-work ratio between males of the faculty group and males of the commercial group. The mean of the rest-work ratio of the faculty group (1.89 mm) was larger than the commercial group (1.74 mm). Cureton stated that the higher figure of the rest-work ratio generally indicates a more efficient heart.[5]

Tables VII and VIII show that there was a significant difference at the .01 level in the vital capacity and maximum breathing capacity between males of the faculty group and males of the commercial group. The means of the vital capacity and maximum breathing capacity of the faculty group (120.86% and 133.45% respectively) were higher than the commercial group (109.73% and 103.37% respectively). Mathews reported that the higher the vital capacity and maximum breathing capacity, the more efficient the respiration function, and those variables may

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[3]Pollock, 1971, p. 126.

[4]J. G. Wolf, "Effects of Posture and Muscular Exercise on the Electrocardiogram," Research Quarterly, XXIV (1953), p. 488.

[5]T. K. Cureton, Physical Fitness of Champion Athletes (Illinois, 1951, p. 151.

slightly increase by an exercise training program.[6]

Table XII shows that there was a significant difference at the .01 level in the weight residual between males of the faculty group and males of the commercial group. To estimate body weight for each subject, an anthropometric tape was utilized at selected sites on the body. The results of the anthropometric tape measurements yielded the mean of 8.95 pounds overweight for the faculty group and 15.46 pounds overweight for the commercial group. This indicates that the commercial group was more overweight than the faculty group.

Table XIII shows that there was a significant difference at the .01 level in the predicted maximum O_2 intake between males of the faculty group and males of the commercial group. The mean of the predicted maximum O_2 intake of the faculty group (42.20 ml. kg. min.) was higher than the commercial group (34.76 ml. kg. min.). Astrand and Rodahl indicated that an exercising individual has higher treadmill scores than a non-exercising individual.[7]

Table XIV shows that there was a significant difference at the .01 level in the lying pulse rates between males of the faculty group and males of the commercial group. The mean of the lying pulse rates of the faculty group (64.68 beats per min.) was lower than the commercial group's (71.23 beats per min.). Wilmore found that the persons with good physical fitness have lower resting pulse rates than those with poor physical fitness. The resting pulse rates may also be

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[6]Mathews, 1964, p. 330.

[7]Astrand, 1970, p. 356.

lowered by an exercise training program.[8]

There were no significant differences observable in the resting O_2 intake (Table V) and the timed vital capacity (Table VI) between males of the faculty group and males of the commercial group. The literature generally indicated that there was very little or no effect of exercising training on the respiratory response.

Although the mean age of the commercial group (45 years) was lower than the faculty group (50 years), most of the physiological variables of the faculty group were significantly better than those of the commercial group. The results show that the faculty group exercised significantly more than the commercial group did. According to the mean weekly aerobic points total, the commercial group can be classified as sedentary and the faculty group as moderately active. The faculty scored significantly better on most of the cardiovascular fitness tests (weekly aerobic points total, lying systolic and diastolic blood pressure, vital capacity, maximum breathing capacity, amplitude of the R and T waves, rest-work ratio, weight residual, predicted maximum O_2 intake and lying pulse rate).

Step two in the statistical analysis was to calculate an analysis of variance to determine whether there was a significant mean change as the mean age increased one year of the physiological variables among all males tested. This is a cross sectional analysis. Edington and Edgerton found that as people grow older, the physical activity tended to decrease.[9] Tables XV and XVI present an analysis of variance of mean change as the mean age increased one year of the

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[8]Wilmore, 1977, p. 54.

[9]Edington and Edgerton, 1976, p. 338.

TABLE XV

ANALYSIS OF VARIANCE OF MEAN CHANGE AS MEAN AGE INCREASED ONE YEAR OF THE PHYSIOLOGICAL VARIABLES AMONG ALL MALES TESTED

Source	Aerobic	BPLy-Sys	BPLy-Dia	O_2Intake	TVC	VC
Common Slope Change per year	-0.30	0.11	0.13	0.00	-0.10	-0.45
Common Slope F	1.73	1.46	4.33*	1.00	1.82	17.01**
Parallelism F	0.06	0.04	0.46	0.00	0.19	0.00
Faculty Slope Change per year	-0.41	0.08	0.05	0.00	-0.17	-0.47
Commercial Slope Change per year	-0.27	0.12	0.16	0.00	-0.08	-0.45

TABLE XVI

ANALYSIS OF VARIANCE OF MEAN CHANGE AS MEAN AGE INCREASED ONE YEAR OF THE PHYSIOLOGICAL VARIABLES AMONG ALL MALES TESTED

Source	MBCpct	AmpR	AmpT	Restwork	WtRes	Ml-kg	Lying
Common Slope Change per year	0.01	-0.09	-0.02	0.00	-0.04	-0.29	-0.16
Common Slope F	0.00	18.49**	11.83**	1.17	0.18	56.51**	5.34*
Parallelism F	0.00	0.78	0.05	2.50	0.04	1.40	1.13
Faculty Slope Change per year	0.02	-0.13	-0.02	0.01	0.00	-0.38	-0.31
Commercial Slope Change per year	0.00	-0.08	-0.02	0.00	-0.05	-0.26	-0.12

*$P < .05$

**$P < .01$

physiological variables among all males tested. Tables XVII and XVIII also present the individual slope of the physiological variables of both the faculty and the commercial group.

TABLE XVII

COMPARISON OF WEEKLY AEROBIC POINTS TOTAL

Group	N	Mean	MS	df	F
Males	222	7.12			
Females	86	1.92			
			1678.07	1	3.04^{NS}

TABLE XVIII

COMPARISON OF LYING SYSTOLIC BLOOD PRESSURE

Group	N	Mean (mm Hg)	MS	df	F
Males	222	130.95			
Females	86	118.08			
			10258.64	1	50.95**

*P < .05

**P < .01

The slope of the lying diastolic blood pressure of all males increased .13 mm Hg. (P < .05) as the mean age increased one year.

The slope of the vital capacity of all males decreased .45% ($P < .01$) as the mean age increased one year.

The slope of the amplitude of the R wave of all males decreased .09 mm ($P < .01$) as the mean age increased one year.

The slope of the amplitude of the T wave of all males decreased .02 mm ($P < .01$) as the mean age increased one year.

The slope of the predicted maximum O_2 intake of all males decreased .29 ml. kg. min. ($P < .01$) as the mean age increased one year.

The slope of the lying pulse rates of all males decreased .16 beats per min. ($P < .05$) as the mean age increased one year.

These data show that aging is apparently a factor of deterioration on those physiological variables. However, the decrease in pulse rate is a trend in the opposite direction from that expected.

There were no significant changes in the slopes of the aerobic points, the lying systolic blood pressure, the resting O_2 intake, the timed vital capacity, the maximum breathing capacity, the rest-work ratio, and the weight residual of all males as the mean age increased one year.

The physiological variables which were used in step three through nine were the weekly aerobic points total, the lying systolic blood pressure, the lying diastolic blood pressure, the resting O_2 intake, the timed vital capacity, the vital capacity, the maximum breathing capacity, the amplitude of the R wave, the amplitude of the T wave, the rest-work ratio, the weight residual, the predicted maximum O_2 intake, the lying pulse rate, the grip strength, the leg strength, the the push strength, the pull strength, the vertical jump reaction time, the reaction time to sound, the flexibility, and the O_2 saturation.

Step three in the statistical analysis was to compare the means of the physiological variables in the study between males and females of the commercial group. Pollock, Wilmore, and Fox indicate that up to the point of puberty, there are essentially no differences between males and females for practically all aspects of physiological variables. Beyond puberty, the males become considerably stronger in upper body strength, have greater power, muscular and cardiorespiratory endurance.[10] Since males and females of the commercial group had the mean age of 45 and 43 years respectively, differences among those physiological variables would be expected to occur between the sexes in the study.

The analysis of variance procedure (ANOVA) was used to test for the significance of differences between means. The results of the "F" test applied to each variable for step three is shown in Tables XVII through XXXVIII.

TABLE XIX

COMPARISON OF LYING DIASTOLIC BLOOD PRESSURE

Group	N	Mean (mm Hg)	MS	df	F
Males	222	83.32			
Females	86	76.40			
			2972.17	1	27.51**

*P $<$ .05

**P $<$ .01

[10]Pollock, 1971, p. 126.

TABLE XX

COMPARISON OF RESTING O_2 INTAKE

Group	N	Mean (L/min)	MS	df	F
Males	220	0.37			
Females	85	0.32			
			0.12	1	12.00**

*P < .05

**P < .01

TABLE XXI

COMPARISON OF TIMED VITAL CAPACITY

Group	N	Mean (%)	MS	df	F
Males	218	80.73			
Females	86	81.06			
			6.48	1	0.04^{NS}

TABLE XXII

COMPARISON OF VITAL CAPACITY

Group	N	Mean (%)	MS	df	F
Males	220	109.73			
Females	85	98.08			
			478.16	1	3.72*

*P < .05

**P < .01

TABLE XXIII

COMPARISON OF MAXIMUM BREATHING CAPACITY

Group	N	Mean (%)	MS	df	F
Males	218	103.37			
Females	86	97.62			
			2042.74	1	3.59*

*P < .05

**P < .01

TABLE XXIV

COMPARISON OF AMPLITUDE OF THE R WAVE

Group	N	Mean (mm)	MS	df	F
Males	222	8.79			
Females	86	9.44			
			26.64	1	2.27^{NS}

TABLE XXV

COMPARISON OF AMPLITUDE OF THE T WAVE

Group	N	Mean (mm)	MS	df	F
Males	222	2.12			
Females	86	1.97			
			1.38	1	1.94^{NS}

TABLE XXVI

COMPARISON OF REST-WORK RATIO

Group	N	Mean (mm)	MS	df	F
Males	222	1.74			
Females	86	1.61			
			1.09	1	9.08**

*P < .05

**P < .01

TABLE XXVII

COMPARISON OF WEIGHT RESIDUAL

Group	N	Mean (lbs)	MS	df	F
Males	219	15.46			
Females	83	11.27			
			1057.47	1	5.44*

*P < .05

**P < .01

TABLE XXVIII

COMPARISON OF PREDICTED MAXIMUM O_2 INTAKE

Group	N	Mean (ml/kg/min)	MS	df	F
Males	218	34.76			
Females	86	27.93			
			2874.06	1	90.72**

TABLE XXIX

COMPARISON OF LYING PULSE RATE

Group	N	Mean (bpm)	MS	df	F
Males	222	71.23			
Females	86	74.01			
			478.16	1	3.72*

TABLE XXX

CONPARISON OF GRIP STRENGTH

Group	N	Mean (lbs)	MS	df	F
Males	222	118.37			
Females	85	64.41			
			178982.82	1	566.83**

*$P < .05$

**$P < .01$

TABLE XXXI

COMPARISON OF LEG STRENGTH

Group	N	Mean (lbs)	MS	df	F
Males	221	118.76			
Females	85	63.98			
			184242.70	1	343.92**

TABLE XXXII

COMPARISON OF PUSH STRENGTH

Group	N	Mean (lbs)	MS	df	F
Males	221	109.33			
Females	83	50.61			
			208053.27	1	321.63**

TABLE XXXIII

COMPARISON OF PULL STRENGTH

Group	N	Mean (lbs)	MS	df	F
Males	222	88.11			
Females	83	46.63			
			103976.83	1	338.92**

*$P < .05$

**$P < .01$

TABLE XXXIV

COMPARISON OF VERTICAL JUMP REACTION TIME

Group	N	Mean (sec)	MS	df	F
Males	222	0.32			
Females	85	0.36			
			0.1228	1	43.86**

TABLE XXXV

COMPARISON OF REACTION TIME TO SOUND

Group	N	Mean (sec)	MS	df	F
Males	221	0.17			
Females	85	0.20			
			0.0642	1	45.86**

TABLE XXXVI

COMPARISON OF FLEXIBILITY

Group	N	Mean (inches)	MS	df	F
Males	222	11.49			
Females	81	9.44			
			248.56	1	19.49**

*$P < .05$

**$P < .01$

TABLE XXXVII

COMPARISON OF O_2 SATURATION

Group	N	Mean (%)	MS	df	F
Males	219	95.62			
Females	83	96.25			
			23.87	1	11.64**

*P < .05

**P < .01

TABLE XXXVIII

ANALYSIS OF VARIANCE OF MEAN CHANGE AS MEAN AGE INCREASED ONE YEAR OF THE PHYSIOLOGICAL VARIABLES OF BOTH MALES AND FEMALES OF THE COMMERCIAL GROUP

Source	Aerobic	BPLy-Sys	BPLy-Dia	O_2Intake	TVC	VC	MBCpct
Common Slope Change per year	-0.19	0.19	0.19	0.00	-0.03	-0.29	0.05
Common Slope F	1.92	5.01*	9.81**	1.00	0.20	7.53**	0.15
Parallelism F	0.87	1.50	0.85	0.00	1.19	5.18*	0.32
Male Slope Change per year	-0.27	0.12	0.16	0.00	-0.08	-0.45**	0.00
Female Slope Change per year	0.01	0.35	0.28	0.00	0.09	0.09	0.00

*P < .05

**P < .01

Tables XVIII and XIX show that there were significant differences at the .01 level in the lying systolic and diastolic blood pressure between males and females of the commercial group. The means of the lying systolic and diastolic blood pressure of the male group (130.95 mm Hg. and 83.32 mm Hg. respectively) were higher than the female group's (118.08 mm Hg. and 76.40 mm Hg. respectively). Paffenbarger stated that the average lying systolic and diastolic blood pressure of the female is lower than those of the male.[11]

Tables XX and XXII show that there were significant differences at the .01 level in the resting O_2 intake and the vital capacity between males and females of the commercial group. The means of the resting O_2 intake and vital capacity of the male group (.37 L/min. and 109.73 percent respectively) were higher than the female group's (0.32 L/min. and 98.08 percent respectively). DeVries reported that the resting O_2 intake and the vital capacity of the male were higher than those of the female because the male body size was larger than the females.[12]

Table XXIII shows that there was a significant difference at the .05 level in the maximum breathing capacity between males and females of the commercial group. The mean of the maximum breathing capacity of the male group (103.37 percent) was higher than that of the female group (97.62 percent).

Table XXVI shows that there was a significant difference at the .01 level in the rest-work ratio between males and females of the commercial group. The mean of the rest-work ratio of the male group (1.74

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[11]Paffenbarger, 1968, pp. 25-32.

[12]DeVries, 1974, p. 479.

mm) was larger than that of the female group (1.61 mm).

Table XXVII shows that there was a significant difference at the .05 level in the weight residual between males and females of the commercial group. The mean of the weight residual of the male group (15.46 lbs.) was higher than the female group's (11.27 lbs.). The result shows that the male group has more excess fat.

Table XXVIII shows that there was a significant difference at the .01 level in the predicted maximum O_2 intake between males and females of the commercial group. The mean of the predicted maximum O_2 intake of the male group (34.76 ml. kg. min.) was higher than the female group's (27.93 ml. kg. min.). Edington and Edgerton stated that maximum O_2 consumption rate of the males are higher than the females. This difference is generally reported to be around 25 percent.[13]

Table XXIX shows that there was a significant difference at the .05 level in the lying pulse rate between males and females of the commercial group. The mean of the lying pulse rate of the male group (71.23 bpm) was lower than the female group's (74.01 bpm).

Tables XXX, XXXI, XXXII, and XXXIII show that there were significant differences at the .01 level in the grip leg, push, and pull strength between males and females of the commercial group. The mean of the grip, leg, push, and pull strength of the male (118.37 lbs., 118.76 lbs., 109.33 lbs., and 88.11 lbs. respectively) were higher than the female group (64.41 lbs., 63.98 lbs., 50.61 lbs., and 46.63 lbs. respectively). Wilmore indicated that the average males had muscle strength approximately 30 to 40 percent more than the average

[13]Edington and Edgerton, 1976, p. 290.

females.[14]

Tables XXXIV and XXXV show that there were significant differences at the .01 level in the vertical jump reaction time and the reaction time to sound between males and females of the commercial group. The means of the vertical jump reaction and the reaction time to sound of the male group (.32 second and .17 second respectively) were shorter than the female group (.36 second and .20 second respectively). Hodgkins stated that males have faster reaction time than females do.[15]

Table XXXVI shows that there was a significant difference at the .01 level in the flexibility between males and females of the commercial group. The mean of the flexibility of the female group (9.44 inches) was better than the male group's (11.49 inches). Phillips stated that females are superior to males in flexibility, and it is likely that this difference exists at all ages and throughout the adult life.[16]

Table XXXVII shows that there was a significant difference at the .01 level in the O_2 saturation between males and females of the commercial group. The mean of the O_2 saturation of the female group (96.25 percent) was higher than that of the male group (95.62 percent). DeVries stated that the O_2 saturation is the amount of red blood cells and hemoglobin which are important in determining

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[14] Wilmore, 1977, p. 182.

[15] J. Hodgkins, "Reaction Time and Speed of Movement in Males and Females of Various Ages," Research Quarterly, XXXIV (1963), pp. 335-343.

[16] Phillips, 1955, pp. 314-323.

how much oxygen can be transported to the working muscles. The average O_2 saturation at sea level is 95 percent. The higher percent of the O_2 saturation, the better.[17]

There were no significant differences in the weekly aerobic points total (Table XVII), the timed vital capacity (Table XXI), the amplitude of the R wave (Table XXIV), and the amplitude of the T wave (Table XXV).

According to the results, males are significantly better on the vital capacity, the maximum breathing capacity, the rest-work ratio, the lying pulse rate, all strength measurements, and all reaction time measurements. Females are significantly better on the flexibility, and O_2 saturation, and the lying systolic and diastolic blood pressure.

Step four in the statistical analysis was to calculate analysis of variance to determine whether there was a significant mean change as mean age increased one year of the physiological variables for males and females of the commercial group. This was a cross sectional analysis. Wessel and Van Huss showed that physical activity decreased significantly with increasing age.[18] Tables XXXVIII, XXXIX, and XL present the analysis of variance of the mean change as the mean age increased one year of the physiological variables for males and females of the commercial group. Tables XXXVIII, XXXIX, and XL also present the individual slope of the physiological variables for males and females of the commercial group.

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[17]DeVries, 1974, p. 176.

[18]J. A. Wessel and W. D. Van Huss, "The Influence of Physical Activity and Age on Exercise Adaptation of Women Aged 20-69 Years," Journal of Sports Medicine, XIX (1969), pp. 173-180.

TABLE XXXIX

ANALYSIS OF VARIANCE OF MEAN CHANGE AS MEAN AGE INCREASED ONE YEAR OF THE PHYSIOLOGICAL VARIABLES OF BOTH MALES AND FEMALES OF THE COMMERCIAL GROUP

Source	AmpR	AmpT	Restwork	WtRes	Ml-kg	Lying	Gripstrg
Common Slope Change per year	-0.07	-0.01	0.00	0.01	-0.22	-0.11	-0.38
Common Slope F	10.55**	5.86*	2.58	0.00	45.73**	2.61	12.99**
Parallelism F	1.98	3.99*	0.33	1.08	3.27	0.15	0.01
Male Slope Change per year	-0.08	-0.02**	0.00	-0.05	-0.26	-0.12	-0.37
Female Slope Change per year	-0.02	0.00	0.00	0.14	-0.13	-0.07	-0.39

*P $<$ .05

**P $<$ .01

TABLE XL

ANALYSIS OF VARIANCE OF MEAN CHANGE AS MEAN AGE INCREASED ONE YEAR OF THE PHYSIOLOGICAL VARIABLES OF BOTH MALES AND FEMALES OF THE COMMERCIAL GROUP

Source	Legstrg	Pushstr	Pullstr	VJRT	SRTAudio	Flex	O_2Sat
Common Slope Change per year	-0.77	-0.63	-0.48	0.001	0.005	0.13	-0.06
Common Slope F	31.99**	17.74**	21.11**	11.71**	4.57*	38.48**	42.09**
Parallelism F	1.21	1.45	2.21	0.71	1.07	0.00	6.84**
Male Group Change per year	-0.87	-0.75	-0.57	0.001	0.001	0.13	-0.07**
Female Group Change per year	-0.54	-0.35	-0.23	0.001	0.00	0.13	-0.01

*$P < .05$

**$P < .01$

The slope of the regression lines of the vital capacity of males and females were not parallel ($P < .05$) as the mean age increased one year. The slope of the vital capacity of the male group decreased .45 percent ($P < .01$) as the mean age increased one year. There was no significant change in the slope of the female group.

The slope of the amplitude of the R wave of males and females decreased .07 mm ($P < .01$) as the mean age increased one year.

The slope of the regression lines of the amplitude of the T wave of males and females were not parallel ($P < .05$) as the mean age increased one year. The slope of the amplitude of the T wave of males decreased .02 mm ($P < .01$) as the mean age increased one year. There was no significant change in the slope of the female group.

The slope of the predicted maximum O_2 intake of males and females decreased .22 ml. kg. min. ($P < .01$) as the mean age increased one year.

The slope of the grip, leg, push, and pull strength of males and females decreased .38 lbs. ($P < .01$), .77 lbs. ($P < .01$), .63 lbs. ($P < .01$), 48 lbs. ($P < .01$) respectively as the mean age increased one year.

The slope of the vertical jump reaction time and reaction time to sound of males and females increased .001 second ($P < .01$) and .005 second ($P < .05$) respectively as the mean age increased one year.

The slope of the flexilibity of males and females increased .13 inch ($P < .01$) as the mean age increased one year.

The slope of the regression lines of the O_2 saturation of males and females were not parallel ($P < .01$) as the mean age increased one year. The slope of the O_2 saturation of the male group decreased .07 percent ($P < .01$) as the mean age increased one year. There was no significant change in the slope of the female group.

There were no significant changes in the slopes of the weekly aerobic points total, the resting O_2 intake, the timed vital capacity, the maximum breathing capacity, the rest-work ratio, the weight residual, and the lying pulse rate.

Step five in the statistical analysis was to compare the means of the physiological variables in the study between females of three different communities in the state of Oklahoma. Those communities were Duncan, Pawhuska, and Shawnee. The other communities which did not have enough female subjects (10 subjects or more) were excluded from the study. The sedentary life of the average city population is thought to have an adverse effect on cardiorespiratory fitness in particular.[19] The mean age of females in the Duncan group was 41 years, in the Pawhuska group it was 46 years, and in the Shawnee group it was 39 years. The Shawnee females (in addition to being younger) were doing office work. The females from other communities were primarily housewives. Females in the Shawnee group might be expected to have better physical fitness than the other groups due to a lower age.

The analysis of variance procedure (ANOVA) was used to test for the significance of differences between the means. The Duncan's Multiple Range Test was applied to variables which showed the significant "F" ratios in the ANOVA. The results of the ANOVA and the Duncan's Multiple Range Test for step five are shown in Tables XLI through Table LXI.

TABLE XLI

COMPARISON OF WEEKLY AEROBIC POINTS TOTAL (FEMALES)

Communities	N	Mean	MS	df	F
Duncan	27	1.63			
Pawhuska	13	5.31			
Shawnee	13	1.00			
			75.70	2	2.45[NS]

[19] W. Raab, Prevention of Ishemic Heart Disease: Principles and Practice (Illinois, 1966), p. 242.

TABLE XLII

ANOVA AND DUNCAN'S MULTIPLE RANGE TEST FOR LYING SYSTOLIC BLOOD PRESSURE (FEMALES)

Communities	N	Mean (mm Hg)	MS	df	F
Pawhuska	13	131.00 A			
Duncan	27	115.93 B			
Shawnee	13	113.46 B			
Between Group			1262.95	2	8.84**
Within Group			122.11	50	

Means with the same letter are not significantly different.

TABLE XLIII

ANOVA AND DUNCAN'S MULTIPLE RANGE TEST FOR LYING DIASTOLIC BLOOD PRESSURE (FEMALES)

Communities	N	Mean (mm Hg)	MS	df	F
Pawhuska	13	82.92 A			
Duncan	27	75.19 B			
Shawnee	13	72.69 B			
Between Group			385.72	2	4.73*
Within Group			69.92	50	

Means with the same letter are not significantly different.

*$P < .05$

**$P < .01$

TABLE XLIV

COMPARISON OF RESTING O_2 INTAKE (FEMALES)

Communities	N	Mean (L/min)	MS	df	F
Duncan	27	0.34			
Pawhuska	13	0.31			
Shawnee	13	0.36			
			0.01	2	0.00^{NS}

TABLE XLV

COMPARISON OF TIMED VITAL CAPACITY (FEMALES)

Communities	N	Mean (%)	MS	df	F
Duncan	27	81.00			
Pawhuska	13	83.92			
Shawnee	13	76.31			
			193.67	2	1.32^{NS}

TABLE XLVI

ANOVA AND DUNCAN'S MULTIPLE RANGE TEST FOR VITAL CAPACITY (FEMALES)

Communities	N	Mean (%)		MS	df	F
Shawnee	13	113.62	A			
Pawhuska	13	92.46	B			
Duncan	26	87.57	B			
Between Group				3008.21	2	12.35**
Within Group				297.69	49	

Means with the same letter are not significantly different.

TABLE XLVII

ANOVA AND DUNCAN'S MULTIPLE RANGE TEST FOR MAXIMUM BREATHING CAPACITY (FEMALES)

Communities	N	Mean (%)		MS	df	F
Shawnee	13	108.00	A			
Duncan	27	99.85	A			
Pawhuska	13	78.00	B			
Between Group				3235.92	2	7.92*
Within Group				298.79	50	

Means with the same letter are not significantly different.

*$P < .05$

**$P < .01$

TABLE XLVIII

COMPARISON OF AMPLITUDE OF THE R WAVE (FEMALES)

Communities	N	Mean (mm)	MS	df	F
Duncan	27	9.26			
Pawhuska	13	8.96			
Shawnee	13	9.46			
			0.83	2	0.06^{NS}

TABLE XLIX

COMPARISON OF AMPLITUDE OF THE T WAVE (FEMALES)

Communities	N	Mean (mm)	MS	df	F
Duncan	27	1.96			
Pawhuska	13	2.22			
Shawnee	13	1.65			
			1.06	2	1.33^{NS}

TABLE L

COMPARISON OF REST-WORK RATIO (FEMALES)

Communities	N	Mean (mm)	MS	df	F
Duncan	27	1.69			
Pawhuska	13	1.53			
Shawnee	13	1.52			
			0.17	2	1.65^{NS}

TABLE LI

COMPARISON OF WEIGHT RESIDUAL (FEMALES)

Communities	N	Mean (lbs)	MS	df	F
Duncan	26	9.08			
Pawhuska	13	13.08			
Shawnee	12	9.67			
			71.87	2	3.12^{NS}

TABLE LII

COMPARISON OF PREDICTED MAXIMUM O_2 INTAKE (FEMALES)

Communities	N	Mean (ml/kg/min)	MS	df	F
Duncan	27	28.37			
Pawhuska	13	27.31			
Shawnee	13	25.92			
			26.63	2	2.47^{NS}

TABLE LIII

ANOVA AND DUNCAN'S MULTIPLE RANGE TEST FOR LYING PULSE RATE (FEMALES)

Communities	N	Mean (bpm)	MS	df	F
Shawnee	13	78.92 A			
Pawhuska	13	72.08 A B			
Duncan	27	71.04 B			
Between Group			284.24	2	6.30**
Within Group			118.58	50	

Means with the same letter are not significantly different.

*P $<$ .05

**P $<$ .01

TABLE LIV

COMPARISON OF GRIP STRENGTH (FEMALES)

Communities	N	Mean (lbs)	MS	df	F
Duncan	27	65.11			
Pawhuska	13	63.08			
Shawnee	13	55.23			
			435.11	2	2.60^{NS}

TABLE LV

COMPARISON OF LEG STRENGTH (FEMALES)

Communities	N	Mean (lbs)	MS	df	F
Duncan	27	65.70			
Pawhuska	13	62.15			
Shawnee	13	63.48			
			61.10	2	0.61^{NS}

TABLE LVI

COMPARISON OF PUSH STRENGTH (FEMALES)

Communities	N	Mean (lbs)	MS	df	F
Duncan	27	51.22			
Pawhuska	13	55.23			
Shawnee	13	42.85			
			530.07	2	2.96^{NS}

TABLE LVII

COMPARISON OF PULL STRENGTH (FEMALES)

Communities	N	Mean (lbs)	MS	df	F
Duncan	27	47.52			
Pawhuska	13	48.69			
Shawnee	13	42.31			
			159.47	2	1.90^{NS}

TABLE LVIII

COMPARISON OF VERTICAL JUMP REACTION TIME (FEMALES)

Communities	N	Mean (sec)	MS	df	F
Duncan	27	0.35			
Pawhuska	13	0.34			
Shawnee	13	0.37			
			0.003	2	1.13^{NS}

TABLE LIX

COMPARISON OF REACTION TIME TO SOUND (FEMALES)

Communities	N	Mean (sec)	MS	df	F
Duncan	27	0.20			
Pawhuska	13	0.20			
Shawnee	13	0.19			
			0.004	2	0.15^{NS}

TABLE LX

COMPARISON OF FLXEIBILITY (FEMALES)

Communities	N	Mean (inch)	MS	df	F
Duncan	27	9.96			
Pawhuska	13	10.23			
Shawnee	12	9.00			
			5.41	2	0.63^{NS}

TABLE LXI

COMPARISON OF O_2 SATURATION (FEMALES)

Communities	N	Mean (%)	MS	df	F
Duncan	27	95.93			
Pawhuska	12	96.57			
Shawnee	13	96.52			
			2.49	2	0.97^{NS}

Table XLI shows that there was no significant difference observable in the weekly aerobic points total among the three groups.

Table XLII shows that there was a significant difference at the .01 level in the lying systolic blood pressure among the three groups. The mean of the Shawnee and Duncan group were lower than the Pawhuska group. There was no significant difference between the mean of the Duncan and Shawnee group.

Table XLIII shows that there was a significant difference at the .05 level in the lying diastolic blood pressure among the three groups. The mean of the Shawnee and Duncan group were lower than the Pawhuska group. There was no significant difference between the mean of the Duncan and Shawnee group.

Table XLVI shows that there was a significant difference at the .01 level in the vital capacity among the three groups. The means of the Shawnee group was higher than those of the Pawhuska and Duncan group. There was no significant difference between the mean of the Pawhuska and Duncan group.

Table XLVII shows that there was a significant difference at the .01 level in the maximum breathing capacity among the three groups. The means of the Shawnee and Duncan groups were higher than the one of the Pawhuska group. There was no significant difference between the means of the Shawnee and Duncan group.

Table LIII shows that there was a significant difference at the .01 level in the lying pulse rate among the three groups. The mean of the Shawnee group was higher than that of the Duncan group. There was no significant difference between the mean of the Shawnee and Pawhuska group or between the Pawhuska and Duncan group.

There were no significant differences observable among the three groups in the resting O_2 intake (Table XLIV), the timed vital capacity (Table XLV), the amplitude of the R wave (Table XLVIII), the rest-work ratio (Table L), the weight residual (Table LI), the predicted maximum O_2 intake (Table LII), the grip strength (Table LIV), the leg strength (Table LV), the push strength (Table LVI), the pull strength (Table LVII), the vertical jump reaction time (Table LVIII), the reaction time to sound (Table LIX), the flexibility (Table LX), and the O_2 saturation (Table LXI).

The Shawnee group had the highest scores on the lying systolic blood pressure ($P < .01$), the lying diastolic blood pressure ($P < .05$), the resting O_2 intake, the vital capacity ($P < .01$), the maximum breathing capacity ($P < .01$), the amplitude of the R wave, the reaction time to sound (Table LIX), and the flexibility. The Pawhuska group had the highest scores on the weekly aerobic points total, the timed vital capacity, the amplitude of the T wave, the push and pull strength, the vertical jump reaction time, and the O_2 saturation.

The Duncan group had the highest scores on the rest-work ratio, the weight residual, the predicted maximum O_2 intake, the lying pulse rate ($P < .01$), the grip strength, and the leg strength.

Females in the Shawnee group were the youngest ones. However, there was no consistent pattern of better physical fitness scores.

Step six in the statistical analysis was to compare the means of the physiological variables in the study between males of eight different communities in the state of Oklahoma. Those communities were Cushing, Duncan, Guthrie, Pawhuska, Ponca City, Shawnee, Thomas, and Yale. The other communities which did not have enough male subjects (10 subjects or more) were excluded from the study. The mean age of the males in the Cushing group was 40 years, the Shawnee group was 46 years, the Thomas group was 46 years, the Guthrie group was 42 years, the Pawhuska group was 48 years, and the Ponca City group was 50 years. Since the Cushing and Thomas male groups were younger than the others, they might be expected to have better physical fitness than the others.

The analysis of variance procedure (ANOVA) was used to test for the significance of difference between means. The Duncan's Multiple Range test was applied to variables which showed the significant "F" ratios in the ANOVA. The results of the ANOVA and the Duncan's Multiple Range Test for step six are shown in Tables LXII through Table LXXXII.

Table LXII shows that there was no significant difference observable in the weekly aerobic points total among the eight groups.

Table LXVI shows that there was a significant difference at the .01 level in the timed vital capacity among the eight groups. The mean of the Cushing group was higher than those of the Duncan, Yale, Guthrie, Ponca City, and Shawnee groups. There was no significant difference among the means of the Cushing, Thomas, and Pawhuska groups or among the means of the Thomas, Pawhuska, Duncan, Yale, Guthrie, Ponca City, and Shawnee groups.

TABLE LXII

COMPARISON OF WEEKLY AEROBIC POINTS TOTAL (MALES)

Communities	N	Mean	MS	df	F
Cushing	10	26.00			
Duncan	56	7.18			
Guthrie	14	3.14			
Pawhuska	16	3.50			
Ponca City	16	2.18			
Shawnee	15	1.60			
Thomas	12	1.00			
Yale	13	1.62			
			763.26	7	0.62^{NS}

TABLE LXIII

COMPARISON OF LYING SYSTOLIC BLOOD PRESSURE (MALES)

Communities	N	Mean (mm Hg)	MS	df	F
Cushing	10	134.20			
Duncan	56	130.80			
Guthrie	14	129.29			
Pawhuska	16	138.56			
Ponca City	16	132.81			
Shawnee	15	132.33			
Thomas	12	137.92			
Yale	13	133.08			
			180.77	7	0.85^{NS}

TABLE LXIV

COMPARISON OF LYING DIASTOLIC BLOOD PRESSURE (MALES)

Communities	N	Mean (mm Hg)	MS	df	F
Cushing	10	87.10			
Duncan	56	83.13			
Guthrie	14	85.00			
Pawhuska	16	87.88			
Ponca City	16	80.63			
Shawnee	15	82.33			
Thomas	12	87.00			
Yale	13	81.54			
			114.57	7	1.07^{NS}

TABLE LXV

COMPARISON OF RESTING O_2 INTAKE (MALES)

Communities	N	Mean (L/min)	MS	df	F
Cushing	10	0.36			
Duncan	56	0.38			
Guthrie	14	0.32			
Pawhuska	16	0.41			
Ponca City	15	0.32			
Shawnee	15	0.40			
Thomas	12	0.34			
Yale	13	0.33			
			0.019	7	1.66^{NS}

TABLE LXVI

ANOVA AND DUNCAN'S MULTIPLE RANGE TEST FOR
TIMED VITAL CAPACITY (MALES)

Communities	N	Mean (%)			MS	df	F
Cushing	10	89.60	A				
Thomas	12	84.75	A	B			
Pawhuska	16	84.63	A	B			
Duncan	55	80.07		B			
Yale	13	79.08		B			
Guthrie	14	78.29		B			
Ponca City	15	77.20		B			
Shawnee	14	75.79		B			
Between Group					270.58	7	3.94**
Within Group					136.47	143	

Means with the same letter are not significantly different.

*$P < .05$

**$P < .01$

TABLE XLVII

COMPARISON OF VITAL CAPACITY (MALES)

Communities	N	Mean (%)	MS	df	F
Cushing	10	106.90			
Duncan	54	111.33			
Guthrie	14	104.07			
Pawhuska	16	112.38			
Ponca City	16	109.88			
Shawnee	15	113.87			
Thomas	12	109.92			
Yale	13	96.15			
			482.91	7	1.73^{NS}

TABLE LXVIII

ANOVA AND DUNCAN'S MULTIPLE RANGE TEST FOR MAXIMUM BREATHING CAPACITY (MALES)

Communities	N	Mean (%)			MS	df	F
Cushing	10	109.67	A				
Duncan	55	106.09	A	B			
Yale	13	105.62	A	B			
Pawhuska	16	104.63	A	B			
Ponca City	15	103.27	A	B			
Thomas	12	97.42	A	B			
Guthrie	14	88.43	C	B			
Shawnee	15	76.20	C				
Between Group					2289.16	7	3.29**
Within Group					628.05	143	

Means with the same letter are not significantly different.

*$P < .05$

**$P < .01$

TABLE LXIX

COMPARISON OF AMPLITUDE OF THE R WAVE (MALES)

Communities	N	Mean (mm)	MS	df	F
Cushing	10	8.85			
Duncan	56	8.46			
Guthrie	14	7.82			
Pawhuska	16	8.08			
Ponca City	16	9.45			
Shawnee	15	8.10			
Thomas	12	7.33			
Yale	13	8.08			
			5.98	7	0.46^{NS}

TABLE LXX

ANOVA AND DUNCAN'S MULTIPLE RANGE TEST FOR AMPLITUDE OF THE T WAVE (MALES)

Communities	N	Mean (mm)			MS	df	F
Cushing	10	2.50	A				
Pawhuska	16	2.21	A	B			
Thomas	12	2.13	A	B			
Duncan	56	2.07	A	B			
Ponca City	16	1.97	A	B			
Shawnee	15	1.83	A	B			
Guthrie	14	1.61		B			
Yale	13	1.59		B			
Between Group					1.20	7	2.12**
Within Group					0.59	146	

Means with the same letter are not significantly different.

*P < .05

**P < .01

TABLE LXXI

COMPARISON OF REST-WORK RATIO (MALES)

Communities	N	Mean (mm)	MS	df	F
Cushing	10	1.62			
Duncan	56	1.80			
Guthrie	14	1.59			
Pawhuska	16	1.60			
Ponca City	16	1.72			
Shawnee	15	1.77			
Thomas	12	1.92			
Yale	13	1.84			
			0.22	7	1.57^{NS}

TABLE LXXII

COMPARISON OF WEIGHT RESIDUAL (MALES)

Communities	N	Mean (lbs)	MS	df	F
Cushing	10	15.70			
Duncan	55	12.84			
Guthrie	14	17.00			
Pawhuska	16	15.13			
Ponca City	16	12.56			
Shawnee	15	17.87			
Thomas	12	15.67			
Yale	13	14.92			
			72.71	7	0.58^{NS}

TABLE LXXIII

COMPARISON OF PREDICTED MAXIMUM O_2 INTAKE (MALES)

Communities	N	Mean (ml/kg/min)	MS	df	F
Cushing	10	34.20			
Duncan	56	33.88			
Guthrie	14	36.71			
Pawhuska	16	36.00			
Ponca City	16	36.00			
Shawnee	15	33.93			
Thomas	12	35.08			
Yale	13	32.23			
			50.73	7	1.38^{NS}

TABLE LXXIV

COMPARISON OF LYING PULSE RATE (MALES)

Communities	N	Mean (bpm)	MS	df	F
Cushing	10	81.40			
Duncan	56	69.39			
Guthrie	14	70.71			
Pawhuska	16	72.81			
Ponca City	16	66.38			
Shawnee	15	71.20			
Thomas	12	68.25			
Yale	13	69.69			
			241.65	7	1.74^{NS}

TABLE LXXV

COMPARISON OF GRIP STRENGTH (MALES)

Communities	N	Mean (lbs)	MS	df	F
Cushing	10	116.40			
Duncan	56	117.45			
Guthrie	14	125.29			
Pawhuska	16	125.44			
Ponca City	16	121.31			
Shawnee	15	118.60			
Thomas	12	121.50			
Yale	13	120.15			
			206.17	7	0.52^{NS}

TABLE LXXVI

COMPARISON OF LEG STRENGTH (MALES)

Communities	N	Mean (lbs)	MS	df	F
Cushing	10	118.90			
Duncan	56	120.48			
Guthrie	14	125.93			
Pawhuska	16	120.25			
Ponca City	16	120.00			
Shawnee	15	112.40			
Thomas	12	121.33			
Yale	12	117.42			
			211.65	7	0.31^{NS}

TABLE LXXVII

COMPARISON OF PUSH STRENGTH (MALES)

Communities	N	Mean (lbs)	MS	df	F
Cushing	9	123.78			
Duncan	56	115.27			
Guthrie	14	99.00			
Pawhuska	16	107.81			
Ponca City	16	110.06			
Shawnee	15	99.13			
Thomas	12	119.00			
Yale	13	116.85			
			1131.51	7	0.96^{NS}

TABLE LXXVIII

COMPARISON OF PULL STRENGTH (MALES)

Communities	N	Mean (lbs)	MS	df	F
Cushing	10	89.40			
Duncan	56	88.02			
Guthrie	14	85.29			
Pawhuska	16	93.50			
Ponca City	16	89.63			
Shawnee	15	83.00			
Thomas	12	94.50			
Yale	13	86.38			
			218.55	7	0.61^{NS}

TABLE LXXIX

COMPARISON OF VERTICAL JUMP REACTION TIME (MALES)

Communities	N	Mean (sec)	MS	df	F
Cushing	10	0.29			
Duncan	56	0.32			
Guthrie	14	0.30			
Pawhuska	16	0.29			
Ponca City	16	0.33			
Shawnee	15	0.32			
Thomas	12	0.32			
Yale	13	0.33			
			0.004	7	1.34^{NS}

TABLE LXXX

COMPARISON OF REACTION TIME TO SOUND (MALES)

Communities	N	Mean (sec)	MS	df	F
Cushing	10	0.17			
Duncan	56	0.17			
Guthrie	14	0.17			
Pawhuska	16	0.15			
Ponca City	16	0.17			
Shawnee	15	0.16			
Thomas	12	0.16			
Yale	13	0.19			
			0.002	7	0.20^{NS}

TABLE LXXXI

COMPARISON OF FLEXIBILITY (MALES)

Communities	N	Mean (inch)	MS	df	F
Cushing	10	11.10			
Duncan	56	11.14			
Guthrie	14	13.43			
Pawhuska	16	11.56			
Ponca City	16	11.56			
Shawnee	15	11.20			
Thomas	12	11.50			
Yale	13	11.92			
			12.02	7	1.00^{NS}

Table LXVIII shows that there was a significant difference at the .01 level in the maximum breathing capacity among the eight groups. The mean of the Cushing group was higher than the one of the Shawnee group. There was no significant difference among the means of the Duncan, Cushing, Yale, Pawhuska, Ponca City, and Thomas groups or among the means of the Duncan, Yale, Pawhuska, Ponca City, Thomas, and Guthrie groups or between the mean of the Guthrie and Shawnee group.

Table LXX shows that there was a significant difference at the .05 level in the amplitude of the T wave among the eight groups. The mean of the Cushing group was higher than those of the Guthrie and Yale groups. There was no significant difference among the means of the Cushing, Pawhuska, Thomas, Duncan, Ponca City, and Shawnee groups or among the means of the Shawnee, Thomas, Pawhuska, Guthrie, Duncan, Yale, and Ponca City groups.

Table LXXXII shows that there was a significant difference at the .05 level in the O_2 saturation among the eight groups. The mean of the Cushing group was higher than those of the Duncan, Yale, and Ponca City groups. There was no significiant difference among the means of Cushing, Thomas, Pawhuska, Shawnee, and Guthrie groups or among the means of Thomas, Pawhuska, Shawnee, Guthrie, Duncan, Yale, and Ponca City.

There were no significant differences observable among the three groups in the lying systolic blood pressure (Table LXIII), the lying diastolic blood pressure (Table LXIV), the resting O_2 intake (Table LXV), the vital capacity (Table LXVII), the amplitude of the R wave (Table LXIX), the amplitude of the T wave (Table LXX), the rest-work ratio (Table LXXI), the weight residual (Table LXXII), the predicted maximum O_2 intake (Table LXXIII), the lying pulse rate (Table LXXIV), the grip strength (Table LXXV), the leg strength (Table LXXVI), the push strength (Table LXXVII), the pull strength (Table LXXVIII), the vertical jump reaction time (Table LXXIX), the reaction time to sound (Table LXXX), and the flexibility (Table LXXXI).

The Cushing group which was the youngest and got the most exercise had the highest scores on the weekly aerobic points total, the timed vital capacity ($P < .01$), the maximum breathing capacity ($P < .01$), amplitude of the T wave ($P < .05$), the push strength, the vertical jump reaction time, the flexibility, and the O_2 saturation ($P < .05$). The Guthrie group had the best scores on the lying systolic blood pressure, the predicted maximum O_2 intake, and the leg strength. The Pawhuska group had the best scores on the resting O_2 intake, grip strength, the vertical jump reaction time, and the reaction time to sound. The Ponca City group had the best scores on the amplitude of the R wave, the weight residual, and the lying pulse rate. The Shawnee group had the best scores on the vital capacity and the rest-work ratio. The Thomas group had the best score on the pull strength. The Yale group had the best score on the lying diastolic blood pressure.

Step seven in the statistical analysis was to compare the means of the physiological variables in the study between males of nine different professions in the commercial group. The subjects were classified by the profession held at the time of the interview prior to the physical fitness evaluation and then grouped. Group One consisted of bankers. Group Two consisted of attorneys. Group Three consisted of physicians, a chiropodist, veterinarian, optometrist, dentist, nurse, pharmacist, and health professionals. Group Four consisted of realtors, insurance people, and abstractors. Group Five consisted of merchants, salesmen, and delivery service people. Group Six consisted of construction workers. Group Seven consisted of engineers. Group Eight consisted of oil businessmen (executive duties). Group Nine consisted of professors, administrators, and a city manager. The mean age of Group One was 45 years, Group Two's was 43 years, Group Three's was 40 years, Group Four's was 42 years, Group Five's was 45 years, Group Six's was 45 years, Group Seven's was 41 years, Group Eight's was 49 years, and Group Nine's was 41 years. Fox and others indicated that physical fitness decreases in individuals whose occupations have required minimum exertion.[20] Since Group Three consisted of the health related professions and was the youngest group in this study, this group might be expected to have better physical fitness than the other groups.

The analysis of variance procedure (ANOVA) was used to test for the significance of differences between means. The Duncan's Multiple Range Test was applied to variables which showed the significant "F" ratios in the ANOVA. The results of the ANOVA and the Duncan's Multiple Range test for step seven are shown in Tables LXXXIII through Table CIII.

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[20] S. M. Fox and J. S. Skinner, "Physical Activity and Cardiovascular Health,: American Journal of Cardiology, XIV (1964), p. 731.

TABLE LXXXII

ANOVA AND DUNCAN'S MULTIPLE RANGE TEST FOR O_2 SATURATION (MALES)

Communities	N	Mean (%)			MS	df	F
Cushing	10	96.82	A				
Thomas	13	96.03	A	B			
Pawhuska	16	96.00	A	B			
Shawnee	15	95.82	A	B			
Guthrie	14	95.71	A	B			
Duncan	55	95.48		B			
Yale	13	95.05		B			
Ponca City	16	95.02		B			
Between Group					3.48	7	2.21*
Within Group					1.81	144	

Means with the same letter are not significantly different.

*P < .05

**P < .01

TABLE LXXXIII

ANOVA AND DUNCAN'S MULTIPLE RANGE TEST FOR WEEKLY AEROBIC POINTS TOTAL (MALES)

Group	N	Mean		MS	df	F
Group Three	11	32.27	A			
Group Four	38	8.87	B			
Group Seven	13	6.30	B			
Group Five	16	6.06	B			
Group Nine	12	5.92	B			
Group Six	14	3.29	B			
Group One	52	3.21	B			
Group Eight	11	2.27	B			
Group Two	15	1.20	B			
Between Group				1106.38	8	2.88**
Within Group				417.01	174	

Means with the same letter are not significantly different.

*$P < .05$

**$P < .01$

Group One: Bankers
Group Two: Attorneys
Group Three: Physicians (Chiropodist, Veterinarian, Optometrist, Dentist, Nurse, Pharmacist, and Health Profession)
Group Four: Real Estate, Insurance, and Abstractors
Group Five: Merchants, Sales, and Delivery Services
Group Six: Construction
Group Seven: Engineers
Group Eight: Oil Business (Executive Duty)
Group Nine: Professors, Administrators, and City Managers

TABLE LXXXIV

COMPARISON OF LYING SYSTOLIC BLOOD PRESSURE (MALES)

Group	N	Mean (mm Hg)	MS	df	F
Group One	52	127.81			
Group Two	15	128.07			
Group Three	11	127.17			
Group Four	16	134.38			
Group Five	38	134.34			
Group Six	14	129.07			
Group Seven	13	128.31			
Group Eight	11	132.18			
Group Nine	12	130.82			
			189.60	8	0.90^{NS}

Group One: Bankers
Group Two: Attorneys
Group Three: Physicians (Chiropodist, Veterinarian, Optometrist, Dentist, Nurse, Pharmacist, and Health Profession)
Group Four: Real Estate, Insurance, and Abstractors
Group Five: Merchants, Sales, and Delivery Services
Group Six: Construction
Group Seven: Engineers
Group Eight: Oil Business (Executive Duty)
Group Nine: Professors, Administrators and City Managers

TABLE LXXXV

COMPARISON OF LYING DIASTOLIC BLOOD PRESSURE (MALES)

Group	N	Mean (mm Hg)	MS	df	F
Group One	52	81.56			
Group Two	15	81.87			
Group Three	11	80.43			
Group Four	16	84.75			
Group Five	38	84.55			
Group Six	14	80.82			
Group Seven	13	81.08			
Group Eight	11	82.91			
Group Nine	12	83.67			
			53.58	8	0.53^{NS}

Group One: Bankers
Group Two: Attorneys
Group Three: Physicians (Chiropodist, Veterinarian, Optometrist, Dentist, Nurse, Pharmacist, and Health Profession)
Group Four: Real Estate, Insurance, and Abstractors
Group Five: Merchants, Sales, and Delivery Services
Group Six: Construction
Group Seven: Engineers
Group Eight: Oil Business (Executive Duty)
Group Nine: Professors, Administrators and City Managers

TABLE LXXXVI

COMPARISON OF RESTING O_2 INTAKE (MALES)

Group	N	Mean (L/min)	MS	df	F
Group One	52	0.36			
Group Two	15	0.40			
Group Three	11	0.36			
Group Four	16	0.35			
Group Five	38	0.37			
Group Six	13	0.35			
Group Seven	13	0.38			
Group Eight	11	0.36			
Group Nine	11	0.39			
			0.0004	8	0.47^{NS}

Group One: Bankers
Group Two: Attorneys
Group Three: Physicians (Chiropodist, Veterinarian, Optometrist, Dentist, Nurse, Pharmacist, and Health Profession)
Group Four: Real Estate, Insurance, and Abstractors
Group Five: Merchants, Sales, and Delivery Services
Group Six: Construction
Group Seven: Engineers
Group Eight: Oil Business (Executive Duty)
Group Nine: Professors, Administrators and City Managers

TABLE LXXXVII

COMPARISON OF TIMED VITAL CAPACITY (MALES)

Group	N	Mean (%)	MS	df	F
Group One	52	77.37			
Group Two	15	83.40			
Group Three	11	86.27			
Group Four	16	81.31			
Group Five	37	80.35			
Group Six	13	83.00			
Group Seven	13	77.46			
Group Eight	11	82.91			
Group Nine	11	83.64			
			173.52	8	0.96^{NS}

Group One: Bankers
Group Two: Attorneys
Group Three: Physicians (Chiropodist, Veterinarian, Optometrist, Dentist, Nurse, Pharmacist, and Health Profession)
Group Four: Real Estate, Insurance, and Abstractors
Group Five: Merchants, Sales, and Delivery Services
Group Six: Construction
Group Seven: Engineers
Group Eight: Oil Business (Executive Duty)
Group Nine: Professors, Administrators and City Managers

TABLE LXXXVIII

COMPARISON OF VITAL CAPACITY (MALES)

Group	N	Mean (%)	MS	df	F
Group One	52	107.10			
Group Two	14	117.21			
Group Three	11	118.45			
Group Four	16	107.31			
Group Five	37	110.59			
Group Six	14	112.86			
Group Seven	13	110.08			
Group Eight	11	108.64			
Group Nine	12	111.75			
			278.40	8	0.91^{NS}

Group One: Bankers
Group Two: Attorneys
Group Three: Physicians, (Chiropodist, Veterinarian, Optometrist, Dentist, Nurse, Pharmacist, and Health Profession)
Group Four: Real Estate, Insurance, and Abstractors
Group Five: Merchants, Sales, and Delivery Services
Group Six: Construction
Group Seven: Engineers
Group Eight: Oil Business (Executive Duty)
Group Nine: Professors, Administrators and City Managers

TABLE LXXXIX

COMPARISON OF MAXIMUM BREATHING CAPACITY (MALES)

Group	N	Mean (%)	MS	df	F
Group One	51	104.43			
Group Two	15	108.93			
Group Three	10	114.40			
Group Four	16	105.06			
Group Five	37	107.03			
Group Six	13	97.15			
Group Seven	13	100.15			
Group Eight	11	101.45			
Group Nine	12	100.00			
			350.64	8	0.52^{NS}

Group One: Bankers
Group Two: Attorneys
Group Three: Physicians (Chiropodist, Veterinarian, Optometrist, Dentist, Nurse, Pharmacist, and Health Profession)
Group Four: Real Estate, Insurance, and Abstractors
Group Five: Merchants, Sales, and Delivery Services
Group Six: Construction
Group Seven: Engineers
Group Eight: Oil Business (Executive Duty)
Group Nine: Professors, Administrators and City Managers

TABLE XC

COMPARISON OF AMPLITUDE OF THE R WAVE (MALES)

Group	N	Mean (mm)	MS	df	F
Group One	52	8.66			
Group Two	15	8.95			
Group Three	11	10.41			
Group Four	16	8.19			
Group Five	38	9.01			
Group Six	14	10.16			
Group Seven	13	8.88			
Group Eight	11	7.27			
Group Nine	12	10.06			
			12.93	8	1.09^{NS}

Group One: Bankers
Group Two: Attorneys
Group Three: Physicians (Chiropodist, Veterinarian, Optometrist, Dentist, Nurse, Pharmacist, and Health Profession)
Group Four: Real Estate, Insurance, and Abstractors
Group Five: Merchants, Sales, and Delivery Services
Group Six: Construction
Group Seven: Engineers
Group Eight: Oil Business (Executive Duty)
Group Nine: Professors, Administrators and City Managers

TABLE XCI

ANOVA AND DUNCAN'S MULTIPLE RANGE TEST FOR AMPLITUDE OF THE T WAVE (MALES)

Group	N	Mean (mm)	MS	df	F
Group Three	11	2.69 A			
Group Seven	13	2.50 A B			
Group Two	15	2.49 A B			
Group Eight	11	2.18 A B			
Group One	52	2.00 B			
Group Nine	12	1.97 B			
Group Five	38	1.96 B			
Group Six	14	1.96 B			
Group Four	16	1.76 B			
Between Group			1.53	8	2.46*
Within Group			0.74	174	

Means with the same letter are not significantly different.

*P < .05

**P < .01

Group One: Bankers
Group Two: Attorneys
Group Three: Physicians (Chiropodist, Veterinarian, Optometrist, Dentist, Nurse, Pharmacist, and Health Profession)
Group Four: Real Estate, Insurance, and Abstractors
Group Five: Merchants, Sales, and Delivery Services
Group Six: Construction
Group Seven: Engineers
Group Eight: Oil Business (Executive Duty)
Group Nine: Professors, Administrators and City Managers

TABLE XCII

COMPARISON OF REST-WORK RATIO (MALES)

Group	N	Mean (mm)	MS	df	F
Group One	52	1.66			
Group Two	15	1.77			
Group Three	11	1.89			
Group Four	16	1.78			
Group Five	38	1.76			
Group Six	14	1.79			
Group Seven	13	1.88			
Group Eight	11	1.64			
Group Nine	12	1.71			
			0.13	8	1.11^{NS}

Group One: Bankers
Group Two: Attorneys
Group Three: Physicians (Chiropodist, Veterinarian, Optometrist, Dentist, Nurse, Pharmacist, and Health Profession)
Group Four: Real Estate, Insurance, and Abstractors
Group Five: Merchants, Sales, and Delivery Services
Group Six: Construction
Group Seven: Engineers
Group Eight: Oil Business (Executive Duty)
Group Nine: Professors, Administrators and City Managers

TABLE XCIII

COMPARISON OF WEIGHT RESIDUAL (MALES)

Group	N	Mean (lbs)	MS	df	F
Group One	51	18.33			
Group Two	15	10.64			
Group Three	11	8.80			
Group Four	16	19.88			
Group Five	38	13.74			
Group Six	14	12.29			
Group Seven	13	13.31			
Group Eight	11	20.55			
Group Nine	12	16.25			
			282.49	8	0.64^{NS}

Group One: Bankers
Group Two: Attorneys
Group Three: Physicians (Chiropodist, Veterinarian, Optometrist, Dentist, Nurse, Pharmacist, and Health Profession)
Group Four: Real Estate, Insurance, and Abstractors
Group Five: Merchants, Sales, and Delivery Services
Group Six: Construction
Group Seven: Engineers
Group Eight: Oil Business (Executive Duty)
Group Nine: Professors, Administrators and City Managers

TABLE XCIV

ANOVA AND DUNCAN'S MULTIPLE RANGE TEST FOR PREDICTED MAXIMUM O_2 INTAKE (MALES)

Group	N	Mean (ml/kg/min)	MS	df	F
Group Three	11	40.55 A			
Group Six	13	38.08 A B			
Group Two	15	36.07 A B C			
Group Seven	13	35.92 A B C			
Group Nine	12	35.08 A B C			
Group One	52	34.48 B C			
Group Five	37	34.03 B C			
Group Four	16	33.81 B C			
Group Eight	11	31.36 B C			
Between Group			88.29	8	3.90**
Within Group			37.27	172	

Means with the same letter are not significantly different.

*$P < .05$

**$P < .01$

Group One: Bankers
Group Two: Attorneys
Group Three: Physicians (Chiropodist, Veterinarian, Optometrist, Dentist, Nurse, Pharmacist, and Health Profession)
Group Four: Real Estate, Insurance, and Abstractors
Group Five: Merchants, Sales, and Delivery Services
Group Six: Construction
Group Seven: Engineers
Group Eight: Oil Business (Executive Duty)
Group Nine: Professors, Administrators and City Managers

TABLE XCV

ANOVA AND DUNCAN'S MULTIPLE RANGE TEST FOR LYING PULSE RATE (MALES)

Group	N	Mean (bpm)			MS	df	F
Group Three	11	66.00	A				
Group Two	15	68.07	A				
Group Eight	11	68.18	A				
Group Six	14	69.43	A				
Group Four	16	69.88	A				
Group Five	38	71.39	A				
Group One	52	72.44	A				
Group Nine	12	75.08	A	B			
Group Seven	13	82.38		B			
Between Group					308.77	8	3.38**
Within Group					115.06	174	

Means with the same letter are not significantly different.

*P $<$ .05

**P $<$ .01

Group One: Bankers
Group Two: Attorneys
Group Three: Physicians (Chiropodist, Veterinarian, Optometrist, Dentist, Nurse, Pharmacist, and Health Profession)
Group Four: Real Estate, Insurance, and Abstractors
Group Five: Merchants, Sales, and Delivery Services
Group Six: Construction
Group Seven: Engineers
Group Eight: Oil Business (Executive Duty)
Group Nine: Professors, Administrators and City Managers

TABLE XCVI

COMPARISON OF GRIP STRENGTH (MALES)

Group	N	Mean (lbs)	MS	df	F
Group One	52	114.50			
Group Two	15	123.13			
Group Three	11	122.36			
Group Four	16	115.81			
Group Five	38	123.76			
Group Six	14	121.71			
Group Seven	13	116.23			
Group Eight	11	114.09			
Group Nine	12	124.33			
			408.43	8	1.22^{NS}

Group One: Bankers
Group Two: Attorneys
Group Three: Physicians (Chiropodist, Veterinarian, Optometrist, Dentist, Nurse, Pharmacist, and Health Profession)
Group Four: Real Estate, Insurance, and Abstractors
Group Five: Merchants, Sales, and Delivery Services
Group Six: Construction
Group Seven: Engineers
Group Eight: Oil Business (Executive Duty)
Group Nine: Professors, Administrators and City Managers

TABLE XCVII

COMPARISON OF LEG STRENGTH (MALES)

Group	N	Mean (lbs)	MS	df	F
Group One	52	113.46			
Group Two	15	124.73			
Group Three	11	125.64			
Group Four	16	114.63			
Group Five	34	116.32			
Group Six	14	120.93			
Group Seven	13	121.69			
Group Eight	11	121.36			
Group Nine	12	123.58			
			433.86	8	0.81^{NS}

Group One: Bankers
Group Two: Attorneys
Group Three: Physicians (Chiropodist, Veterinarian, Optometrist, Dentist, Nurse, Pharmacist, and Health Profession)
Group Four: Real Estate, Insurance, and Abstractors
Group Five: Merchants, Sales, and Delivery Services
Group Six: Construction
Group Seven: Engineers
Group Eight: Oil Business (Executive Duty)
Group Nine: Professors, Administrators and City Managers

TABLE XCVIII

COMPARISON OF PUSH STRENGTH (MALES)

Group	N	Mean (lbs)	MS	df	F
Group One	51	106.37			
Group Two	15	103.60			
Group Three	11	116.64			
Group Four	16	100.50			
Group Five	38	119.24			
Group Six	14	111.43			
Group Seven	13	110.00			
Group Eight	11	108.18			
Group Nine	12	105.08			
			848.19	8	1.28^{NS}

Group One: Bankers
Group Two: Attorneys
Group Three: Physicians (Chiropodist, Veterinarian, Optometrist, Dentist, Nurse, Pharmacist, and Health Profession)
Group Four: Real Estate, Insurance, and Abstractors
Group Five: Merchants, Sales, and Delivery Services
Group Six: Construction
Group Seven: Engineers
Group Eight: Oil Business (Executive Duty)
Group Nine: Professors, Administrators and City Managers

TABLE XCIX

COMPARISON OF PULL STRENGTH (MALES)

Group	N	Mean (lbs)	MS	df	F
Group One	52	90.04			
Group Two	15	87.47			
Group Three	11	84.82			
Group Four	16	86.19			
Group Five	38	90.82			
Group Six	14	85.71			
Group Seven	13	85.85			
Group Eight	11	87.27			
Group Nine	12	89.25			
			100.13	8	0.23^{NS}

Group One: Bankers
Group Two: Attorneys
Group Three: Physicians (Chiropodist, Veterinarian, Optometrist, Dentist, Nurse, Pharmacist, and Health Profession)
Group Four: Real Estate, Insurance, and Abstractors
Group Five: Merchants, Sales, and Delivery Services
Group Six: Construction
Group Seven: Engineers
Group Eight: Oil Business (Executive Duty)
Group Nine: Professors, Administrators and City Managers

TABLE C

COMPARISON OF VERTICAL JUMP REACTION TIME (MALES)

Group	N	Mean (sec)	MS	df	F
Group One	52	0.32			
Group Two	15	0.29			
Group Three	11	0.32			
Group Four	16	0.32			
Group Five	38	0.32			
Group Six	14	0.32			
Group Seven	13	0.34			
Group Eight	11	0.33			
Group Nine	12	0.31			
			0.002	8	0.70^{NS}

Group One: Bankers
Group Two: Attorneys
Group Three: Physicians (Chiropodist, Veterinarian, Optometrist, Dentist, Nurse, Pharmacist, and Health Profession)
Group Four: Real Estate, Insurance, and Abstractors
Group Five: Merchants, Sales, and Delivery Services
Group Six: Construction
Group Seven: Engineers
Group Eight: Oil Business (Executive Duty)
Group Nine: Professors, Administrators and City Managers

TABLE CI

COMPARISON OF REACTION TIME TO SOUND (MALES)

Group	N	Mean (sec)	MS	df	F
Group One	52	0.17			
Group Two	15	0.16			
Group Three	11	0.15			
Group Four	16	0.17			
Group Five	38	0.17			
Group Six	13	0.17			
Group Seven	13	0.18			
Group Eight	11	0.17			
Group Nine	12	0.16			
			0.001	8	0.77^{NS}

Group One: Bankers
Group Two: Attorneys
Group Three: Physicians (Chiropodist, Veterinarian, Optometrist, Dentist, Nurse, Pharmacist, and Health Profession)
Group Four: Real Estate, Insurance, and Abstractors
Group Five: Merchants, Sales, and Delivery Services
Group Six: Construction
Group Seven: Engineers
Group Eight: Oil Business (Executive Duty)
Group Nine: Professors, Administrators and City Managers

TABLE CII

COMPARISON OF FLEXIBILITY (MALES)

Group	N	Mean (inch)	MS	df	F
Group One	52	12.13			
Group Two	15	10.80			
Group Three	11	11.45			
Group Four	16	10.69			
Group Five	38	11.21			
Group Six	14	10.50			
Group Seven	13	10.23			
Group Eight	11	14.18			
Group Nine	12	11.42			
			19.51	8	1.36^{NS}

Group One: Bankers
Group Two: Attorneys
Group Three: Physicians (Chiropodist, Veterinarian, Optometrist, Dentist, Nurse, Pharmacist, and Health Profession)
Group Four: Real Estate, Insurance, and Abstractors
Group Five: Merchants, Sales, and Delivery Services
Group Six: Construction
Group Seven: Engineers
Group Eight: Oil Business (Executive Duty)
Group Nine: Professors, Administrators and City Managers

TABLE CIII

SUMMARY OF TEST AND RETEST DATA ON PAIRED COMPARISON TEST OF CONTINUOUS EXERCISER'S GROUP (N = 27)

Variables	Test	Retest	F
Percent body fat	26.93	26.09	2.81
Systolic blood pressure	129.79	125.21	3.81
Diastolic blood pressure	79.44	78.33	0.33
Lying pulse rate	69.33	68.56	0.65
Predicted maximum O_2 intake	34.23	39.03	28.86**

*P < .05

**P < .01

Table LXXXIII shows that there was a significant difference at the .01 level in the weekly aerobic points total among the nine professions. The mean of Group Three was higher than those of the others. There was no significant difference among the means of Group One, Two, Four, Five, Six, Seven, Eight, and Nine. This indicated that Group Three exercised more than the other groups did and should have better physical fitness than the rest of them.

Table XCI shows that there was a significant difference at the .05 level in the amplitude of the T wave among the nine professions. The mean of Group Three was higher than those of Group One, Four, Five, Six, and Nine. There was no significant difference among the means of Group Three, Seven, Two, and Eight or among the means of Group Seven, Two, Eight, One, Nine, Five, Six, and Four.

Table XCIV shows that there was a significant difference at the .01 level in the predicted maximum O_2 intake among the nine professions. The mean of Group Three was higher than the mean of Group One, Five, Four, and Eight. There was no significant difference among the means of Group Three, Six, Two, Seven, and Nine or among the means of Group Six, Two, Seven, Nine, One, Five, Four, and Eight or among the means of Group Two, Seven, Nine, One, Five, Four, and Eight.

Table XCV shows that there was a significant difference at the .01 level in the resting pulse rate among the nine professions. The mean of Group Seven was higher than those of Group One, Five, Four, Six, Eight, Two, and Three. There was no significant difference between the mean of Group Seven and Nine or among the means of Group Nine, One, Five, Four, Six, Eight, Two, and Three.

There were no significant differences observable among the nine professions in the lying systolic blood pressure (Table LXXXIV), the lying diastolic blood pressure (Table LXXXV), the resting O_2 intake (Table LXXXVI), the timed vital capacity (Table LXXXVII), the vital capacity (Table LXXXVIII), the maximum breathing capacity (Table LXXXIX), the amplitude of the R wave (Table XC), the rest-work ratio (Table XCII), the weight residual (Table XCIII), the grip strength (Table XCVI), the leg strength (Table XCVII), the push strength (Table XCVIII), the pull strength (Table XCIX), the vertical jump reaction time (Table C), the reaction time to sound (Table CI), the flexibility (Table CII), and the O_2 saturation (Table CIII).

In addition to being younger, the health related professionals, Group Three, had the best scores on the weekly aerobic points total ($P < .01$), the lying systolic blood pressure, the lying diastolic blood pressure, the timed vital capacity, the vital capacity, the maximum breathing capacity, the amplitude of the R wave, the amplitude of the T wave ($P < .05$), the rest-work ratio, the weight residual, the predicted maximum O_2 intake ($P < .01$), the lying pulse rate ($P < .01$), the leg strength, and the reaction time to sound. Group Two scored higher on the resting O_2 intake and the vertical jump reaction time. Group Four had the highest score on the O_2 saturation. Group Five had the highest score on the push and pull strength. Group Seven had the highest score on the flexibility. Group Nine had the highest score on the grip strength.

Step eight in the statistical analysis was to measure the means of a list of variables in the study contrasting test and retest scores in an attempt to ascertain if some changes had occurred among sixty-four subjects in the commercial group. The physiological variables which were used in this study were the percent of body fat, the lying systolic and diastolic blood pressure, the lying pulse rate, and the predicted maximum O_2 intake. A paired comparison test was used to analyze the changes. The results of the "F" test applied to each variable for both tests are shown in Tables CIII through Table CV.

According to the interview, the subjects were classified into three groups: Continuous Exercisers, New Exercisers, and Non Exercisers. The Continuous Exerciser Group consisted of the subjects who regularly exercised before and after the first test. The New Exerciser Group consisted of the subjects who did not exercise before the first test but did exercise after the first test. The Non Exerciser Group consisted of the subjects who did not exercise before or after the first test.

TABLE CIV

SUMMARY OF TEST AND RETEST DATA ON PAIRED COMPARISON TEST OF NEW EXERCISER'S GROUP (N = 24)

Variables	Test	Retest	F
Percent body fat	26.20	24.97	5.15*
Systolic blood pressure	129.26	124.81	5.39*
Diastolic blood pressure	82.08	78.75	2.63
Lying pulse rate	73.50	70.50	3.83
Predicted maximum O_2 intake	30.89	35.01	44.19**

*$P < .05$

**$P < .01$

TABLE CV

SUMMARY OF TEST AND RETEST DATA ON PAIRED COMPARISON TEST OF NON EXERCISER'S GROUP (N = 13)

Variables	Test	Retest	F
Percent body fat	25.27	25.38	0.03
Systolic blood pressure	124.23	132.69	3.89
Diastolic blood pressure	80.38	83.85	1.15
Lying pulse rate	67.38	71.31	1.46
Predicted maximum O_2 intake	34.08	34.83	2.10

Table CIII shows that there was a significant increase from 34.24 to 39.03 ml. kg. min. ($P < .01$) in the predicted maximum O_2 intake of the Continuous Exerciser's Group. This indicates that this group may have accelerated their physical activity patterns which contributed to an increase of the predicted maximum O_2 intake. There were no significant differences observable in the percent body fat, the lying systolic and diastolic blood pressure, and the lying pulse rate of the Continuous Exerciser's Group.

Table CIV shows that there were significant decreases from 26.20 to 24.97 lbs ($P < .05$) in the percent body fat, from 129.26 to 124.81 mm Hg. ($P < .05$) in the systolic blood pressure, and an increase from 30.89 to 35.01 ml. kg. min. ($P < .01$) in the predicted maximum O_2 intake of the New Exerciser's Group. This indicates that the exercise did improve those physiological variables. There were no significant differences observable in the lying diastolic blood pressure and the lying pulse rate of the New Exerciser's Group.

Table CVI shows that there were no significant differences observable in any physiological variables of the Non Exerciser's Group. Since this group was considered the non-exercise group, the improvement of those physiological variables would not be expected to occur.

Summary of Results

Except for the resting O_2 intake and the timed vital capacity, most of the physiological variables of the Oklahoma State University faculty were better than those of the commercial males.

As the mean age increased one year, all tested males showed an increase in their lying diastolic blood pressure and a decrease in their vital capacity, amplitude of the R and T waves, predicted maxmum O_2 intake, and lying pulse rate. These changes tend to agree with the previous reports.

There were significant differences between males and females of the commercial group in their lying systolic and diastolic blood pressure, resting O_2 intake, vital capacity, maximum breathing capacity, rest-work ratio, weight residual, predicted maximum O_2 intake, lying pulse rates, grip and leg strength, push and pull strength, reaction time to sound, vertical jump reaction time, flexibility, and O_2 saturation. Most previous studies indicated that males have better physical fitness scores than females. These data also agree with those studies.

As the mean age increased one year, males and females in the commercial group showed increases in the lying systolic and diastolic blood pressure, the reaction time tests, and the flexibility, and decreases in the amplitude of the R wave, predicted maximum O_2 intake, and all of the strength tests. Only the male group showed decreases in the vital capacity, the amplitude of the T wave, and the O_2 saturation.

Among three different communities, the females in Shawnee who were the youngest had the highest significant scores on the lying systolic and diastolic blood pressure, the vital capacity, and the maximum breathing capacity. The females in the Duncan group had the highest significant score on the lying pulse rate.

Among eight different communities, the males in Cushing who were the youngest had the highest significant scores on the timed vital capacity, the maximum breathing capacity, the amplitude of the T wave, and the O_2 saturation.

Among nine different professions, the health related profession exercised habitually according to their weekly aerobic points total. They were the youngest group and had the highest significant scores on the amplitude of the T wave, the predicted maximum O_2 intake, and the lying pulse rate. These scores tend to support the value of exercise in attaining high fitness scores.

Between the test and retest on the physiological variables of the commercial group, the group who exercised before and after the test showed an increase in the predicted maximum O_2 intake. The group who did not exercise before the first test but did after the first test showed a decrease in the percent body fat, the lying systolic blood pressure, and an increase in the predicted maximum O_2 intake. The group who did not exercise before and after the first test showed no significant change in any selected physiological variables.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The purpose of this study was to compare the physical fitness level of the Oklahoma State University faculty group (N = 62) with those of the commercial group (N = 308) which were tested in the Mobile Lab program. The results of the physiological tests administered to the subjects in the study indicated the following conclusions:

1. There is no significant difference in the results of the physiological variables between males of the Oklahoma State University faculty and males of the Commercial Group.

Hypothesis One was rejected for the weekly aerobic points total, the lying systolic and diastolic blood pressure, the amplitude of the R and T waves, the rest-work ratio, the vital capacity, the maximum breathing capacity, the weight residual, the predicted maximum O_2 intake, and the lying pulse rate. It was accepted for the resting O_2 intake and the timed vital capacity.

2. There is no significant mean change with mean age increased one year of the physiological variables among all males tested.

Hypothesis Two was rejected for the lying diastolic blood pressure, the vital capacity, the amplitude of the R and T waves, the predicted maximum O_2 intake, and the lying pulse rate. It was accepted for the lying systolic blood pressure, the resting O_2 intake, the timed vital capacity, the maximum breathing capacity, the rest-work ratio, and the weight residual.

3. There is no significant difference in the results of the physiological measures between males and females of the Commercial Group.

Hypothesis Three was rejected for the lying systolic and diastolic blood pressure, the resting O_2 intake, the vital capacity, the maximum breathing capacity, the rest-work ratio, the weight residual, the predicted maximum O_2 intake, the lying pulse rate, the grip and leg strength, the push and pull strength, the vertical jump reaction time, the reaction time to sound, the flexibility, and the O_2 saturation. It was accepted for the weekly aerobic points total, the timed vital capacity, and the amplitude of the R and T waves.

4. There is no significant mean change with mean age increased one year of the physiological variables among males and females of the Commercial Group.

Hypothesis Four was rejected for the amplitude of the R wave, the predicted maximum O_2 intake, the grip strength, the leg strength, the push strength, the pull strength, and the flexibility, and in the male group only for the vital capacity, the amplitude of the T wave, and the O_2 saturation. It was accepted for the weekly aerobic points total, the resting O_2 intake, the timed vital capacity, the maximum breathing capacity, the rest-work ratio, the weight residual, and the lying pulse rate.

5. There is no significant difference in the results of the physiological measures between females of three different communities in the Commercial Group.

Hypothesis Five was rejected for the lying systolic and diastolic blood pressure, the vital capacity, the maximum breathing capacity, and the lying pulse rate. It was accepted for the weekly aerobic points total, the resting O_2 intake, the timed vital capacity, the amplitude of the R and T waves, the rest-work ratio, the weight residual, the predicted maximum O_2 intake, the grip and leg strength, the push and pull strength, the vertical jump reaction time, the flexibility, and the O_2 saturation.

6. There is no significant difference in the results of the physiological measures between males of eight different communities in the Commercial Group.

Hypothesis Six was rejected for the timed vital capacity, the maximum breathing capacity, the amplitude of the T wave, and the O_2 saturation. It was accepted for the weekly aerobic points total, the lying systolic and diastolic blood pressure, the resting O_2 intake, the vital capacity, the amplitude of the R wave, the rest-work ratio, the weight residual, the predicted maximum O_2 intake, the lying pulse rate, the grip and leg strength, the push and pull strength, the vertical jump reaction time, the reaction time to sound, and the flexibility.

7. There is no significant difference in the results of the physiological measures between males of nine different professional groups.

Hypothesis Seven was rejected for the weekly aerobic points total, the amplitude of the T wave, the predicted maximum O_2 intake, and the lying pulse rate. It was accepted for the lying systolic and diastolic blood pressure, the resting O_2 intake, the timed vital capacity, the vital capacity, the maximum breathing capacity, the amplitude of the R wave, the rest-work ratio, the weight residual, the grip and leg strength, the push and pull strength, the vertical jump reaction time, the reaction time to sound, the flexibility, and the O_2 saturation.

8. There is no significant difference between test and retest scores of 64 subjects who were re-evaluated during the year of 1979-1980.

Hypothesis Eight was rejected for the predicted maximum O_2 intake on the subjects who regularly exercised before and after the first test and for the percent body fat, and the lying systolic blood pressure, and the predicted maximum O_2 intake on the subjects who did not exercise before the first test but did later. It was accepted for the percent body fat, the lying systolic and diastolic blood pressure, and the lying pulse rate on the subjects who regularly exercised before and after the first test, for the lying diastolic blood pressure and the lying pulse rate on the subjects who did not exercise before the first test but did later, and for all physiological variables on the subjects who did not exercise before or after the first test.

Recommendations

1. Follow-up studies should be carried on every year by using the same subjects to indicate the lasting effects of the exercise.

2. Further studies should be done to determine how many subjects do exercise after receiving an exercise prescription.

3. An attempt should be made to determine the exercise compliance in relation to the exercise group programs that are available in the communities.

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APPENDIX A

SUMMARY SHEET

OKLAHOMA STATE UNIVERSITY
PHYSIOLOGY OF EXERCISE LABORATORY
PHYSICAL FITNESS SUMMARY SHEET

DATE__________ FACULTY______ ADMIN.______ OTHER__________

NAME__________ HOME ADDRESS__________ PHONE______

DEPT.__________ BLDG. ROOM__________ EXT.______

AGE______ HEIGHT (NO SHOES)______ WEIGHT (NO SHOES)____ BSA____

PHYSICIAN__________ TOWN__________

LAST MEDICAL EXAM (DATE)__________ CONTRAINDICATIONS__________

SMOKING: NON SMOKER______ QUIT______ YEARS SMOKED______ TYPE AND AMOUNT______
SMOKER______ TYPE______ YEARS SMOKED______ AMOUNT______

ACTIVITY PATTERN: TYPE OF ACTIVITY__________
FREQUENCY__________ AMOUNT__________
AVERAGE AEROBIC PTS./WEEK______ TIME ON THIS PATTERN____

RESTING: PULSE RATE-SITTING______ LYING______ STANDING______

BLOOD PRESSURE: SITTING______ LYING______ STANDING______

SCHNEIDER INDEX______ ICE WATER______ CHANGE______

OXYGEN INTAKE: CLOSED______ OPEN______ MIN. VOL VENT______

VENT EQUIV.______ OXYGEN SAT.______ TVC______

VITAL CAP.______ % OF NORM______ MBC______ % OF NORM______

EKG: PULSE RATE______ AMP. P______ AMP. R______ AMP.T______
WORK TIME______ REST TIME______ REST/WORK______ ST. DEPRESSION____
Q-IHS______ ARRHYTHMIA__________

ANTHROPOMETRIC: PREDICTED WT. BEHNKE 4 MEAS.______ BEHNKE 11 MEAS.____ RES.____
CURETON SKELETAL______ MUSCULAR______ R. WRIST DIAM.______
SKINFOLD FAT: ARM______ CHEST______ ABDOM.______
SUBSCAPULAR______ ILLIAC______
% BODY FAT______ SP GR.______

EXERCISE TEST: ASTRAND BICYCLE: HEART RATE____ PRED. OXYGEN INTAKEL____ ML/KG____
BALKE TREADMILL: % GRADE AT 180______ PRED. OXYGEN L______ ML/KG____ CLASS____
OPEN CIRCUIT MEASURES: OXYGEN INTAKE AT____ HR OXYGEN INTAKE AT______ HR
PRED. MAXIMAL OXYGEN INTAKE L______ ML/KG______
MEASURED MAXIMAL OXYGEN INTAKE L______ ML/KG______ HR______
OXYGEN DEBT REPAID:______ LITERS IN______ MIN.

EXERCISE EKG CHANGES:

RECOVERY EKG CHANGES:

RECOVERY TIME: 1 2 3 4 5
HEART RATE:
BLOOD PRESSURE:

APPENDIX B

BEST BODY COMPOSITION NOMOGRAM FOR MALES

Table 19-1
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 ____________

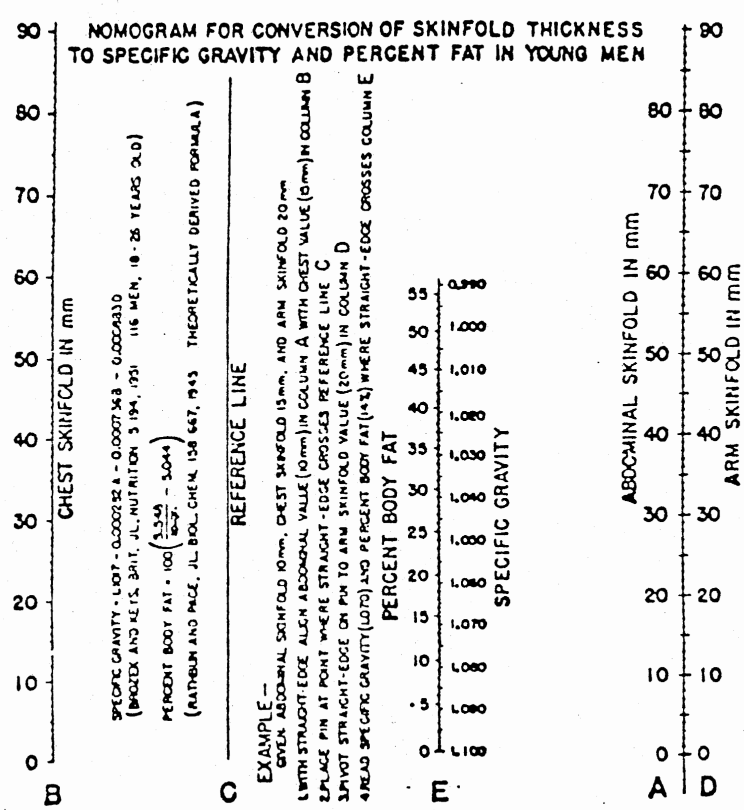


Figure 19-2. Nomogram for conversion of skinfold thickness to specific gravity and percent fat in young men. (From W.R. Best USAMRNL Report no. 113. August, 1953.).

APPENDIX C

BEST BODY COMPOSITION NOMOGRAM FOR FEMALES

Table 20-1
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. Iliac						
2. Arm						

Specific Gravity__________ Specific Gravity__________

Percent Body fat __________ Percent Body fat __________

Using these average values, calculate the density and percent body fat as in the following example:

X_2 (iliac skinfold thickness) = 19.2 mm.

X_3 (arm skinfold thickness) = 16.1 mm.

$$X_1 = 1.0764 - 0.00081\,X_2 - 0.00088\,X_3$$

$$= 1.0764 - (0.00081 \times 19.2) - (0.00088 \times 16.1)$$

$$= 1.0764 - (0.015552) - (0.014168)$$

$$= 1.0764 - 0.029720 = 1.04668$$

then

$$\%F = \left(\frac{4.201}{D} - 3.813\right) 100$$

$$= \left(\frac{4.201}{1.04668} - 3.813\right) 100$$

$$= (4.014 - 3.813)\ 100$$

= 20.1 percent.

APPENDIX D

BEHNKE BODY BUILD ANALYSIS SHEET

ANALYSIS OF BODY BUILD

Table 21-2
Data Collection for Analysis of Body Build by Method of A.R. Behnke

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) $d^2 \times H$
	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 $\frac{C}{K} = \frac{\text{Sum (col. 2)}}{300}$ ____________

APPENDIX E

INFORMED CONSENT SHEET

OKLAHOMA STATE UNIVERSITY

PHYSIOLOGY OF EXERCISE LABORATORY

INFORMED CONSENT FORM

Subject's name________________________ Date______________

I hereby authorize Dr. A. B. Harrison and/or such assistants as may be selected by him to perform the following procedure (s) and investigation (s):

A laboratory physical fitness evaluation including electrocardiogram, phonocardiogram, pulse waves, blood pressure, weight analysis, respiratory capacities and function and a treadmill walking test to predict maximal oxygen intake capacity,

on______________________________.
Subject

The procedure (s) and investigation (s) has (have) been explained to me by Dr. A. B. Harrison or his assistant.

I understand that the procedure (s) and investigation (s) involve the following possible risks and discomforts:

All tests except the treadmill walk are resting tests and involve no unusual risk or discomfort. The treadmill test involves walking at a gradually increasing grade up to a target heart rate. The target heart rate is determined by age level, medical and physical condition. The EKG is monitored during the treadmill walk and the test is terminated upon signs of cardiac distress. The subject is free to terminate the test at any time at his own discretion.

I also understand that all test records will be kept confidential and will not be released to anyone without permission of myself or family. Test results will be tabulated for research purposes as group data and in no case will a subject's personal identity be associated with his test results without his express permission.

I understand that the potential benefits of the investigation are as follows:

The results of the test battery will give the subject an in depth view of his current fitness status. Test results will be explained and interpreted to the subject. Guidance concerning exercise programs will be given. Subjects will be encouraged to engage in a systematic exercise program to produce favorable changes in test scores. Subjects will be offered the opportunity for a re-evaluation annually.

I understand that I may terminate my participation in the study at any time.

Subject's signature___________________________

Witness______________________________________

APPENDIX F

TREADMILL RESULTS AT 3.4 MPH

Treadmill Results

NAME ______________________ AGE ________ SEX ________ DATE ____________

Resting: Heart Rate Blood Pressure Cat. ______________

Supine ______________ _____/_____

Standing ______________ _____/_____

3.4 mph

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

Recovery: HR BP

3 min. __________ _______/_______

5 min. __________ _______/_______

8 min. __________ _______/_______

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

APPENDIX G

TREADMILL RESULTS AT 3.0 MPH

Treadmill Results

NAME ______________________ AGE ________ SEX __________ DATE ____________

Resting: Heart Rate Blood Pressure Cat. ______________

Supine ______________ ______/______

Standing ______________ ______/______

3.0 mph

Grade	METS / 02		Heart Rate	BP	EKG Comments
0	3.0	10.5			
2	3.9	13.65			
3	4.2	14.87			
4	4.5	15.75			
5	5.0	17.5			
6	5.4	18.9			
7	5.8	20.3			
8	6.2	21.7			
9	6.6	23.1			
10	7.0	24.5			
11	7.45	26.07			
12	7.9	27.65			
13	8.3	29.05			
14	8.7	30.45			
15	9.0	31.5			
16	9.5	33.25			
17	9.87	34.56			
18	10.25	35.87			
19	10.625	37.19			
20	11.0	38.5			

Recovery: HR BP

3 min. ______________ ________/________

5 min. ______________ ________/________

8 min. ______________ ________/________

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

APPENDIX H

COOPER'S AEROBIC FITNESS RATING SCALE

Cooper's Fitness Classification: Men

Category	Measure 0^{2}ml/kg/min	Age 13–19	20–29	30–39	40–49	50–59	60+
I. Very Poor		< 35.0	< 33.0	< 31.5	< 30.2	< 26.1	< 20.5
II. Poor		35.0–38.3	33.0–36.4	31.5–35.4	30.2–33.5	26.1–30.9	20.5–26.0
III. Fair		38.4–45.1	36.5–42.4	35.5–40.9	33.6–38.9	31.0–35.7	26.1–32.2
IV. Good		45.2–50.9	42.5–46.4	41.0–44.9	39.0–43.7	35.8–40.9	32.2–36.4
V. Excellent		51.0–55.9	46.5–52.4	45.0–49.4	43.8–48.0	41.0–45.3	36.5–44.2
VI. Superior		> 56.0	> 52.5	> 49.5	> 48.1	> 45.4	> 44.3

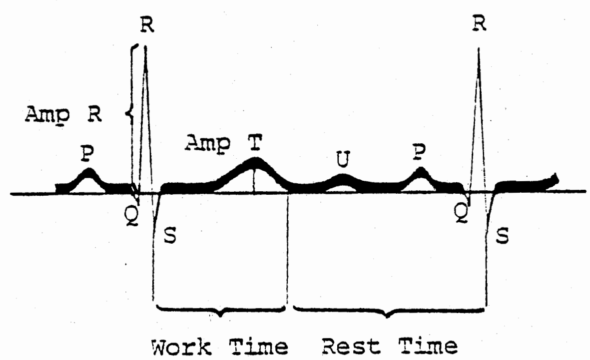
Coopers Fitness Classification: Women

Category	Measure 0^{2}ml/kg/min	Age 13–19	20–29	30–39	40–49	50–59	60+
I. Very Poor		< 25.0	< 23.6	< 22.8	< 21.0	< 20.2	< 17.5
II. Poor		25.0–30.9	23.6–28.9	22.8–26.9	21.0–26.4	20.2–22.7	17.5–20.3
III. Fair		31.0–34.9	29.0–32.9	27.0–31.4	24.5–28.9	22.8–26.9	20.2–24.4
IV. Good		35.0–38.9	33.0–36.9	31.5–35.6	29.0–32.8	27.0–31.4	24.5–30.2
V. Excellent		39.0–41.9	37.0–40.9	35.7–40.0	32.9–36.9	31.5–35.7	30.3–31.4
VI. Superior		> 42.0	> 41.0	> 40.1	> 37.0	> 35.8	> 31.5

APPENDIX I

SAMPLE: ELECTROCARDIOGRAM

SAMPLE OF ELECTROCARDIOGRAM



An example of measuring the amplitude of the R and T waves and the rest-work ratio.

VITA

Chalerm Chaiwatcharaporn

Candidate for the Degree of

Doctor of Education

Thesis: A COMPARISON OF THE PHYSICAL FITNESS LEVELS OF SELECTED OKLAHOMA STATE UNIVERSITY FACULTY AND SELECTED COMMERCIAL PEOPLE OF THE STATE OF OKLAHOMA

Major Field: Higher Education

Minor Field: Health, Physical Education and Recreation

Biographical:

Personal Data: Born in Bangkok, Thailand, October 2, 1951, the son of Chua Su Nguang and Ou Ngek Kiang. Married to Dhiraporn Dhiradhamrong in August, 1976.

Education: Graduated from Assumption Sriracha High School, Chonburi, Thailand, in March, 1971; received the Bachelor of Education degree from Chulalongkorn University with a major in Physical Education in March, 1975; received the Master of Science in Education degree from Central Missouri State University at Warrensburg, with a major in Physical Education in May, 1977; completed requirements for the Doctor of Education degree at Oklahoma State University in July, 1982.