THE EFFECT OF THE INCH MASTER EXERCISER ON BODY GIRTH, SUBCUTANEOUS FAT, AND SELECTED PHYSIOLOGICAL VARIABLES OF ADULT WOMEN

By

REGINALD LEE PRICE

Bachelor of Science
MacMurray College
Jacksonville, Illinois
1964

Master of Arts
The Ohio State University
Columbus, Ohio
1967

Submitted to the Faculty of the Graduate College
of the Oklahoma State University
in partial fulfillment of the requirements
for the Degree of
DOCTOR OF EDUCATION
May, 1973

THE EFFECT OF THE INCH MASTER EXERCISER ON
BODY GIRTH, SUBCUTANEOUS FAT, AND
SELECTED PHYSIOLOGICAL VARIABLES
OF ADULT WOMEN

Thesis Approved:

A. B. Harrison
Thesis Adviser

Albin P. Warner

Ruth Lindsey

D B Aichele

N N Durham
Dean of the Graduate College

ACKNOWLEDGMENTS

The author wishes to express his appreciation to his major adviser, Dr. Aix B. Harrison, for his guidance and assistance throughout this investigation. Appreciation is also expressed to the other committee members, Dr. Albin P. Warner, Dr. D. Ruth Lindsey, and Dr. Douglas B. Aichele, for their invaluable assistance in the preparation of the final manuscript.

A note of thanks is given to the very cooperative ladies who served as subjects for this study. Thanks are also extended to the fellow graduate students for their assistance in collection of the data, and to Mrs. Fry, the Inch Master Distributor for Oklahoma, for providing the Inch Master Exercisers. In addition, appreciation is extended to Mrs. Janie Martin for serving as the model for the photographs.

Finally, a special note of thanks is expressed to my wife, Kay, and our daughters, Wendy and Christy, for their unfailing encouragement and understanding while this investigation and manuscript were completed.

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES (CONTINUED)

CHAPTER I

INTRODUCTION

Many claims have been made regarding the effect of exercise on loss of body weight, spot reduction of subcutaneous fat, and physical fitness. Articles on these topics and related subjects appear regularly in popular magazines. These topics are becoming an ever increasing concern in our highly mechanized society where one's work requires shorter hours and less manual labor. Due to this reduction in manual labor, man has a lower caloric expenditure, plus his cardiovascular, respiratory and muscular systems are not used sufficiently to maintain a maximal level of efficiency. It is a known fact that exercise is necessary for growth and maintenance of optimum physiological function.[1] This lack of exercise contributes to two things. First, there is an increase in body weight, due to the accumulation of fat, and secondly, the physical fitness level of the individual decreases. This raises a question: what can a mechanized society of sedentary people do to obtain the necessary exercise to maintain desired levels of physical fitness and body weight? Seeking an answer to this question is of vital importance considering that overweight is one of the most prevalent health problems

[1]C. L. Anderson, Health Principles and Practice (2d ed., St. Louis, Mo.: The C. V. Mosby Company, 1970), p. 219.

in the United States today.[2] The general public's awareness of this situation and the need to resolve it, has resulted in great interest in various forms of exercise. Common topics of discussion, whenever men and/or women get together, are weight control and exercise activities.

Manufacturers are taking advantage of this increased interest in exercise, by flooding the market with various types of home exercise equipment. Among the hundreds of gadgets are numerous cycle type exercisers, walking treadmills, push-pull devices, rowing machines, and hinged-cot exercisers. The hinged cots include such trade name products as Inch Master, Slim-Gym, Flex-A-Lounge, Trim Lounger, Exer Flex, Skinny-Dipper, and Flip-Flop Lounge. Most of the home exercise equipment appeals to individuals who wish to control body weight and improve their physique or figure without devoting a large portion of time or energy to exercise activities. In essence, these individuals seek an "instant" and often "effortless" home type exercise program to fulfill their needs. Manufacturers and/or distributors claim their products meet these needs; hence, consumers, ignorant about the type and duration of exercise which is safe and effective, invest hundreds of millions of dollars in this equipment.[3] The purchases are based on manufacturer's claims rather than on scientific evidence, largely because little research has been done to either support or disprove the claims made by these companies. Consumers are interested in securing a simple prescribed exercise program which neatly fits into their busy

---

[2] Obesity and Health (Washington, D.C.: U. S. Department of Health, Education, and Welfare, No. 1485), p. iv.

[3] "Exercise Equipment: The Good, the Bad, and the Ugly," Fitness for Living, V (March-April, 1971), 25.

schedule.

The Inch Master Exerciser (Figure 1), which retails for $108.00 to $120.00, is one type of home exercise device which has achieved popularity. The Inch Master comes with a Home Exercise Course manual that contains an outlined six months course, plus illustrations of the various exercise positions and the recommended time duration and number of repetitions per minute for each exercise.

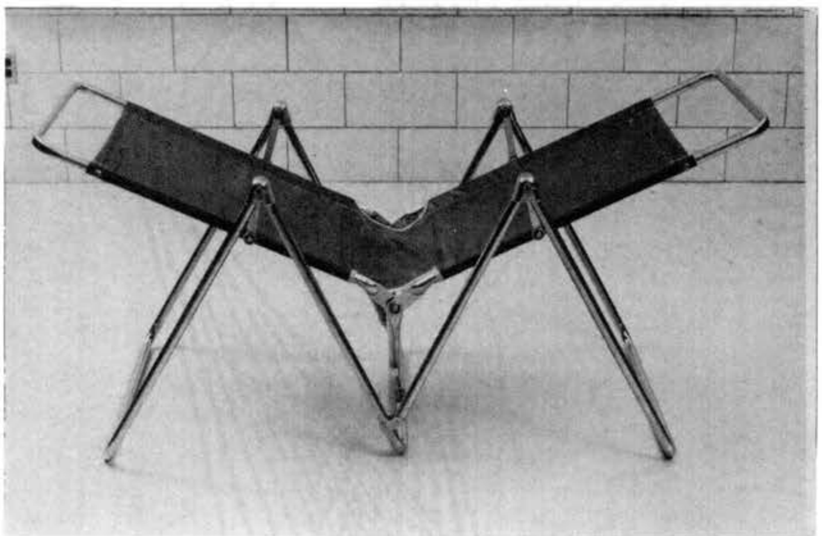


Figure 1. Inch Master Exerciser

Homex Corporation, national distributor of the Inch Master Exerciser, claims that the "Inch Master" will do five things:

(1) "Tone muscles by the principle of stretching and relaxing them."

(2) "Improve breathing."

(3) "Increase circulation throughout the body."

(4) "Spot reduce, which is one of the greatest benefits of the Inch Master."

(5) "Take off inches - without dieting."[4]

In addition to the aforementioned claims, various statements are made in conjunction with the illustration of the exercises. The Home Exercise manual also indicates the exercises are designed to cope with the areas of prime interest to women.[5] It is assumed, this is why specific claims are made in discussing each exercise.

Thighs - "This exercise works and strengthens the muscles in the thighs and upper legs, plus several sets of 35 to 40 complete motions per minute will take off inches."[6]

Alternating Leg Push - "One or two minutes a day, will give you more leg power than you can imagine."[7]

Yogi - "Will trim the inner thigh if done for three minutes per day."[8]

Flank - "Will trim the entire flank, or side of the body."[9]

Push-Up - "The 'Inch Master' push-up is about 70% as effective as doing one on the floor, but about two-thirds easier."[10]

Saddle Bend - "Two minutes per side per day, will show amazing

---

[4] Inch Master Home Exercise Course (Phoenix: Homex Corporation, 1970), pp. 3-7.

[5] Ibid., p. 7.

[6] Ibid.

[7] Ibid.

[8] Ibid., p. 8.

[9] Ibid.

[10] Ibid., p. 9.

results and quickly trim your ankles."[11]

V-Push - "This exercise will trim the fleshy under part of the upper arm, strengthen the upper arm, and firm and lift a woman's bustline, thereby giving her a more youthful appearance."[12]

Relaxation - "Increases the circulation to the face and brain and will put your organs where they belong."[13]

The manufacturer of Inch Master implies that each of the different exercises will produce change in the different body regions. However, the Home Exercise manual does not contain any scientifically based research information which substantiates or provides support for these implications.

This lack of information resulted in the author conducting a pilot investigation to determine the effects of a five week, twenty-five session, progressive Inch Master exercise program on the variables of body girth, subcutaneous fat, and vital capacity. Subjects were ten college age women. The pre-test and post-test means were tested for significance of difference utilizing the $\underline{t}$ test. The only significant decrease was body girth of the upper right arm.[14] In view of these results, it was decided that a more elaborate investigation, using more subjects, a control group, lasting six weeks, a heavier work load, and studying more variables, should be conducted to test the validity of

---

[11] Ibid., p. 10.

[12] Ibid., p. 11.

[13] Ibid., p. 12.

[14] Reginald L. Price, "A Study of the Effects of the Inch Master on Body Girth, Subcutaneous Fat, and Vital Capacity," (unpublisher HPER Research Paper, Oklahoma State University, 1970), p. 11.

the claims for this device.

Statement of the Problem

The purpose of this investigation was to determine the effect of a six week, thirty session exercise program, using the Inch Master Exerciser, on body girth, subcutaneous fat and the following physiological variables of women: strength, flexibility, cardiovascular fitness, aerobic capacity, and maximum breathing capacity. More specifically, the mean changes (increase and/or decrease) of the experimental group and control group were tested for significance of difference and variability in:

1. Body Girth
    a. Right upper arm
    b. Bust
    c. Waist
    d. Hips
    e. Right thigh
    f. Right calf
2. Subcutaneous Fat
    a. Right tricep
    b. Right subscapular
    c. Abdomen
    d. Upper chest
    e. Right thigh
3. Strength
    a. Abdominal
    b. Hip flexors

c. Shoulder extensors

d. Back extensors

e. Shoulder horizontal adductors and elbow extensors

4. Flexibility

a. Trunk extension

b. Lateral trunk flexion

c. Spinal rotation

5. Cardiovascular Fitness as measured by the Schneider Index

6. Aerobic Capacity

7. Vital Capacity

8. Maximum Breathing Capacity

In addition, a kinesiological analysis of the muscles used in the exercises and heart rate during exercise were examined to provide an in-depth study.

Statement of the Hypotheses

The purpose of the study was to test the following null hypotheses:

H_1: There would be no significant difference between the mean change in body girth for the members of the experimental group and the mean change in body girth for the members of the control group.

H_2: There would be no significant difference between the mean change in subcutaneous fat of the members of the experimental group and the mean change in subcutaneous fat for the members of the control group.

H_3: There would be no significant difference between the mean change in the strength of the members of the experimental group and the mean change in strength for the members of the control group.

H_4: There would be no significant difference between the mean change in flexibility of the members of the experimental group and the mean change in flexibility for the members of the control group.

H_5: There would be no significant difference between the mean change in aerobic capacity of the members of the experimental group and the mean change in aerobic capacity for the members of the control group.

H_6: There would be no significant difference between the mean change in Schneider Index scores of the members of the experimental group and the mean change in Schneider Index scores for the members of the control group.

H_7: There would be no significant difference between the mean change in vital capacity of the members of the experimental group and the mean change in vital capacity for the members of the control group.

H_8: There would be no significant difference between the mean change in maximum breathing capacity of the experimental group and the mean change in maximum breathing capacity for the control group.

These hypotheses were tested for statistical significance on the mean changes between groups. The level of significance acceptable was set at the .05 level.

Significance of the Study

This investigation provided scientific evidence regarding the effects of the Inch Master Exerciser on selected anthropometric and physiological variables.

Americans spend over $100,000,000 a year on exercise equipment. Much of this equipment has little or no scientific basis for support of its claims. According to Dr. William Haskell, former program director for the President's Council on Physical Fitness and Sports, there is indeed need for research to test the validity of claims of manufacturers because, "There seems to be an inverse relationship between the claims made and the actual effectiveness of a device; it appears that the greater the claims made the poorer the device."[15] Dr. Joseph B. Davis, Director of the Division of Clinical and Medical Devices for the Food and Drug Administration (FDA) states that many of the exercise devices on the market are "pure junk" and despite their makers' claims of proved medical worth, ". . . there is no valid scientific evidence at all that they work."[16] The American Medical Association's Committee on Exercise and Physical Fitness is concerned that individuals who use the effortless exercisers are being cheated out of proper exercise which could contribute to weight control and physical fitness.[17]

The lack of information pertaining to the effectiveness and

---

[15] "Exercise Equipment," Fitness for Living.

[16] Jean Carper, "Beware Those 'Quick-Reducing' Gadgets," Reader's Digest, XCIX (September, 1971), p. 60.

[17] Ibid.

possible harmfulness indicated a need for a comprehensive investigation. The data collected during the study will provide the consumer with some research based information on one type of exercise equipment, thus protecting his pocketbook as well as his health.

Limitations of the Study

The subjects in this study were "volunteers" and did not represent a random sampling. The experimental group and control group were not matched on the variables.

Delimitations of the Study

The investigation was limited to the study of adult women between the ages of 20-48 years.

Assumptions of the Study

In the investigation, the following assumptions were made:

1. The control group subjects' exercise patterns were not changed during the period of this investigation.
2. The experimental group and control group subjects' diet patterns were not changed during the experimental program.

Definition of Terms

1. Aerobic capacity: Aerobic capacity is the maximal rate at which oxygen can be consumed.[18]

---

[18]Donald K. Mathews and Edward L. Fox, The Physiological Basis of Physical Education and Athletics (Philadelphia: W. B. Saunders Company, 1971), p. 19.

2. Body girth: Body girth is the dimension of body parts as determined by measuring the circumference.

3. Cardiovascular fitness: Cardiovascular fitness is the ability of the cardiovascular system to take up oxygen and utilize it in the energy production.

4. Control group: The control group consisted of twenty-seven adult women who engaged in their normal daily routines during the six week investigation, and did not engage in any exercise program.

5. Experimental group: The experimental group consisted of twenty-five adult women who participated in a six week, thirty session, exercise program on the Inch Master Exerciser, in addition to their normal daily routines during the study.

6. Flexibility: Flexibility is the range of motion as measured by the ability to bend and/or rotate in a given direction with the aid of gravity and muscle power from the individuals.

7. Inch Master Exerciser: The exercise equipment, a hinged cot, utilized for the exercise sessions was the Inch Master Exerciser, Patent No. 3315666.[19] (Figure 1)

8. Kinesiological analysis: The kinesiological analysis of exercises determined prime moving muscle groups involved by observation of the joint action taking place and the application of anatomical and mechanical principles.

9. Maximum breathing capacity: Maximum breathing capacity is the maximal volume of air that can be moved in and out of the lungs in one minute.[20]

10. Mean change: Mean change was considered as either an "increase" and/or a "decrease" in the mean measurements for the experimental group or the control group. Mean change was viewed as a two tailed test.

11. Muscle tone: Muscle tone is a quality of firmness due to a state of partial tetanus and/or elasticity, which is ascertained by palpation and by resistance to passive movements.[21]

---

[19]The Inch Master Story (Phoenix: Homex Corporation, 1970), p. 2.

[20]C. Frank Consolazio, Robert E. Johnson, and Louis J. Pecora, Physiological Measurements of Metabolic Functions in Man (New York: McGraw-Hill Book Company, 1963), p. 225.

[21]Peter V. Karpovich and Wayne E. Sinning, Physiology of Muscular Activity (Philadelphia: W. B. Saunders Company, 1971), p. 29.

12. Schneider Index: The Schneider Index is a test of cardiovascular fitness which is based on heart rate and blood pressure under three circumstances: lying, standing, and after a brief stepping exercise.

13. Spot reduction: Spot reduction is a decrease in a specific body part and/or region (such as thigh) as determined by circumference (girth) and/or subcutaneous fat level.

14. Strength: For this investigation, strength is the maximum amount of static force applied by muscle groups for a specific action at a given angle in one trial.[22]

15. Subcutaneous fat: Subcutaneous fat is the adipose tissue directly beneath the skin surface which can be pinched with a Skin Caliper.

16. Vital capacity: Vital capacity is the maximal volume of air that can be expired after forced inspiration.

---

[22]Mathews and Fox, The Physiological Basis of Physical Education and Athletics, p. 68.

CHAPTER II

REVIEW OF LITERATURE

In reviewing the literature, a lack of research regarding the effects of exercise equipment was most evident. This seemed most unusual considering the great variety in types of exercise equipment available on the market and the amount of money invested in the purchasing of these devices. Current popular publications do not contain any articles discussing the use, benefits, and/or effects of exercise equipment, such as the Inch Master Exerciser. Apparently very little research is being devoted to this area.

Due to the scope of this investigation, the related literature reviewed was limited to completed studies which involved motorized or non-motorized exercise equipment. Since the study was also concerned with spot reduction, a section of this chapter was devoted to the presentation of literature concerning this topic.

The literature reviewed will be presented under the following headings: (1) Studies on Motorized Exercise Equipment, (2) Studies on Non-Motorized Exercise Equipment, (3) Studies on the Inch Master Exerciser, and (4) Studies on Spot Reduction.

Studies on Motorized Exercise Equipment

Studies in this area have been concerned with either the motor-driven bicycle ergometer (Exercycle) or motor-driven vibrating equipment.

The reviewed literature will be presented under the following sub-headings: (1) Studies on the Exercycle, and (2) Studies on Vibrating Equipment.

Studies on the Exercycle

Utilizing the Exercycle, Fries[1] investigated the cardiovascular response to passive and active exercise. Two adult women, ages 22 and 32 years, were used as subjects. The heart rate, blood pressure, and pulse pressure of each subject were recorded in the recumbent and sitting positions prior to and following each of the eight exercise sessions. During each of the ten minute sessions, subjects rode the Exercycle in a different exercise, which ranged from mild passive activity to heavy work. In all eight exercises, the varying degree of active exercise was limited to the arms, shoulders, and trunk muscles. The legs were always engaged in passive activity.

Fries observed that passive exercise resulted in negligible changes in the subjects' heart rate and blood pressure, and caloric expenditure increased only two to three times over the sitting rate. When the subject engaged in heavy work, noticeable cardiovascular adjustments occurred and caloric expenditure increased to eleven times over the sitting rate. She concluded:

> (1) The circulatory adjustment of the individual to a given exercise on the motor-driven bicycle ergometer offers an objective method of defining the severity of the work done.
>
> (2) Exercises can be performed on this machine which range from

---

[1]E. Corinne Fries, "Some Physiologic Effects of Passive and Active Exercise: The Cardiovascular Response to Graded Exercises," Archives of Physical Therapy, XXV (September, 1944), 540-44.

a mild passive type involving no circulatory stress, to those of heavy muscular work, causing vascular adjustments paralleling those of anaerobic activity.

(3) The rapid leg motion, as incited passively by the machine, exerts little or no effect on the general circulatory mechanism.[2]

In another study, Fries[3] investigated the training effects on the strength level of specific muscle groups used in riding the Exercycle. The eleven adult women, ages 20 to 41 years, rode the Exercycle ten minutes per day for 21 consecutive days. The exercise program, which was utilized daily, consisted of eight different exercises that ranged from passive activity to active exercise. A modified Martin Strength Test was used to pre-test and post-test the following muscle groups: (1) shoulder protractors and retractors, (2) elbow flexors and extensors, (3) hip extensors, (4) knee extensors and flexors, and (5) abdominals. The data were statistically evaluated by computing the critical ratio for each muscle group. Significant ratios were noted in the abdominals, shoulder protractors and retractors, knee extensors, and hip extensors. The most significant increase was attained by the abdominal muscles. Fries concluded that a short period of systematized daily training on an Exercycle will produce a demonstrable increase in muscle strength in those groups which are made to develop active tension during exercise. In addition, it appears the flexors and extensors of the elbow joint were used very little in performing the strong arm movements of the active exercises.

---

[2]Ibid., 545.

[3]E. Corinne Fries, "Some Physiological Effects of Passive and Active Exercise: Training Effects on the Strength of Specific Muscle Groups," Archives of Physical Therapy, XXV (September, 1944), 546-49.

Saunders[4] used the Exercycle to investigate the metabolic cost of passive cycling movements at two rates of pedal rotation, 56 r.p.m. and 74 r.p.m. He defined cycling movements that were motor assisted as passive cycling. The rate of rotation was not the determining factor as to whether the cycling movement was passive or active exercise. Five subjects, four males and one female, ages 19 to 27 years, participated in 122 exercise sessions. The metabolic rate of the subjects was determined utilizing the indirect method; hence, expired air was collected prior to, during and following each exercise ride and analyzed with a Haldane apparatus. It was found that when a subject engaged in slow passive cycling movements (46 r.p.m.) the metabolic cost was seven to fifteen calories per hour. Fast passive cycling movements (74 r.p.m.) resulted in a metabolic cost of nineteen to twenty-six calories per hour. Saunders attributed this increase in metabolism to increased muscle tone, respiration, and extra effort required to maintain posture.

Jensen[5] investigated the effects that passive exercise on the Exercycle had on various metabolic measurements, especially energy metabolism. Ten college women, ages 18 to 34 years participated in thirty, thirty-minute exercise sessions. Indirect calorimetry was utilized to determine each subject's basal and sitting resting metabolism prior to exercise, exercise metabolism during the last five minutes of the ride, and recovery metabolism during a ten minute recovery period. Expired gases were collected in Douglas bags and analyzed for oxygen and carbon

---

[4] J. A. Saunders, "The Metabolic Cost of Passive Cycling Movements," Journal of Physiology, CVIII (May, 1949), 353-358.

[5] Annelis Strange Jensen, "The Metabolic Cost of Riding an Exercycle," (unpublished Master's thesis, University of Illinois, 1952), pp. 1-2.

dioxide content with the modified Haldane apparatus. Respiratory quotients, oxygen intake, energy cost, and metabolic rates of each subject were determined and presented by the case study method.

Jensen's study yielded the following information:

(1) The mean exercise respiratory quotient (R.Q.) showed a very slight rise from the resting R.Q. value.

(2) The metabolic rate during exercise was only two to three times greater than the resting rate.

(3) Training on the Exercycle had little or no influence upon oxygen intakes.

(4) The net oxygen debt averaged .59 liters and was repaid within the ten minute recovery period.

(5) The ratio of total energy metabolic rate to the sitting resting metabolic rate showed an overall mean of 1.97; thus, the exercise was only twice as strenuous as quiet sitting.

(6) The caloric cost of the exercise averaged 64.63 calories per thirty minute ride. The caloric cost per minute was 2.15 calories. This suggests there are many more efficient ways of losing weight than riding the Exercycle.[6]

Pollack[7] conducted a study which determined and compared the metabolic cost of work performed on the Exercycle and the Resistance Bicycle, which is a non-motorized piece of exercise equipment. Eight

---

[6] Ibid., pp. 53-54.

[7] Michael Lee Pollack, "The Metabolic Cost of the Exercycle and Resistance Bicycle on Middle-Aged Women," (unpublished Master's thesis, University of Illinois, 1961), pp. 1-3.

adult women, ages 25 to 54 years, served as subjects with four riding the Exercycle and four riding the Resistance Bicycle. Each subject participated in two exercise sessions with the Exercycle group riding for one hour each session and the Resistance Bicycle group riding for thirty minutes each session. Indirect calorimetry was utilized to determine each subject's metabolic rate in the sitting resting position prior to exercise, during the first and last ten minutes of exercise, and following exercise during the fifteen minute recovery period. In addition, pulse rates, blood pressures, respiratory quotients (R.Q.), true oxygen values, oxygen debts, caloric cost, and net oxygen intake were determined and all results were presented by the case study method.

In comparing the results of the Exercycle group and Resistance Bicycle group, the following information was revealed:

(1) The R.Q. of the Exercycle group increased slightly during exercise and recovery while the R.Q. of the Resistance Bicycle group showed considerable increase during the same period.

(2) Even though the oxygen intake level of both groups increased during exercise, the Resistance Bicycle group had the much greater increase.

(3) Caloric cost paralleled the results of the oxygen intake values. The caloric cost per minute of exercise was 4.24 calories for the Resistance Bicycle group and 0.87 calories for the Exercycle group.

(4) The Resistance Bicycle group had a pulse rate increase of forty-one beats per minute during exercise, while the Exercycle group had an increase of seven beats per minute.

(5) Systolic blood pressure during exercise rose twenty-eight m.m. mercury in the Resistance Bicycle group and seven m.m. mercury in the Exercycle group.

(6) Diastolic blood pressure remained fairly constant in both groups during exercise.

(7) All oxygen debts were below three liters, with the Resistance Bicycle group having the higher debt.[8]

Based on these results Jensen concluded the following:

(1) Both exercise machines created sub-maximal work for the eight subjects.

(2) The Resistance Bicycle can be considered a more severe exercise than that of the Exercycle.

(3) Exercising on the Exercycle machine resulted in an extremely low caloric cost per minute of exercise.[9]

Jones,[10] Thomas,[11] and Morris[12] jointly investigated the effects of a progressive program of exercise on the Exercycle, utilizing sixty-one college women as subjects. Jones studied anthropometric measurements and skinfold thickness, Thomas studied cardiorespiratory endurance, and

---

[8] Ibid., pp. 51-52.

[9] Ibid., p. 64.

[10] Lavetta Sue Jones, "The Effect of a Progressive Program of Exercise, Using the Exercycle, on the Anthropometric Measurements of College Women," (unpublished Master's thesis, University of Washington, 1963), pp. 1-2.

[11] Judith Carol Thomas, "The Effect of a Progressive Program of Exercise, Using the Exercycle, on the Development of Cardiorespiratory Endurance of College Women," (unpublished Master's thesis, University of Washington, 1963), pp. 1-2.

[12] Arlene Marie Morris, "The Effect of a Progressive Program of Exercise, Using the Exercycle, on the Strength of College Women," (unpublished Master's thesis, University of Washington, 1963), pp. 1-2.

Morris studied strength. The exercise program consisted of fifteen minute rides, five days per week for six weeks. All three investigations were designed with three groups of subjects which participated in testing sessions before and after the six week program. Two groups were experimental and rode the Exercycle while the third group was control (N=19) and did not engage in an exercise program or physical education class. The "work" experimental group (N=26) tried to increase the speed of the Exercycle while the "relaxed" experimental group (N=16) simply rode the Exercycle and offered no resistance. The data from the three investigations were statistically analyzed by computing the difference between the means utilizing a t test.

Jones, in the study of body circumference and subcutaneous fat, measured girth of upper arms, forearms, thighs, calves, hips and waist. Skinfold thickness was determined over the triceps, on the abdomen, and below the scapula. The analysis of data within groups yielded the following information:

(1) The "work" group had no significant changes.

(2) The "relaxed" group had a significant reduction in fat over the triceps.

(3) The "control" group had a significant reduction in fat over the triceps and on the abdomen.[13]

Continued analysis of the means between the groups resulted in the following information.

(1) Circumference of the left forearm and the triceps fat reduced significantly more in the "relaxed" group than in the "work"

---

[13]Jones, "The Effect of a Progressive Program of Exercise on the Anthropometric Measurements of College Women," p. 83.

group.

(2) Circumference of the calves reduced significantly more in the "work" group than in the "relaxed" group.

(3) All other differences were non-significant.[14]

Thomas utilized the Harvard Step Test, vital capacity test, and pulse rates (before, during and following each exercise session) to obtain data for her study of cardiorespiratory endurance. The analysis of the collected data yielded the following information:

(1) The "work" group had significant improvement in cardiorespiratory endurance, as measured by the Harvard Step Test.

(2) The "relaxed" and "control" groups did not improve in cardiorespiratory endurance.

(3) No significant improvement was found in lung capacity or pulse rates.[15]

Morris studied the effects of a progressive exercise program on the Exercycle on strength. Cable tension strength tests, utilizing a Cable Tensiometer, were administered to all sixty-one subjects before and after the exercise program. Strength levels were ascertained in right elbow, left shoulder, trunk, left hip, right knee, and left ankle flexion and extension. Analysis of the data yielded the following information:

(1) The "work" group improved significantly in elbow, trunk, and ankle plantar flexion.

(2) The "relaxed" group improved significantly in elbow flexion.

---

[14]Ibid., p. 84.

[15]Thomas, "The Effect of a Progressive Program of Exercise on the Development of Cardiorespiratory Endurance of College Women," p. 62.

(3) The "control" group was significantly improved in trunk flexion.

(4) The "work" group improved significantly more than the "relaxed" group in shoulder and trunk flexion.

(5) Subjects, in all three groups, who were weaker initially gained more on all tests than subjects who were stronger initially.[16]

Dr. Paul Hunsicker,[17] University of Michigan, conducted a comparative study of pulse rates obtained during participation in bowling, volleyball, handball, and tennis and those obtained during participation in exercise routines on the Exercycle. College athletes were utilized as subjects. He found that pulse rates attained through exercise routines on the Exercycle equaled and/or exceeded the pulse rates obtained for the sports investigated.

Studies on Vibrating Equipment

Skinner[18] conducted a study to determine and compare the metabolic costs of lying on a vibrating table and participation in a program of free exercise. Subjects were eight adult women, ages 27 to 54 years. The exercise program for four subjects consisted of lying on a vibrating table for one hour, two to three times per week. The other four subjects participated in a free exercise program which consisted of two hours of exercise every Tuesday afternoon, plus two one hour sessions

---

[16]Morris, "The Effect of a Progressive Program of Exercise on the Strength of College Women," pp. 105-6.

[17]Exercycle (New York: Exercycle Corporation, 1965), p. 19.

[18]James Stanford Skinner, "The Metabolic Cost of the Vibrating Table and a Program of Free Exercise on Middle-Aged Women," (unpublished Master's thesis, University of Illinois, 1960), pp. 23-24.

at home. Utilizing the technique of indirect calorimetry, all subjects' metabolic rates were ascertained on two different days during the sixteen week program. In addition, pulse rates, blood pressures, respiratory quotients (R.Q.), true oxygen values, caloric cost, net oxygen intake, and oxygen debt were computed. Data were presented using the case study method.

In comparing the data of the vibrating table group and the free exercise group the following information was revealed:

(1) Caloric cost per minute of exercise was 0.01 calories for the vibrating table group and 5.93 calories for the free exercise subjects.

(2) The R.Q. of the vibrating table group remained constant, while the recovery R.Q. for the free exercise group increased.

(3) The oxygen intake for the free exercise group increased appreciably during exercise and recovery. The vibrating table group had very little change during exercise and no difference during recovery.

(4) The pulse rates of the vibrating table subjects remained constant throughout exercise and recovery. The free exercise group had a pulse rate increase of about forty-eight beats per minute and recovery rate was above the resting level.

(5) The systolic and diastolic blood pressures of the vibrating table subjects remained fairly constant. The free exercise subjects had an increase of 39 m.m. mercury in systolic blood pressure, while the diastolic blood pressure varied only one

to two m.m. mercury.[19]

Based on these results Skinner concluded the following:

(1) All work performed was submaximal.

(2) The subjects on the vibrating table expended very little, if any, energy over and above their quiet lying metabolic rates.

(3) The free exercise program can be considered more severe than lying on the vibrating table.[20]

Chrietzberg[21] investigated the effects of mechanical vibration on spot reduction of seven undergraduate college women, ages 19 to 21 years; however, a control group was not utilized. Subjects used the Samson Massage-a-Belt eight minutes per day, five days per week for six weeks. Measurements were taken before and after the program in waist, hips, and thigh girth, skinfold thickness at the waist, and total body weight. When the data were computed and statistically tested for significance at the .05 level, it was revealed that total body weight, waist and hip girth had significant changes. Total body weight had increased, five subjects had gained weight, while waist and hip girth had decreased. Thigh girth and skinfold thickness at the waist had no significant changes.[22] Empirical observations by Chrietzberg and the seven subjects had resulted in no change being noted in the variables under investigation. Chrietzberg concluded that the changes noted were not due to the

---

[19] Ibid., pp. 58-59.

[20] Ibid., p. 70.

[21] Agnes L. Chrietzberg, "The Effects of Mechanical Vibration on Spot Reduction of College Women," (unpublished Master's thesis, Florida State University, 1963), pp. 2-3.

[22] Ibid., p. 56.

mechanical vibration belt.[23]

Hernlund and Steinhaus[24] conducted a study which attempted to determine the validity of claims made by manufacturers of mechanical vibrators. The investigation was based on the premise that if fat was oxidized by vibration the oxygen consumption level should increase, but if the fat is "massaged away" by vibration, some trace of the fat should appear in the blood.

With the vibrator belt placed around their abdomens, thirteen overweight men particpated in a single fifteen minute vibration period which was of the most vigorous type. Each subject's metabolic rate was determined (1) while sitting at rest, (2) while standing and participating in the vibration program, and (3) during the recovery period. From these three values, the oxygen consumption attributable to the standing vibration program was calculated. Venous blood samples were also drawn from each subject so the saponifiable blood fats could be determined. Samples were taken (1) before vibration, (2) shortly after vibration, and (3) two to three hours following vibration.

The data yielded the following information:

(1) The average increase in oxygen consumption over the sitting value was 2.37 liters for the total fifteen minute vibration period.

(2) The average increase in caloric expenditure for the vibration period was 11.41 calories above the sitting resting rate.

---

[23]Ibid., pp. 63-64.

[24]Vernon Hernlund and Arthur H. Steinhaus, "Do Mechanical Vibrators Take Off or Redistribute Fat?" Journal of Association for Physical and Mental Rehabilitation, XI (March, 1957), p. 96.

This is equivalent to 1/23 of an ounce of fat.

(3) To lose one pound of fat by mechanical vibration would roughly require participation in a fifteen minute period of vibration each day for one year.

(4) Five subjects showed an average drop of 8-12 milligrams of fat per 100 cc. of blood following the vibration period, while seven subjects showed an average increase of 14.2 milligrams following vibration. Neither of these values were significant however.

Based on these results, Hernlund and Steinhaus concluded that the mechanical vibrator was not to be taken seriously as a means for fat reduction or fat redistribution.[25]

Studies on Non-Motorized Exercise Equipment

Domke[26] investigated the effect of a training program on the Ro-Trim Exerciser on the physical fitness of middle aged men, ages 26 to 46 years. Three subjects participated in an exercise program while the other subject served as a control subject and did not exercise on the Ro-Trim. The Ro-Trim subjects rowed the exerciser fifteen minutes per day, five days per week for eight weeks. All four subjects were administered a battery of tests which measured the physique, organic, and motor areas of physical fitness. Data were presented by the case study method and the following information was revealed:

---

[25] Ibid.

[26] Arnold Edward Domke, Jr., "Conditioning Effects of Work Performed on an Exercise Machine," (unpublished Master's thesis, University of Illinois, 1955), pp. 1-27.

Physique:

(1) Chest-abdominal differences were increased.

(2) All other physique measures remained fairly constant.

Organic:

(1) All heartometer measures, five minute step tests, Barach Indexes, progressive pulse ratio tests improved.

(2) Schneider Index remained constant.

(3) R and T waves in the 5th (precordial) lead of the E.C.G. decreased in all subjects.

(4) No improvement in pulse rates or blood pressure before and after treadmill runs.

(5) All respiratory measures remained constant.

Motor Fitness:

(1) All strength measures increased significantly.

(2) Dipping, vertical jump, chin-dip-vertical jump test, and side leg rises all improved.

(3) Reaction times improved.

(4) Flexibility measures improved slightly.

(5) Treadmill run times and sitting tucks improved significantly.

(6) Endurance hops and agility run remained constant.[27]

Herden[28] conducted an investigation to determine the effect of an exercise program on the Health-Walker Dynamic Exerciser on the physical fitness of adult men, ages 27 to 39 years. Two of the four subjects

---

[27] Ibid., p. 54.

[28] Everett Leslie Herden, Jr., "The Effects of the Health-Walker Dynamic Exercise Machine on the Physical Fitness of Two Adult Men," (unpublished Master's thesis, University of Illinois, 1956), pp. 183-84.

walked up a fourteen percent grade on the Health-Walker portable treadmill. The other two individuals served as control subjects and did not participate in the exercise program. All subjects were administered a battery of physical fitness tests and measurements designed to appraise physique, organic fitness, and motor fitness. Data were presented by the case study method with t tests computed on each subject. The following conclusions were based on these data:

Physique:

(1) The Health-Walker subjects had a significant reduction in body weight.

(2) The adipose index did not change during the experiment.

(3) The exercise program had no effect on external fat.

(4) No consistent change occurred in muscle girth measurements, except in the calf girth of the Health-Walker subjects.

(5) The exercise program had no effect on blood pressure measurements in either the lying, sitting, or standing position.

(6) A significant reduction occurred in pulse rate as a result of exercise.

(7) The Schneider Index remained fairly constant during the experiment.

Motor Fitness:

(1) The strength items were not effected by the exercise program.

(2) The exercise program produced significant increases in sitting tucks and standing broad jump.

(3) The various motor performance tests, reaction time, and

muscular endurance items were not effected by the exercise program.[29]

Riendeau[30] conducted a comparative study, without a control group, which investigated the metabolic rate of training programs on the Health-Walker and the Ro-Trim Exerciser. Subjects were four adult men who worked out five days per week for eight weeks. Two walked thirty minutes each exercise session on the Health-Walker while the other two rowed for fifteen minutes on the Ro-Trim. Results were similar for both machines. Each group significantly improved in the metabolic measures of endurance, but no significant changes were noted in sitting metabolic rates. Riendeau felt there was a limit to the improvement which could be produced by machines.

Hayden[31] conducted an investigation to determine what effects a joint exercise program on the Ro-Trim Exerciser and Health-Walker had on the physique and motor fitness of adult women, ages 28 to 49 years. Four women worked on the machines in a program that consisted of a forty-five minute work session, three times per week for twelve weeks. Thirty minutes of each exercise session was devoted to walking on the Health-Walker up a fourteen percent grade and rowing on the Ro-Trim for fifteen minutes at a rate of twenty-five strokes per minute. Two other

---

[29]Ibid., pp. 185-88.

[30]R. P. Riendeau, "The Metabolic Effects of Exercising on Certain Machines," (unpublished Master's thesis, University of Illinois, 1956) cited by Francis Joseph Hayden, "The Physique and Motor Fitness Effects of Machine Exercise," (unpublished Master's thesis, University of Illinois, 1958), p. 15.

[31]Francis Joseph Hayden, "The Physique and Motor Fitness Effects of Machine Exercise," (unpublished Master's thesis, University of Illinois, 1958), pp. 183-84.

women served as control subjects which entailed participation in an organized program of strenuous fitness activities (walking, jogging, running, and rhythmical endurance-type calisthenics) for two hours, one afternoon per week, plus several hours of home exercises. All subjects were administered an extensive battery of tests previous to and after the exercise programs to determine their cardiovascular-respiratory, physique and motor fitness levels. The pre-testing occurred in November and December even though the exercise programs did not begin until January. Data were presented by the case study method with _t_ tests computed for each subject to determine differences that were significant.

Based on the individual case studies, Hayden drew the following general conclusions:

(1) It is possible to reduce fat through exercise.

(2) Fat losses are not always accompanied by corresponding loss of weight.

(3) The training program on the Health-Walker and Ro-Trim Exerciser was much more efficient in removing fat than the exercise program followed by the two control subjects.

(4) The fat reductions were fairly well distributed.

(5) The machines have a limited capacity for developing strength and increasing muscle girths.

(6) The experimental program is capable of producing great improvement in general motor fitness.

(7) The machines may produce some overall improvement in muscular strength.

(8) The experimental program was of definite value in improving balance.

(9) The machines did not appear to influence body flexibility.

(10) Although the machine program produced large improvements in the endurance measurements, it was not as effective as the control program in this regard.[32]

Studies on the Inch Master Exerciser

Three studies have been completed which investigated the effects of the Inch Master Exerciser. Wright,[33] in a pilot study, investigated the energy cost of a single five minute exercise on the Inch Master Exerciser. Three women subjects, ages 23 to 41 years, each exercised one time on the Inch Master for five minutes at a rate of forty movements per minute. Resting and working energy costs were determined by indirect calorimetry. Heart and respiratory rates were also recorded in both instances. Data were presented by the case study method with group means computed. Results yielded the following information:

(1) The mean energy cost, in calories per hour per square meter of body surface area, was 82.56.

(2) The energy cost of exercising was two to three times that of the resting rate.

(3) The mean exercise pulse rate was 89 beats per minute.

(4) The mean exercise respiratory rate was 16 breaths per minute.

Based on this information Wright concluded that the basic exercise

---

[32]Ibid., pp. 210-12.

[33]Ernestine Wright, "An Investigation of the Energy Cost of a Basic Exercise Conducted on the Inch Master," (unpublished HPER Research Paper, Oklahoma State University, 1970), p. 3.

performed for five minutes was a sub-maximal work load for the subjects.[34]

Since this was the first study which had been conducted on the Inch Master Exerciser, the results were quite interesting. The investigation would have been a better study if more subjects had been utilized and other exercises had been investigated.

Detamore[35] conducted a pilot study which investigated the effects of a progressive exercise program on the Inch Master Exerciser on the flexibility and cardiovascular fitness of college women, ages 18 to 23 years. Ten subjects exercised five days per week for five weeks in a progressive exercise program which began with eleven minutes of exercise the first week, increased to sixteen minutes the second week, and expanded to twenty-one minutes for the third, fourth, and fifth weeks. Subjects were tested prior to and following the exercise program in cardiovascular fitness, as measured by the Schneider Index, and trunk and hip flexibility, as measured by Fleishman's Abdominal Stretch and Extent Flexibility Tests and Wells' Sit-and-Reach Test. Statistical analysis of the data was accomplished by computing t-ratios. Only spinal rotation, as measured by the Extent Flexibility Test, improved significantly at the .05 level of confidence.

The Detamore study was a more in-depth investigation than the Wright study because it involved a greater number of subjects and the subjects participated in a prescribed exercise program which incorporated the total effects of nine different exercises performed on the Inch

---

[34]Ibid., p. 23.

[35]Trent Detamore, "A Study of Flexibility and Cardiovascular Fitness on the Inch Master Exerciser," (unpublished HPER Research Paper, Oklahoma State University, 1970), pp. 5-10.

Master Exerciser. However, this investigation would have been more meaningful had a control group been utilized and the subjects had been more sedentary in their exercise patterns. Many individuals who might use the Inch Master are more sedentary than college students. An investigation with the sedentary subject would be of value. The control group would be of value for comparative purposes.

The third investigation regarding the effects of the Inch Master Exerciser was cited previously in Chapter I, page 5. This study also needed to utilize a control group and more sedentary subjects for the same reasons cited in the discussion of the Detamore study.

Studies on Spot Reduction

The appearance of several commercial products, which supposedly were capable of spot reduction, stimulated Rony,[36] an Associate Professor of Clinical Medicine at the Chicago Medical School, to conduct an investigation as to the value of certain commercial products. These products included "slimming" creams, specific massage techniques, massaging devices, electric rollers, vibrators, reducing garments, muscular exercises, and exercisers. He concluded that spot reduction was not possible utilizing these products. Rony also asserted that any exercise, including regional exercise, may help reduce weight, thereby creating a reduction in a particular area which is a part of the general region. Hence, general exercise is just as advantageous as special exercises when the purpose is spot reduction.

---

[36]Hugo R. Rony, M. D., "Can You Lose Fat Where You Want To?" Science Digest, XXVI (December, 1949), 59-63.

A study by Mohr[37] investigated the effects of a four week isometric exercise program on the waistline, abdominal girth, and subcutaneous fat of thirty women, ages 18 to 45 years. Subjects performed six isometric abdominal contractions per day, each held for six seconds. Each subject's body weight, waistline girth, umbilical girth, waistline skinfold, and abdominal skinfold were determined before and after the exercise program. The t-ratio was computed on means and significant changes were noted in waistline girth, umbilical girth, waistline skinfold, and abdominal skinfold. Mohr concluded that the results supported the hypothesis that isometric contractions can aid in reducing girth and skinfold thickness at the waistline and the umbilical level of the abdomen, and that this could be considered a form of spot reduction. The results of this investigation are questionable because a control group was not studied at the same time; hence, the changes that were revealed could have resulted without the exercise program.

Conger and Macnab[38] conducted a study which compared the strength, maximal oxygen uptake, and body composition of women participating in intercollegiate athletics with women who were nonparticipants. Each group of forty subjects took part in the testing program which determined the strength of selected muscle groups, skinfold thickness at selected landmarks, and maximal oxygen uptake as measured by the Astrand Bicycle Ergometer Test. The F test and t test were employed for

---

[37]Dorothy R. Mohr, "Changes in Waistline and Abdominal Girth and Subcutaneous Fat Following Isometric Exercises," Research Quarterly, XXVI (May, 1965), 168-73.

[38]Patricia R. Conger and Ross B. J. Macnab, "Strength, Body Composition, and Work Capacity of Participants and Nonparticipants in Women's Intercollegiate Sports," Research Quarterly, XXXVIII (May, 1967), 184-91.

statistical analysis of the data, which yielded the following information:

(1) The participant group was significantly stronger on all strength tests.

(2) Predicted maximal oxygen uptake was significantly higher in the participant group.

(3) The participant group had significantly less thigh skinfold fat.

The significant difference in thigh skinfold fat did not support the hypothesis of spot reduction because seven other skinfold measures exhibited lesser mean values, which were not at a significant level. These results would indicate active participation in intercollegiate athletics cannot spot reduce an individual.

A study designed by Olson and Edelstein[39] determined if the triceps skinfold measurement of an exercised arm would decrease more than the skinfold measurements of the opposite unexercised arm. Thirty-two boys, ages 14 to 16 years, completed three sets of seven arm curls and seven tricep extensions on either a daily or alternate day schedule for six weeks. Skinfold, girth, and strength measurements were taken on both arms before and after the exercise program. The _t_ test was employed to determine the difference between means. The following changes were noted:

(1) The exercised arm decreased significantly in triceps skinfold thickness.

(2) The exercised arm and unexercised arm increased in girth,

[39]Arne L. Olson and Elliott Edelstein, "Spot Reduction of Subcutaneous Adipose Tissue," Research Quarterly, XXXIX (October, 1968), 647-52.

but not significantly.

(3) Only the exercised arm increased significantly in strength. The result of this investigation would indicate that spot reduction of the tricep skinfold fat level can be accomplished through participation in a weight training program which emphasizes lower arm flexion and extension.

Lundegren[40] utilized twelve women varsity field hockey players and seventeen women varsity basketball players to investigate the seasonal changes in subcutaneous fat, girth, and body weight. Subjects were measured before and after their respective seasons. The following information was revealed when the means were tested for significance of difference utilizing the t test.

(1) The field hockey players decreased significantly in arm, umbilicus, and thigh skinfold measures.

(2) The basketball players decreased significantly in arm, iliac, and umbilicus skinfold measures.

(3) The field hockey players decreased significantly in umbilicus girth, while the basketball players decreased significantly in thigh girth.

These results would indicate that general body skinfold measurements decreased during the respective seasons. The results did not provide support for the hypothesis of spot reduction because skinfold measurements decreased in several areas which implies that subcutaneous fat levels of the entire body were reduced and not just the specific areas

---

[40] Herbeta M. Lundegren, "Changes in Skinfold and Girth Measures of Women Varsity Basketball and Field Hockey Players," Research Quarterly, XXXIX (December, 1968), 1020-24.

most exercised in the sports.

Roby[41] conducted an investigation to determine the effects of an exercise program on the triceps subcutaneous fat level. Fifteen male students, mean age 21 years, participated in a weight training program three times per week for ten weeks. The training program consisted of three sets of ten repetitions with the dominant arm. The subcutaneous fat, as measured by skinfold thickness, was determined previous to and at the conclusion of the investigation on the dominant arm and the non-dominant arm which was not exercised and thus used to study as the control variable. The significance of the difference between the mean changes was computed by means of the _t_-ratio. A non-significant _t_-ratio was found to exist; thus, the results of this investigation did not support the postulate that subcutaneous fat is reduced in areas where muscles are utilized a great deal.[42]

Schade and others[43] conducted a study to determine the effects of exercise in reducing body weight of overweight female adults. The exercise was of two types, generalized, which consisted of nine exercises, and spot, which consisted of three of the nine exercises for the generalized exercise program. The eighteen randomly assigned (nine to each group) subjects participated in the exercise programs for six weeks, three times per week for 45 minutes. In addition, all subjects were

---

[41]Fred B. Roby, "Effect of Exercise on Regional Subcutaneous Fat Accumulations," Research Quarterly, XXXIII (May, 1962), 273-78.

[42]Ibid., p. 277.

[43]Maja Schade, F. A. Hellebrandt, Joan C. Waterland, and Marie L. Carns, "Spot Reducing in Overweight College Women: Its Influence on Fat Distribution as Determined by Photography," Research Quarterly, XXXIII (October, 1962), 361-71.

placed on a special diet which ranged from 2,000 to 2,200 calories per day.

All subjects had somatotype photographs taken in the posterior view and in profile before and at the conclusion of the investigation. Planimetric measurements were then derived from the enlarged photographs. The pre- and post-exercise diameters were then statistically analyzed by means of covariance.

Both groups showed a reduction in weight, but the reductions were not significantly different. The spot exercise group tended to have a greater decrease in diameter measurements than the exercise group, but the differences between the two groups were not significantly different. Based on these results, Schade and others concluded that fat deposits are utilized proportionately from the entire body when energy demands are greater than the caloric intake. Regardless of the muscle group utilized fat deposits from the entire body are utilized for energy supply.[44]

In a recent article, Kuntzleman stated that a major function of adipose tissue is to provide energy for the body along with heat insulation; and he contended exercise will result in breakdown of fat over the entire body and not just in one location.[45] This opinion conflicts with the findings of some of the previous spot reduction studies which Kuntzleman reviewed. Kuntzleman's reply was that two things happened which accounted for the apparent spot reduction effects. First, overall fat levels were reduced; thus, the area under study was reduced, and secondly, the weakened musculature beneath the subcutaneous fat was

[44]Ibid., p. 470.

[45]Charles T. Kuntzleman, "The Truth About Spot Reducing," Fitness For Living, V (November-December, 1971), 80.

firmed; hence, body girth was reduced.[46]

For exercise to be effective it must be of such an intensity and/or duration that the body will start to mobilize fat deposits as an energy supply. Kuntzleman stated that rolling, skimming, shaking, sauna, and rubberized sweat suits cannot accomplish this and that only a restriction in calories and/or an increase in energy expenditure will reduce fat deposits.[47]

Summary

After reviewing the literature, it became apparent that relatively little research regarding the effects of motorized and non-motorized exercise machines had been reported. The majority of the studies found were conducted in the 1950's and early 1960's, with the most recent research being 1965. Most of the investigations on motorized exercise equipment were devoted to determining the values of the Exercycle. The non-motorized machine studies were concerned with the effects of the Ro-Trim, Health-Walker, and Inch Master.

Most of the previously cited studies were concerned with investigating the physiological effects, such as metabolic cost, of exercise programs. Generally the investigations utilized a small number of subjects and the case study method of presentation.

The Inch Master studies cited have provided a very limited view as to the effects of this particular type of exercise equipment. They provide a basis for greater in-depth studies.

---

[46]Ibid.

[47]Ibid.

The majority of the spot reduction studies that were reviewed have yielded results which indicate that spot reduction is not possible. In actuality, the subcutaneous fat levels of the entire body are utilized for energy production; thus, one particular spot cannot be isolated for expenditure of energy.

CHAPTER III

METHODOLOGY

This chapter describes the various procedures that were utilized during the investigation.

Subjects

The study initially began with sixty adult female volunteers, ages 20–48 years, who responded to an appeal in a newspaper article. All subjects were asked, and agreed, not to change their exercise routines and diet patterns during the investigation. The subjects were randomly assigned to one of two groups; experimental or control. The experimental group (30) participated in a six week, thirty session, exercise program using the Inch Master Exerciser. The control group (30) did not engage in any exercise program. Age, height, and body weight of all subjects were recorded in addition to the other variables being studied. Both groups were tested prior to and at the conclusion of the investigation.

Fifty-two subjects, twenty-five experimental and twenty-seven control, completed the six week study.

Exercise Program

The exercise program consisted of thirty sessions over a period of six weeks (January 31, 1962, through March 12, 1972). During each seven day period, subjects exercised one session each day for five days, Sunday through Thursday with Friday and Saturday being utilized as make-up days. If subjects were forced to miss one of the regularly scheduled exercise sessions because of other committments they were allowed to make up this session on either Friday or Saturday. The subjects exercised at designated times in groups of ten or less. Exercise sessions were scheduled at 2:30 P.M., 4:15 P.M., 5:30 P.M., 6:30 P.M. and 7:00 P.M., except Saturday when the times were 3:00 P.M. and 3:30 P.M. Each exercise session was twenty-eight minutes in duration, with twenty-five minutes being spent in actual exercise. No rest was allowed between the exercise positions, except the time required to change to the next exercise position.

The nine exercises utilized during the exercise sessions were those described in the Inch Master Home Exercise Manual. A front view and side view of these exercise positions are illustrated in Appendix A. The exercise program was based on the distributor's recommendations regarding duration and number of repetitions per exercise. The program appears in Table I. The subjects exercised to verbal commands and tempo pre-recorded on a casette type magnetic tape; hence, the exercise rhythm was constant throughout the study.

Prior to the experiment, the subjects participated in an orientation program in which they were familiarized with the Inch Master devices, the nine exercise positions, and the exercise program as it was recorded on the tape.

TABLE I

INCH MASTER EXERCISE PROGRAM

	Exercise Position	Minutes	Repetitions Per Minute	Total Repetitions
1.	Basic	2	40	80
2.	Thighs	2	40	80
3.	V-Push	1	20	20
4.	Alternating Leg Push	2	35	70
5.	Yogi	3	40	120
6.	V-Push	1	20	20
7.	Flank (Right Side)	2	35	70
	(Left Side)	2	35	70
8.	Push-up	1	30	30
9.	Saddle Bend (Right Side)	2	30	60
	(Left Side)	2	30	60
10.	V-Push	1	30	30
11.	Thighs	2	40	80
12.	Relaxation	2	20	40

Testing Program

All subjects participated in a five session testing program prior to and at the conclusion of the six week program of exercise. The tests in order of administration were:

Session 1: a. Vital capacity

b. Maximum breathing capacity

c. Flexibility

Session 2: a. Anthropometric measurements

Session 3: a. Resting cardiovascular fitness

Session 4: a. Strength

Session 5: a. Aerobic capacity

The tests were administered, in the Colvin Physical Education Center, by the investigator and/or fellow graduate students, who had been carefully trained. Since more than one test was administered during the first testing session and the subjects were in a semi-nude condition during the second testing session, additional personnel, other than the investigator, were used to collect the data before and after the exercise program. In all instances, these individuals participated in training sessions where they became proficient in administering their test or measuring body girth and skinfold thickness. The two female graduate students who measured body girth and skinfold thickness practiced until they were able to obtain consistent measurements on a subject. All testing, except aerobic capacity, was done between 7:00 P.M. and 10:00 P.M.

Test Selection

Since the literature did not contain any research regarding the effects of hinged-cot exercisers, other than the Oklahoma State University studies, this study was designed to be as comprehensive as feasible; hence, tests for strength, flexibility, and the cardiorespiratory system were administered in addition to measuring body girth and skinfold thickness. The tests utilized in this study were selected with the assistance of the writer's advisor, Dr. A. B. Harrison.

Body Girth Measurement

The circumference of selected body parts were determined utilizing an anthropometric tape. Clarke and others[1] found a correlation of 0.95 between girth measured by an anthropometric tape and that measured by roentgenogram (x-ray); since the tape technique is much more feasible it is widely used in determining anthropometric sizes.

Skinfold Thickness

The amount of subcutaneous fat was ascertained by determining the thickness of pinched skinfolds utilizing a skinfold caliper. Measurement of this kind appears to be the most simple, single, and practical means of determining adipose tissue.[2] Pascale and others[3] found a multiple regression coefficient of 0.85 between predicted body density as determined by skinfold thickness and by underwater weighing. Clarke and others[4] also compared the adipose tissue levels as determined by skinfold thickness and by roentgenogram (x-ray) width. They found a correlation of 0.79 between the two obtained levels.

---

[1] H. Harrison Clarke, L. Richard Geser, and Stanley B. Hundsdon, "Comparison of Upper Arm Measurements by Use of Roentgenogram and Anthropometric Techniques," Research Quarterly, XXVII (December, 1956), 384.

[2] Obesity and Health, p. 14.

[3] L. R. Pascale, et al., "Correlations Between Thickness of Skinfolds and Body Density in 88 Soldiers," Human Biology, XXVIII (1956), cited in C. Frank Consolazio, Robert E. Johnson, and Louis J. Pecora, Physiological Measurements of Metabolic Functions in Man (New York: McGraw-Hill Book Company, 1963), p. 256.

[4] Clarke, Geser, and Hundsdon, "Comparison of Upper Arm Measurements by Use of Roentgenogram and Anthropometric Techniques," Research Quarterly, XXVII (December, 1956), p. 384.

Strength

The isometric strength levels of the selected muscle groups were obtained using the Elgin Exercise Table and the Cable Tensiometer. The Elgin Table was utilized because the various testing positions, including angles, could be reproduced for testing each subject. Strength levels were measured by employing the Cable Tensiometer to determine cable tension. This method of determining strength was developed by Clarke and is probably the simplest and most widely used means of determining static muscle strength. Objectivity coefficients of 0.90 have been obtained utilizing this method to determine isometric strength levels.[5]

Flexibility

Since the literature did not contain flexibility tests which measured the desired areas without incorporating other variables of flexibility, the investigator modified three flexibility tests suggested by Fleishman: abdominal stretch, lateral bend, and twist and touch.[6] These modified tests are explained and illustrated in the discussion of flexibility procedures presented later in this chapter. The three tests used were designed to measure only the flexibility involved in trunk extension, right lateral trunk flexion, and spinal rotation. These areas were of interest because they seemed to be the most likely to be stretched by the exercises even though Inch Master did not

---

[5]Herbert A. de Vries, *Physiology of Exercise for Physical Education and Athletics* (Dubuqe: Wm. C. Brown Company Publishers, 1966), pp. 311-12.

[6]Edwin A. Fleishman, *The Structure and Measurement of Physical Fitness* (Englewood Cliffs, New Jersey: Prentice-Hall, 1964), pp. 77-80.

claim specific exercises would increase flexibility.

Cardiorespiratory System

Four different tests were administered in this area, each measuring a different aspect of the total cardiorespiratory system. Two tests, vital capacity (VC) and maximal breathing capacity (MBC) were specifically concerned with ascertaining pulmonary volumes.

Vital Capacity. The vital capacity test determined the volume of air that could be expelled from the lungs following a maximum inspiration. According to Ricci, there is a relationship between this volume and physiological fitness, but it is an erroneous conclusion to automatically relate large capacities to high levels of cardiopulmonary fitness.[7] Stuart and Collings found physically active male students had a significantly greater mean vital capacity than physically inactive male students. They attributed the increase to the development of respiratory musculature due to regular physical training.[8]

Maximum Breathing Capacity. The maximal breathing capacity test (MBC) determined the volume of air a subject could move through her lungs in a period of one minute. As an individual engages in physical exercise, the metabolic rate increases, which in turn means more oxygen is needed to manufacture the additional energy supply; hence, a subject must be able to move large volumes of air in and out of the lungs so the

---

[7]Benjamin Ricci, Physiological Basis of Human Performance (Philadelphia: Lea & Febiger, 1967), pp. 127-28.

[8]D. G. Stuart and W. D. Collings, "Comparison of Vital Capacity and Maximum Breathing Capacity of Athletes and Non-Athletes," Journal of Applied Physiology, XIV (July, 1959), pp. 507-9.

needed amount of oxygen can be absorbed into the blood stream and then transported to the muscle tissue. If a subject is unable to inhale and exhale air at a rate sufficient to meet these demands, her physical performance will be limited because of the reduced amount of oxygen available for the production of energy. Thus, one's level of pulmonary fitness, as measured by maximal breathing capacity, is reflected by one's ability to score high on this test.

Aerobic Capacity. The Balke Treadmill Test was administered to determine the subject's aerobic capacity or maximal oxygen intake at a heart rate of 180 beats per minute. Physiologists consider maximal oxygen intake as the most significant criterion of physical fitness.[9] The Balke Test is not an all-out exercise because it is terminated when the subject's heart rate reaches 180 beats per minute; however, Billings and others[10] did find a very high correlation between the optimal work capacity as predicted by the Balke test and actual work capacity as performed in an all-out exercise.

Resting Cardiovascular Fitness. Resting cardiovascular efficiency was determined by the Schneider Index, which attempts to combine measurement of the effect that standing has on heart rate and blood pressure with measurement of the effect that mild exercise has on the cardio-

---

[9] Bruno Balke and R. T. Clark, "Cardio-Pulmonary and Metabolic Effects of Physical Training," Health and Fitness in the Modern World (n.p.: The Athletic Institute, 1961), p. 83.

[10] Charles E. Billings, Jr., et al., "Measurement of Human Capacity for Aerobic Muscular Work," Journal of Applied Physiology, XV (November, 1960), p. 1001-06.

vascular system.[11] This test appeared shortly after World War I and represented the first comprehensive cardiovascular test; however, in the last twenty years it has not been utilized extensively because of its crude method of scoring which does not provide detailed discrimination regarding the degree of fitness.[12] Additional questions have been raised as to the reliability even though Cureton obtained a 0.89 reliability coefficient. The index appears weak when compared with physical performance, as was indicated by the correlation coefficient of 0.44 when the test was compared with improvement time on the half-mile run.[13] In this investigation, the Schneider Index was utilized as a gross measure of resting cardiovascular fitness so empirical observations could be made as to how its results compared with the results of the Balke Treadmill Test.

Testing Procedures

The testing procedures utilized while collecting the raw data are explained in the following section.

Body Girth

The desired body girth measurements were obtained by utilizing a Lufkin linen anthropometric tape calibrated in millimeters. The results were recorded to the nearest millimeter.

---

[11]Donald K. Mathews, Measurement in Physical Education (2nd ed., Philadelphia: W. B. Saunders Company, 1963), p. 204.

[12]Carlton R. Meyers and T. Erwin Blesh, Measurement in Physical Education (New York: The Ronald Press Company, 1962), pp. 237-38.

[13]Carl E. Willgoose, Evaluation in Health Education and Physical Education (New York: McGraw-Hill Book Company, Inc., 1961), p. 116.

Six body girths were obtained: right upper arm, bust, waist, hip, right thigh, and right calf. All girth landmarks are illustrated by the white markings in Figure 2. All body girth measurements were taken one time, prior to and following the study, by a female assistant on the skin surface, except bust and hips which were ascertained over pants and bra. Uniform tension on the tape was achieved by the spring handle on the Lufkin tape.

Landmarks. The right upper arm landmark, which was chosen by the investigator, was located at a point half the distance between the arm pit and the elbow. Bust girth was ascertained at the largest circumference of the bustline perpendicular to the long axis of the body, while waist girth was measured at the umbilicus level even though it was not the smallest circumference. The hip girth was determined by measuring the hips at their largest circumference, also perpendicular to the long axis of the body. Thigh girth was measured at a landmark, selected by the investigator, which was located eight inches above the superior border of the patella. The girth of the right calf was determined by measuring the calf area at its largest circumference. Hip girth, thigh girth, and calf girth were all taken with the subject standing with weight evenly distributed on both feet.

The subjects were measured prior to and following the six week program. However, body girth measurements were not taken during the three day period preceding the menstrual cycle or the first day of the cycle because the female body tends to have a higher water retention at this time; measurements taken during this period would not reflect normal girth measurements.

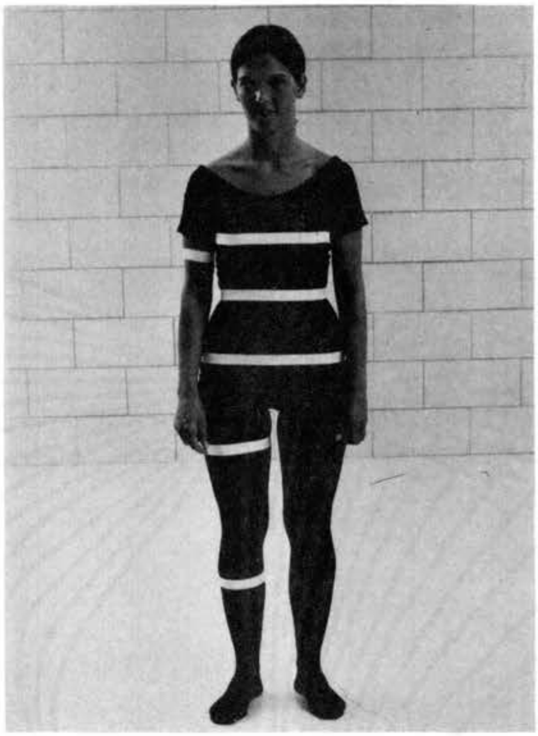
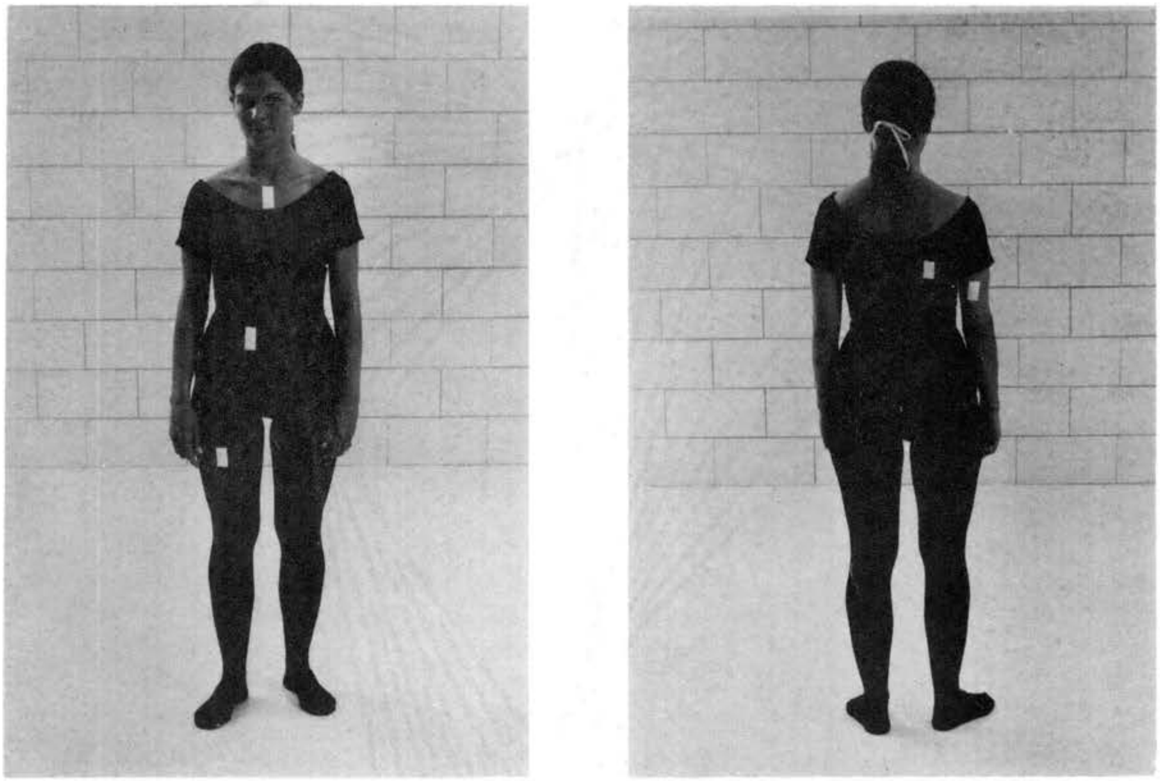


Figure 2. Body Girth Landmarks

Subcutaneous Fat

Subcutaneous fat was determined by measuring skinfold thickness with the Lange Skinfold Calipers, manufactured by Cambridge Scientific Industries, Inc., Cambridge, Maryland. The calipers were calibrated in millimeters; results were recorded to the nearest .5 millimeter.

Skinfold thickness was ascertained at five landmarks: right tricep, upper chest (below sternal notch), right subscapular, abdomen, and right thigh. These landmarks are illustrated by the white marks in Figure 3. All thicknesses were measured one time prior to and following the investigation, by a female assistant, on the skin surface in the vertical plane. The landmarks, except the chest and thigh, were located according to the method of Consolazio and others.[14]



A B

Figure 3. Skinfold Landmarks

Landmarks. The right arm landmark was located at the midposterior point between the arm pit and the elbow with the arm in 90° flexion, the forearm pronated, and the hand in a relaxed fist position. The chest site was over the sternum just below the sternal notch and in the

[14]Consolazio, Physiological Measurements, pp. 302-3.

midaxillary line. The landmark for the abdomen was located adjacent to the umbilicus on the right side. Measurement of the right subscapular fold was taken at a site directly below the inferior angle of the scapula with the subject in a relaxed standing position. The thigh landmark was marked eight inches above the superior border of the patella on the anterior side with the subject standing with weight evenly distributed on both feet. However, the skinfold test was taken with the subject in a sitting position in a chair with the knee in 90° flexion. The arm and thigh landmarks were selected by the investigator, while the other three sites were selected by the female assistant because of the semi-nude condition of the subjects.

Subjects were measured prior to and following the exercise program. Skinfold thickness was not taken during the three day period preceding the menstrual cycle or the first day of the cycle because of a possible increased water retention level at this time which might reflect an abnormal thickness.

Strength

Strength was ascertained utilizing the Elgin Exercise Table and Cable Tensiometer. Originally only fifteen subjects from the experimental group and the control group were randomly assigned and given the five tests because the Cable Tensiometer was late in arriving from being repaired and recalibrated. Of the original thirty subjects, only eleven from the experimental group and thirteen from the control group completed the investigation.

The tests consisted of the following "movements": hip flexion, trunk flexion, arm pull-over, back extension, and push-up for determining the strength level of the following muscle groups: hip flexors, abdominals, shoulder extensors, back extensors, shoulder horizontal adductors and elbow extensors. These muscle groups, except the shoulder adductors and elbow extensors, were used in performing five of the exercise positions: basic, thighs, alternating leg push, yogi, and saddle bend. The shoulder horizontal adductors and elbow extensors were utilized in performing the push-up exercise position. Strength levels were obtained from Cable Tensiometer readings which indicated the subject's maximum force applied on a 3/16 inch weighted immovable cable. Subjects were given two consecutive trials in each position and the best effort was recorded.[15] The tensiometer scores were not converted to pounds because the cable was 3/16 inch in diameter and the Cable Tensiometer was calibrated for a 1/8 inch cable; thus, the scores recorded were force units and not pounds. The subjects were instructed to exert a maximum effort, but received no additional verbal motivation.

Hip Flexion. The back section of the Elgin Table was elevated 10° in order to attain the desired angle of pull and thus ascertain the strength of the hip flexors and abdominals (Figure 4). The 10° angle of pull was recommended by the manufacturers of the Elgin Table.[16]

The subject's legs were stabilized in an extended position by two straps to prevent movement and a taut strap, which was connected to an immovable cable, was placed around her chest just below the arm pits. The tensiometer reading was obtained while the subject tried, without

---

[15] Herbert A. deVries, Laboratory Experiments in Physiology of Exercise (Dubuque, Iowa: Wm. C. Brown Company Publishers, 1971), pp. 1-2.

[16] Progressive Resistance Exercise Technic (n.p.: Elgin Exercise Appliance Co., n.d.), p. 10.

jerking, to do a sit-up with the hands interlocked behind her head (Figure 5).

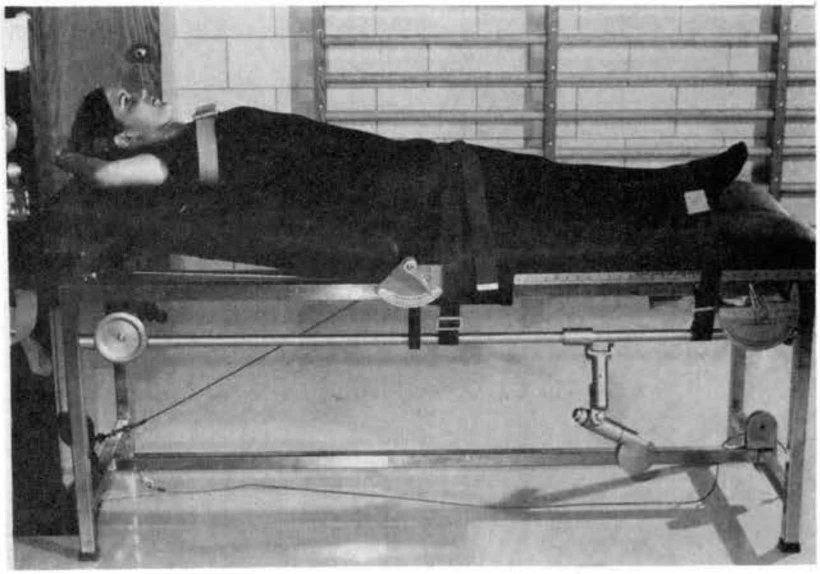


Figure 4. Hip Flexion - Pre-Test Position

Trunk Flexion. To obtain abdominal strength, the back of the Elgin Table was elevated to a 45° angle position and the pelvic rest was placed beneath the subject's knees which resulted in the hips and knees being moderately flexed (120°) to aid in inhibiting the hip flexors (Figure 6).

The subject's legs were stabilized by two straps to prevent movement and a taut strap, which was connected to an immovable cable, was placed around her chest just below the arm pits. While the subject tried, without jerking, to perform a sit-up with the hands interlocked behind the head, the reading on the Cable Tensiometer was recorded (Figure 7).

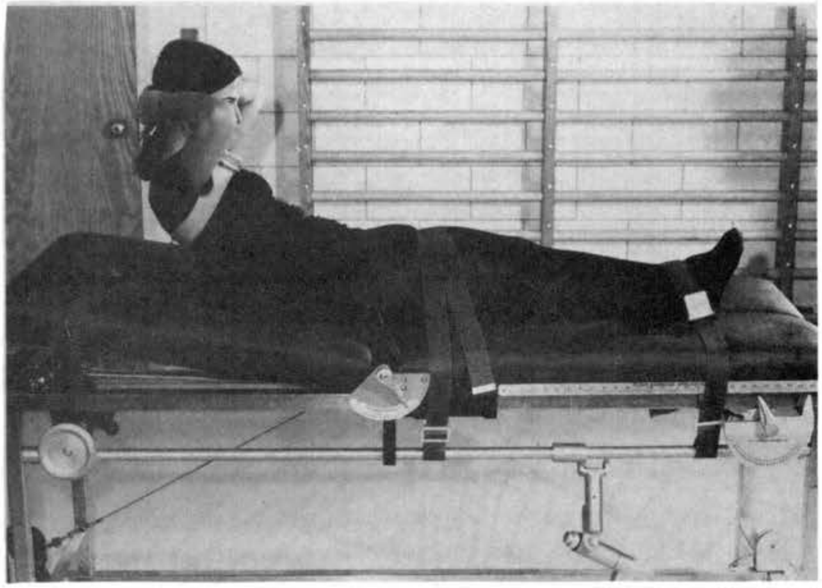


Figure 5. Hip Flexion - Test Position

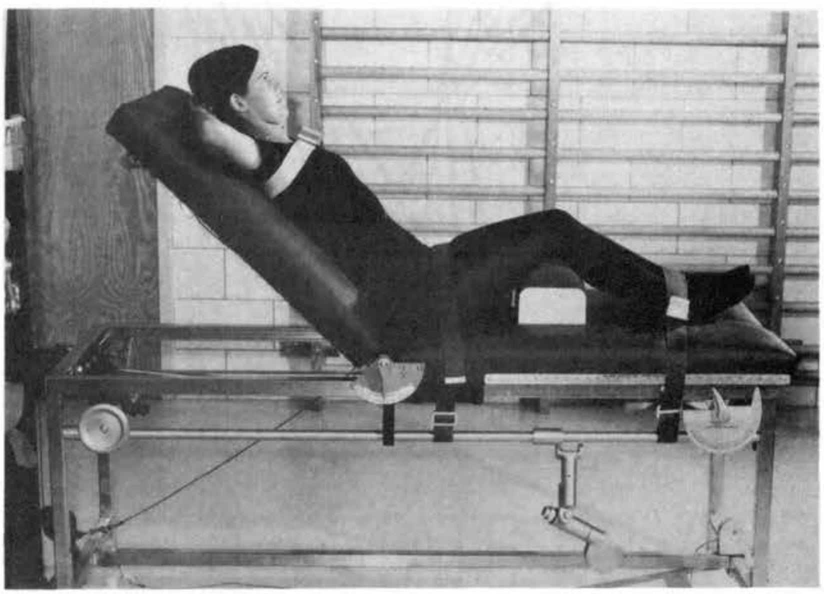


Figure 6. Trunk Flexion - Pre-Test Position

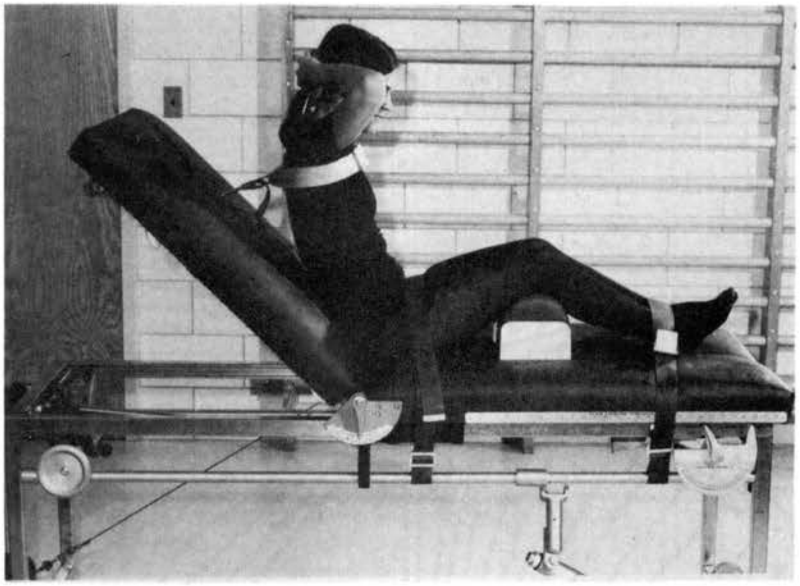


Figure 7. Trunk Flexion - Testing Position

Arm Pull-Over. Shoulder extension strength was ascertained by having the subject try to perform an arm pull-over. To obtain the desired testing position, the back of the Elgin Table was raised to a 90° (right angle) position and the subject fully extended both arms directly overhead and grasped the ends of a circular bar (18 inches by 1 inch) which was connected to an immovable cable (Figure 8). With both legs stabilized by two straps and elbows maintained in extension, the subject tried to pull the bar directly out in front of her from its overhead position. After this muscle contraction period, the tensiometer reading was recorded.

Back Extension. To ascertain the strength level of the back extensors, the subject assumed a prone position on the flat Elgin Table. The thigh rest was placed beneath the pelvic girdle to elevate the hips and both legs were stabilized by two straps. A taut strap was attached to an immovable cable and placed around the chest just below the arm pits (Figure 9).[17]

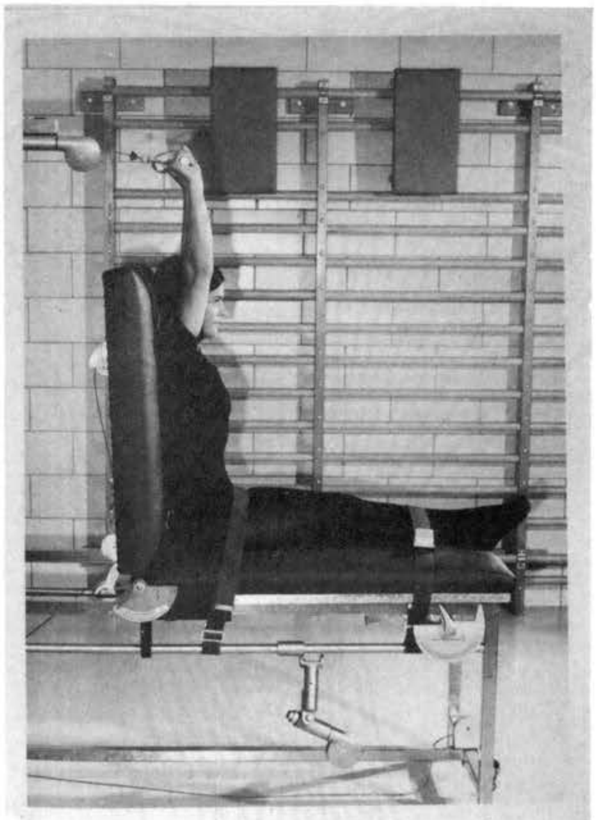


Figure 8. Arm Pull-Over - Testing Position

The Cable Tensiometer reading was recorded while the subject, hands interlocked behind the head, pulled the trunk away from the table by extending the back (Figure 10).

[17]Ibid.

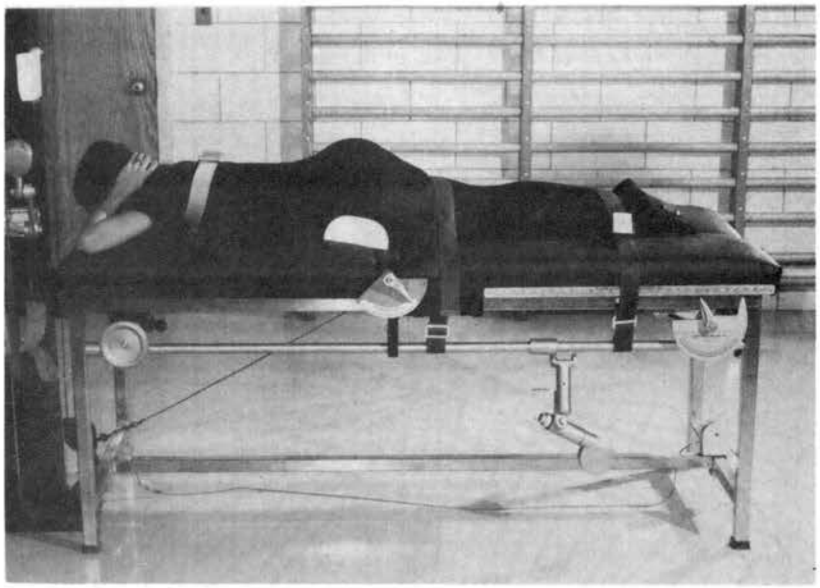


Figure 9. Back Extension - Pre-Test Position

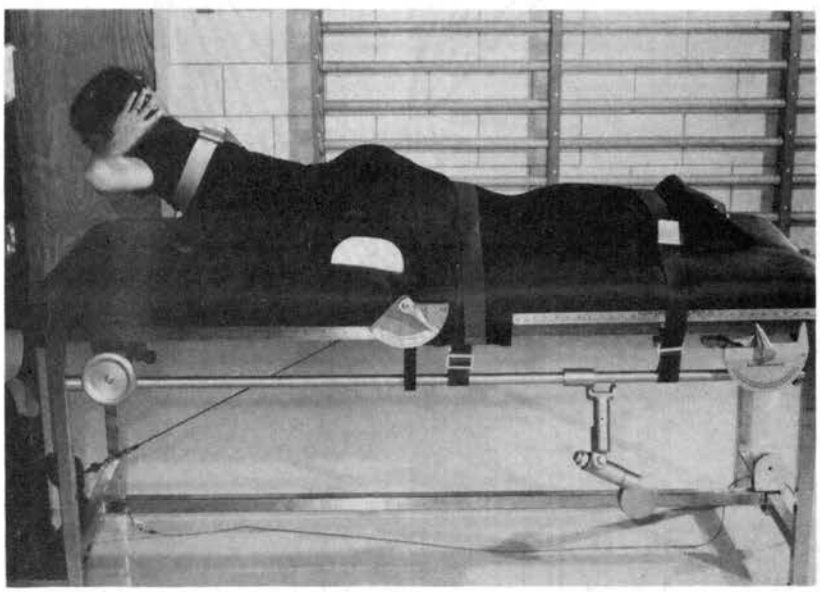


Figure 10. Back Extension - Testing Position

Push-Up. The combined strength of the shoulder horizontal adductors and elbow extensors were ascertained on the Elgin Table by utilizing the push-up movement. The subject assumed a prone position with a taut strap, which was connected to an immovable cable, placed around the chest just below the arm pits. The knees were extended but the ankles were stabilized by a strap. The hands were located at shoulder level and slightly wider than shoulder width apart (Figure 11). There was no restriction on the position of the elbows. This was the subject's choice.

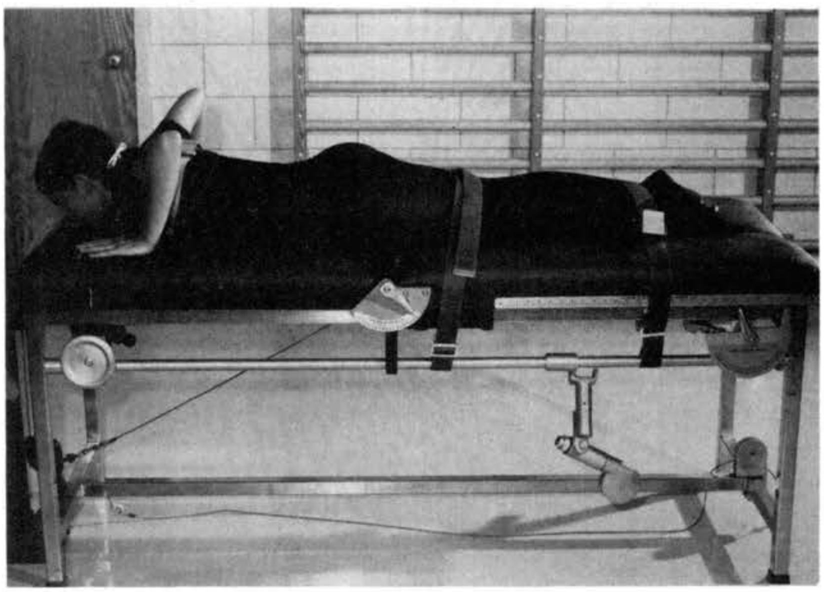


Figure 11. Push-Up - Pre-Test Position

The tensiometer reading was recorded when the subject, without jerking, tried to lift the body trunk from the table by performing a push-up. No restrictions were placed on "body sag" (Figure 12).

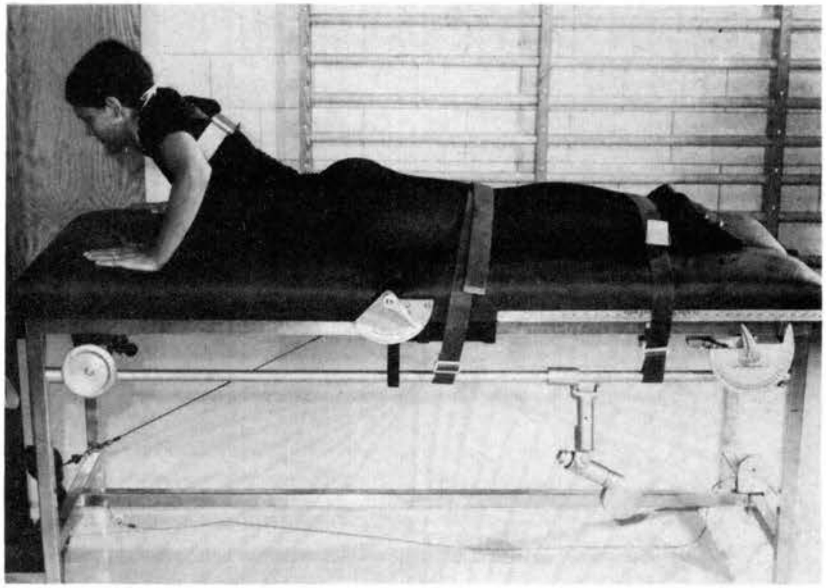


Figure 12. Push-Up - Testing Position

Subjects were tested prior to and following the exercise program.

Flexibility

Flexibility was determined by tests involving trunk extension, right lateral trunk flexion, and spinal rotation. Subjects were measured one time prior to and one time following the exercise program; however, flexibility was not measured during the three day period preceding the menstrual cycle or the first day of the cycle because flexibility is sometimes reduced during this time.

Trunk Extension. To determine trunk extension, the subject assumed a position facing the stall bars with the pelvic girdle stabilized against them by a strap around the hips, as illustrated in Figure 13.

Figure 13. Trunk Extension Flexibility - Pre-Test Position

The distance from the stall bars to the top of the sternal notch with the subject's back hyperextended as far as possible was recorded as trunk extension (Figure 14). Results were recorded to the nearest one-half inch.

Right Lateral Trunk Flexion. Right lateral trunk flexion was measured by having the subject assume a position with the back against the stall bars. The pelvic girdle was stabilized by a strap around the hips (Figure 15).

The subject bent as far to the right as possible, without bouncing, while the shoulders were kept against the bars, both legs locked straight, and both heels on the floor to eliminate trunk rotation. The distance from the longest finger (second) to the floor was measured to the nearest one-half inch and recorded as right lateral trunk flexion (Figure 16).

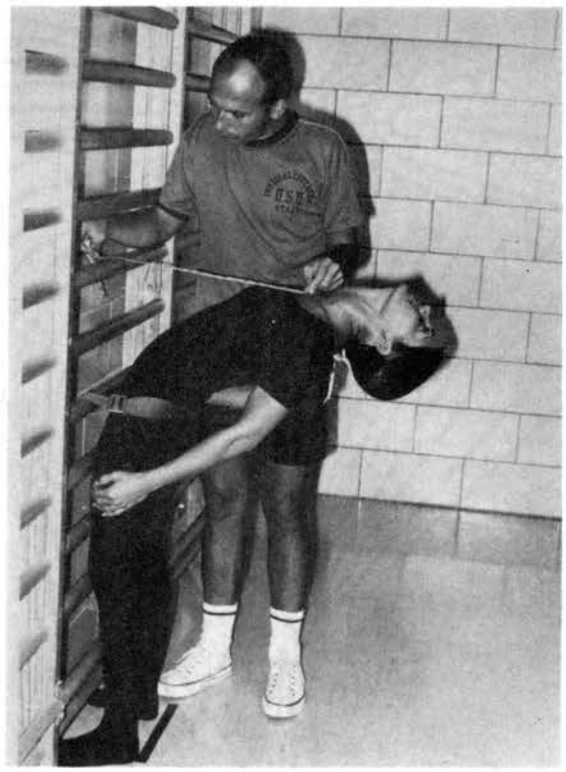


Figure 14. Trunk Extension Flexibility - Testing Position

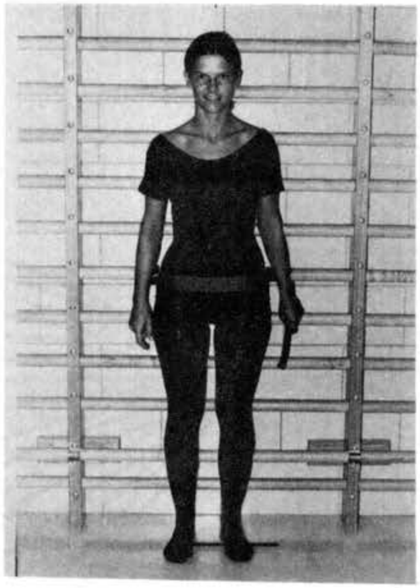


Figure 15. Lateral Trunk Flexion Flexibility - Pre-Testing Position

Spinal Rotation. Spinal rotation was ascertained utilizing a large protractor face drawn on the floor (Figure 17).

The subjects stood erect in the center of the face and held a wooden want (dowel rod 4 feet long and 1 inch in diameter) across the back of the shoulders to prevent movement in the shoulders. A plumb line was attached to the right end of the wand and adjusted to the proper length so it did not touch the floor (Figure 18). The subject was then positioned so the plumb bob was on zero degrees.

With knees locked and feet flat on the floor, the subject slowly rotated the upper trunk as far as possible to the right. This position was held while the degrees of rotation were determined from the protractor face by the location of the plumb bob (Figure 19).

Figure 16. Lateral Trunk Flexion
Flexibility - Testing
Position

Aerobic Capacity

Aerobic capacity was determined by administering the Balke Treadmill Test. Since the Balke Test requires from twenty to thirty minutes to administer to a single subject, fifteen subjects from the experimental group and fifteen subjects from the control group were randomly assigned and given the test prior to and following the investigation. Of these original thirty subjects, only twenty-three completed the study, ten from the experimental group and thirteen from the control group.

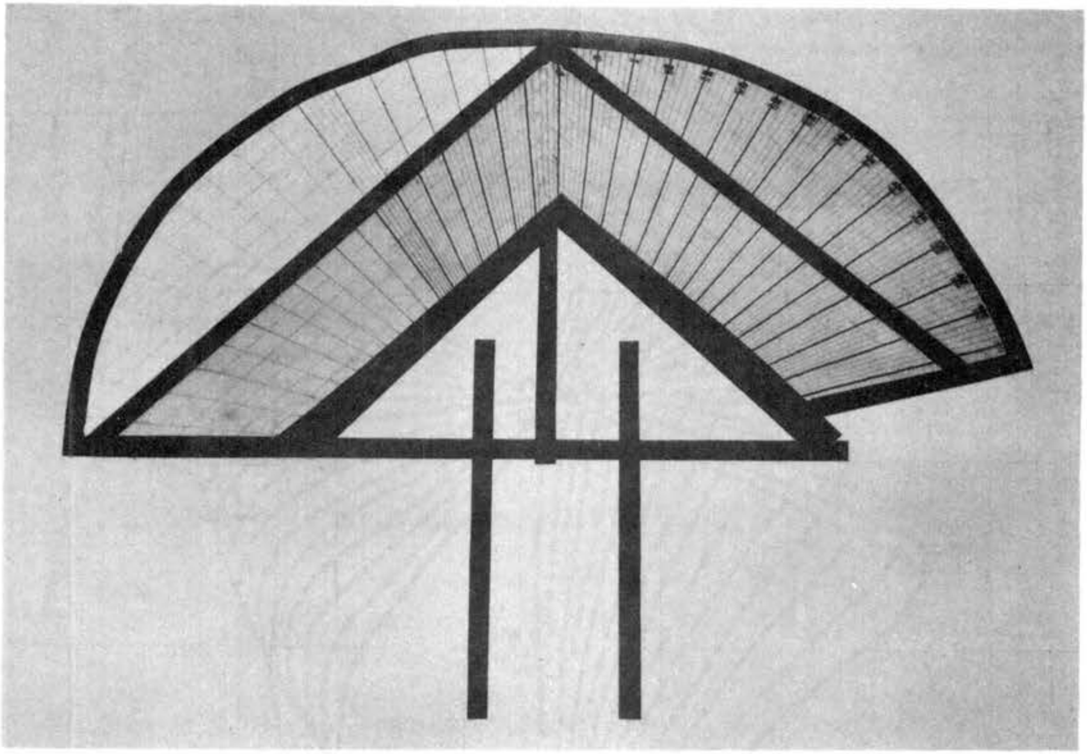


Figure 17. Spinal Rotation - Protractor Face

To perform the Balke Test, the subject began walking on a Quinton motor-driven treadmill at a rate of 3.4 mph on a zero percent grade. At the end of one minute, the grade was increased to two percent while the subject continued walking. At the end of each succeeding minute, the grade was increased by one percent while walking continued. The test was terminated when the subject achieved a heart rate of 180 beats per minute and her score was recorded as the number of minutes she had walked on the treadmill before reaching this heart rate level.[18] The subjects' fitness classification and predicted oxygen intake (reported in milli-

---

[18]Consolazio, Physiological Measurements, p. 371.

meters per kilogram of body weight per minute) at crest load were determined from Dr. Balke's chart.[19]

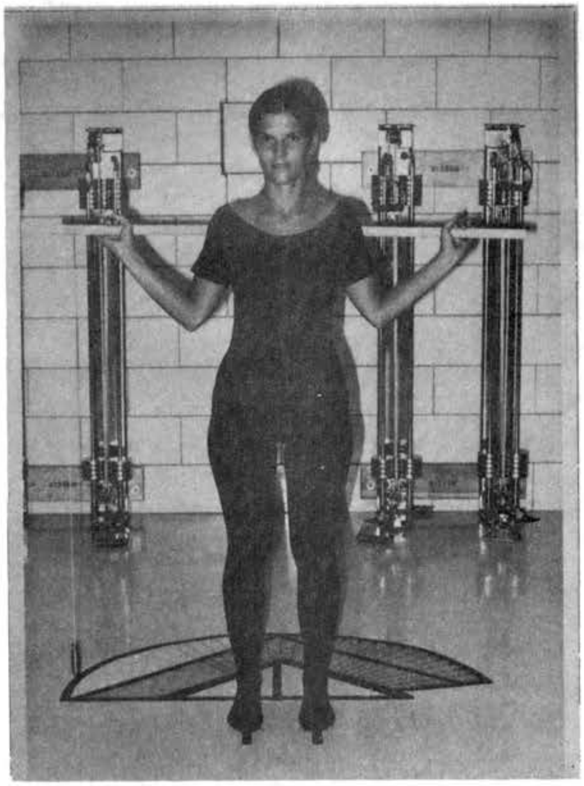


Figure 18. Spinal Rotation Flexibility - Pre-Testing Position

Heart rate during the Balke Test was recorded by radio-telemetry and a physiograph machine. The electrode plates were located on the sternum, just below the sternal notch, and on the lower left side of

[19]Balke and Clark, Health and Fitness, p. 84.

the thorax approximately two inches below and two inches to the left of the breast.

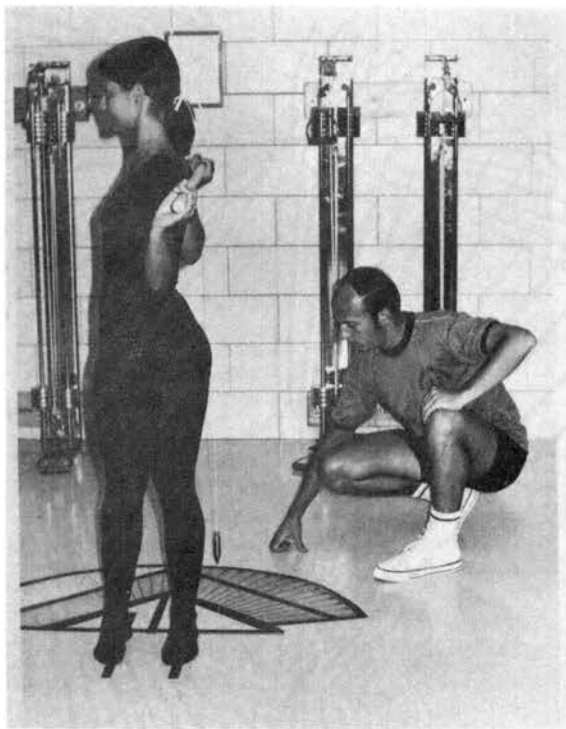


Figure 19. Spinal Rotation Flexibility - Testing Position

Vital Capacity

Vital capacity was measured by the Collins six liter wet spirometer, which is read in tenths of a liter. The subject stood facing away from the spirometer, took a maximum inspiration and held it, pinched close her nose, inserted the mouth piece into her mouth and then exhaled, at a medium rate, as much air as possible into the canister of the wet spirometer.[20] Vital capacity was ascertained prior to and at the conclusion of the study.

Resting Cardiovascular Fitness

The subject's resting cardiovascular fitness was determined by the Schneider Index. This test was administered to the same twenty-three subjects utilized in the Aerobic Capacity research. The subject's heart rate and blood pressure were ascertained in the quiet lying and normal standing positions utilizing a sphygomanometer and stethoscope. In addition, heart rate was determined every fifteen seconds for two minutes immediately following a brief exercise which consisted of stepping up and down five times on a 20-inch stool for fifteen seconds. The reclining and standing systolic blood pressures, plus the reclining, standing, and post exercise heart rates were applied to the Schneider Index score sheet (Appendix B) to obtain the level of fitness.

The sub-group subjects were tested prior to and following the exercise program.

Maximum Breathing Capacity

Each subject's maximum breathing capacity (MBC) was obtained utilizing the Collins 100 liter Tissot Tank. The subject inserted a mouth piece into her mouth and a nose clip was placed on her nose. The mouth piece was connected to the Tissot Tank by means of a Collins two-way plastic "J" respiratory valve and a flexible tube. The subject

---

[20] Consolazio, Physiological Measurements, p. 221.

inhaled and exhaled, medium depth breaths, as rapidly as possible for a 15-second period while the expired air was collected in the Tissot Tank. The readings were taken in millimeters and converted into liters for recording purposes. From this collected volume, the MBC per minute was calculated utilizing a Wang Electronic Calculator.

Subjects were tested prior to and at the conclusion of the study.

Heart Rate

In order to determine heart rate during the exercise program, three subjects from the experimental group agreed to come to the physiology of exercise laboratory and have their heart rates monitored continuously. The heart rate of each subject was recorded two times during the period of the fourth and fifth weeks of the exercise program, thus providing heart rates which reflected actual exercise condition after the subjects had become well adjusted to the apparatus. The heart rates were monitored by placing electrode plates on each side of the thorax just below bra level. These plates were held in place by rubber chest straps and connected directly by wires to a Hi-Gain Preamplifier which in turn was connected to a Narco Bio-Systems' Physiograph Machine which recorded the heart rates. Prior to each exercise session, the subject assumed a quiet lying position in the Inch Master until two consecutive identical resting heart rates were obtained, then the exercise program was started. Upon conclusion of the program, the subject continued to lie in the Inch Master during the two minute recovery period. The exercise and recovery heart rates were determined for each exercise position and recovery. Exercise position rates were taken from the heart rate recordings during the last fifteen seconds of each position, while recovery rates were taken during the last fifteen seconds of each recovery minute.

Kinesiological Analysis

All nine exercises utilized in the exercise program were analyzed as to joint action and muscle groups assumed to be acting as prime movers. The exercises were analyzed with the assistance of sequential photographs and muscle palpation (Chapter IV).

The kinesiological analysis was completed in order that the muscle groups utilized in performing the nine exercises could be determined. Muscle groups not being utilized during the exercises obviously would not be strengthened by the Inch Master program.

Analysis of Data

The collected raw data are presented in Appendix D. Statistical procedures were utilized to test for the significance of the differences between the pre- and post-test means within the experimental and control groups, between the post-test means of the experimental and control groups, and between the mean changes of each group.

The eight null hypotheses of this study were tested utilizing the BMDX70-t Program and an IBM 360 Computer.[21] This program computed Student's *t*-value, Fisher's F-ratio of variance and the degrees of freedom. The computational procedures for this program appear in Appendix C.

The level of significance acceptable for the *t*-values and F-ratios

---

[21] W. J. Dixon, ed., BMD Biomedical Computer Programs, Vol. III (Los Angeles: University of California Press, 1969), pp. 79-85.

was set at the .05 level. These values were determined by consulting tables provided by Runyon and Haber.[22]

---

[22]Richard P. Runyon and Audrey Haber, Fundamentals of Behavioral Statistics (2nd ed., Reading, Massachusetts: Addison-Wesley Publishing Company, 1971), pp. 293-97.

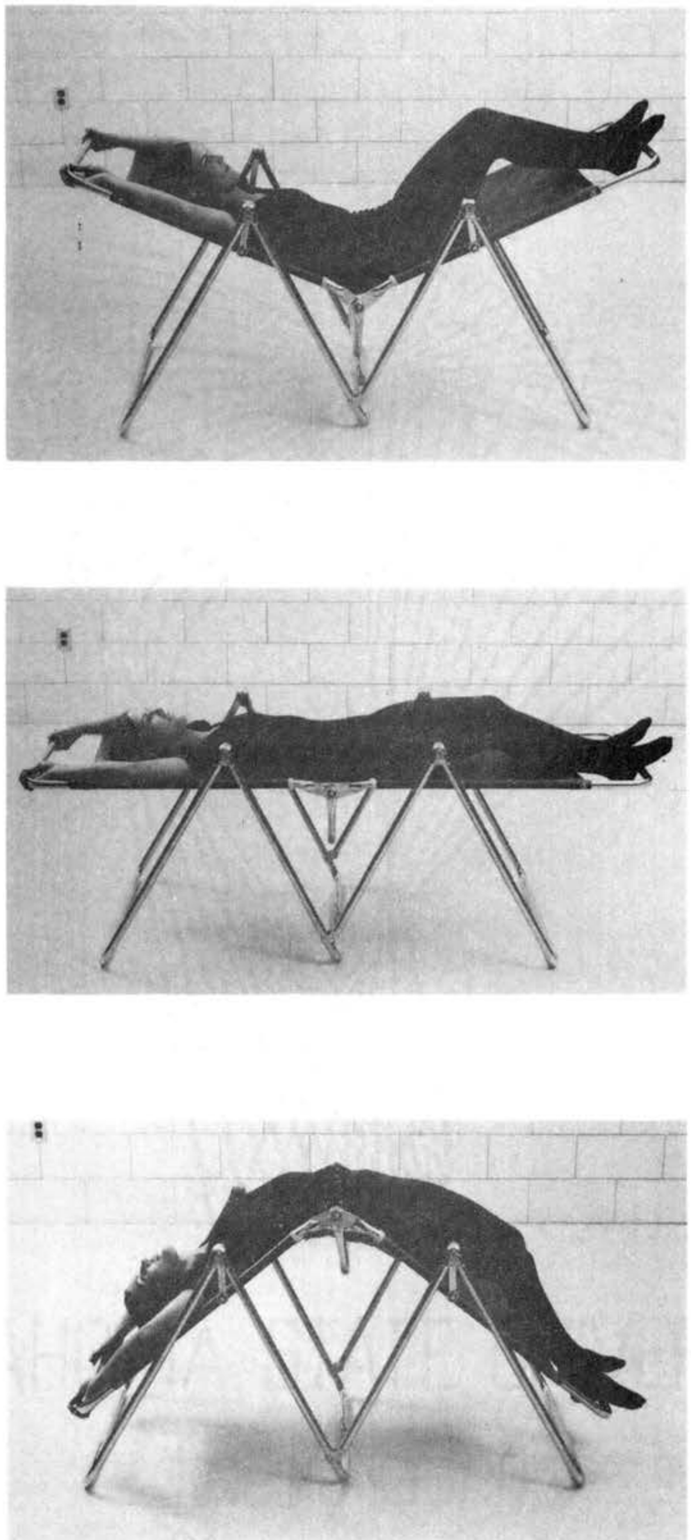
CHAPTER IV

KINESIOLOGICAL ANALYSIS

A kinesiological analysis of the nine exercises is presented in this chapter. The analysis was aided by sequential photographs and muscle palpation of a subject while she performed the exercises. The joint action and/or actions which were performed in executing the exercises were named in addition to the muscle groups assumed to be the prime movers during the effort and recovery phases of the exercises.

Basic Exercise

The Basic Exercise is illustrated in Figure 20. To perform the exercise, the subject assumed a supine position on the bed of the exerciser (Figure 20-A) with the navel level located at the center hinges. The arms were extended over the head with elbows slightly flexed and the hands grasping the end crossbar, while the feet were placed on the opposite end crossbar, resulting in slight flexion at the knees and hips. The subject performed the exercise by pushing with the feet, thus forcing the ends of the cot downward and the hinged middle upward (Figure 20-B and -C). This movement resulted in hyperextension of the back and hip with the assumed prime movers being the hip extensor muscles with some aid coming from the back extensor muscles during the latter phase of the effort movement. The knee extensor muscles acted as stabilizers for the knee, which remained slightly flexed.



A

B

C

Figure 20. Basic Exercise

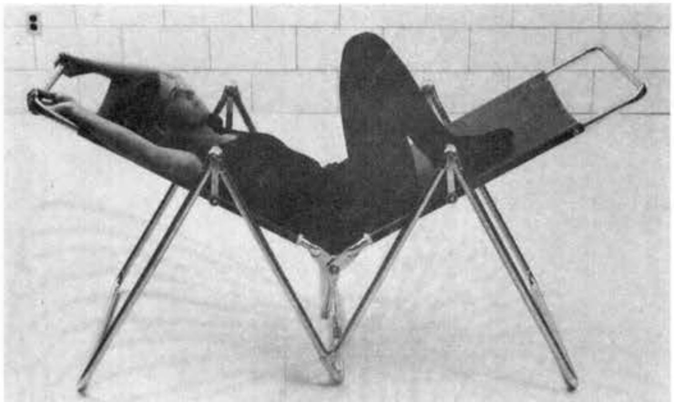
The recovery phase of the exercise was accomplished by decreasing the pressure applied by the feet (Figure 20-A). This resulted in an eccentric contraction of the hip extensors because of the gravitational pull on the subject. The abdominals, upper trunk, and arms did not appear to be utilized during the exercise.

The same back hyperextension and return movements used to perform the Basic Exercise, were incorporated to some degree in performing five of the other exercises. Only the exercises of V-Push, Flank, and Push-Up do not use back hyperextension.

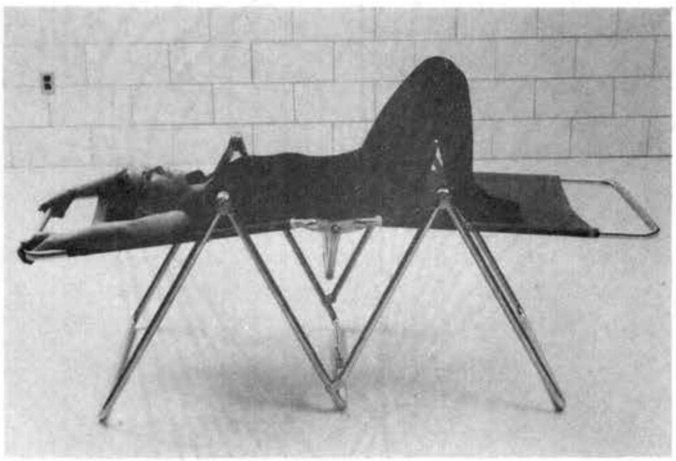
Thigh Exercise

The Thigh Exercise is illustrated in Figure 21. To perform the exercise, the subject assumed the same supine position as that of the Basic Exercise, except the feet were placed flat on the exerciser bed with the heels against the buttocks. This resulted in the knees being fully flexed (calf against thigh) while hips were flexed to about a 90° angle (Figure 21-A). The exercise was accomplished by pressing down with the feet which forced the cot to bend upward in the middle and downward on the ends. This action resulted in hip extension and back hyperextension; however, the prime movers for the exercise appeared to be the hip extensor muscles. The contraction of the hip extensors was greater for this exercise than the Basic Exercise because of the shorter force arm.

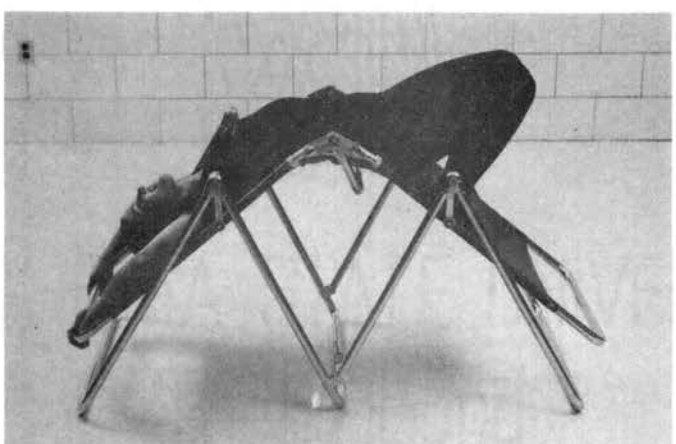
The recovery phase of the exercise was accomplished by an eccentric contraction of the hip extensors and the aid of gravity (Figure 21-A). Again the abdominals, upper trunk, and arms did not appear to be used during the exercise.



A



B



C

Figure 21. Thigh Exercise

V-Push Exercise

In assuming the beginning position, the subject sat upright across the center (V) hinges of the cot with elbows flexed so both hands grasped the back edge of the cot on each side of the body. The knees were flexed so the feet could not touch the floor (Figure 22-A). To execute the effort phase of the exercise, the subject pushed down with both hands until the arms were straight, forcing the ends of the cot downward until the bed was parallel with the floor (Figure 22-B). This straightening of the arms was accomplished by extension of the elbow joints and adduction of the shoulder joints. The assumed prime movers for extension of the lower arms were the elbow extensors, while the shoulder joint movement was the result of action by the shoulder adductors.

The subject completed the recovery phase of the exercise by slowly decreasing the arm pressure on the cot (Figure 22-A). This resulted in an eccentric contraction of the extensor and adductor muscles. This action was possible because of the gravitational pull on the subject.

This exercise appeared to be one of the most difficult because the subject was required to lift the majority of the body weight with arms alone.

Alternating Leg Push

The Alternating Leg Push Exercise is illustrated in Figure 23. The starting position was the supine position utilized in the Basic Exercise (Figure 23-A). This exercise actually had two effort phases and two recovery phases, with each involving one leg. To accomplish the first effort phase, the subject pushed down on the end crossbar, until the exerciser bed was parallel with the floor, with his right foot while

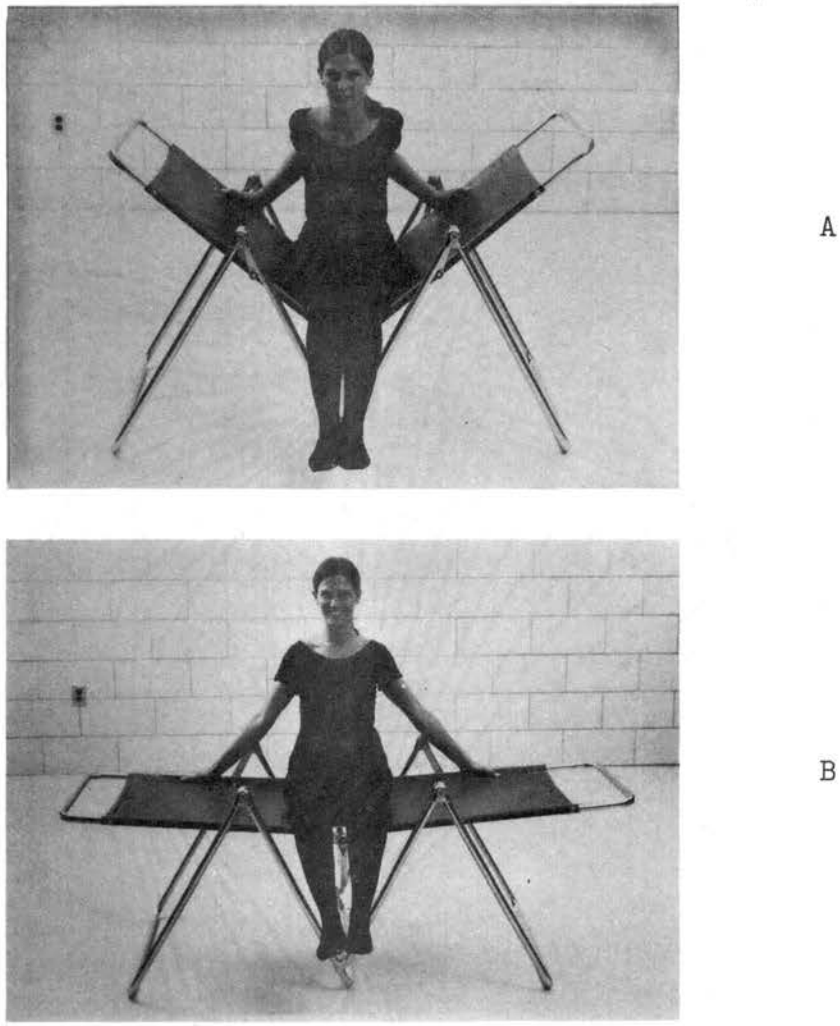
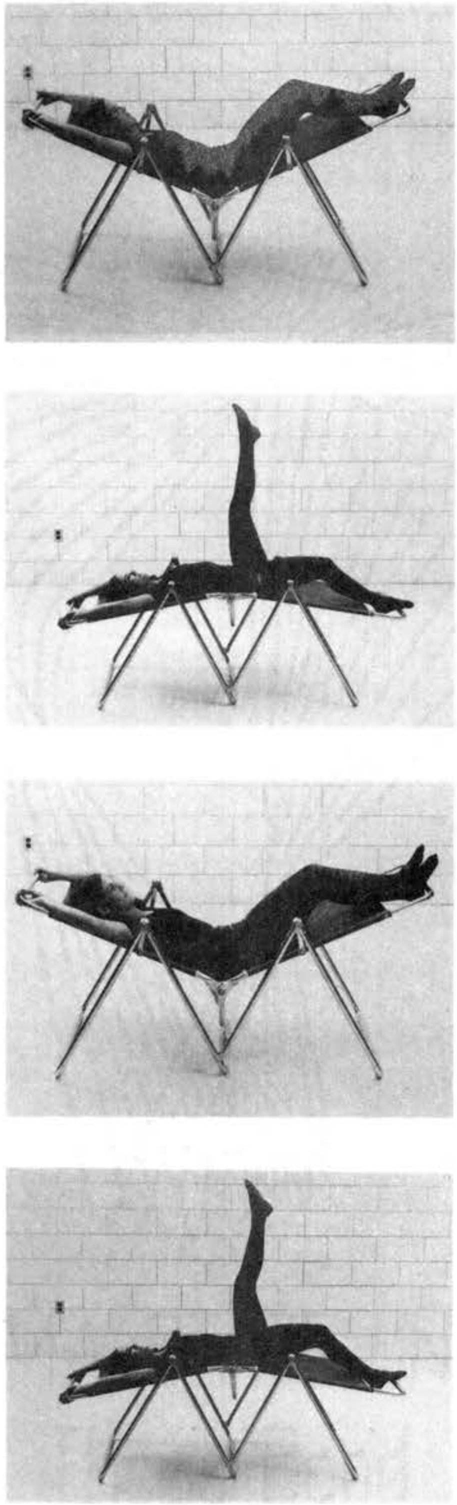


Figure 22. V-Push Exercise

simultaneously lifting the extended left leg until the pointed toe was directed toward the ceiling (Figure 23-B). The force by the right foot resulted from extension of the right hip by the hip extensor muscles, while the lifting of the left leg was primarily accomplished by the hip flexor muscles. The back was hyperextended as in the Basic Exercise.

The first recovery phase consisted of an eccentric contraction by the hip extensors in the right leg and an eccentric contraction by the



A

B

C

D

Figure 23. Alternating Leg Push Exercise

hip flexors in the left leg. These two muscle contractions resulted in the subject's returning to the original starting position.

The second effort and recovery phases of the exercise were performed with the left leg being utilized to level the cot bed and the extended right leg being lifted so the pointed toe was directed toward the ceiling (Figure 23-C and -D). In performing these movements the opposite side hip extensors and hip flexors were utilized.

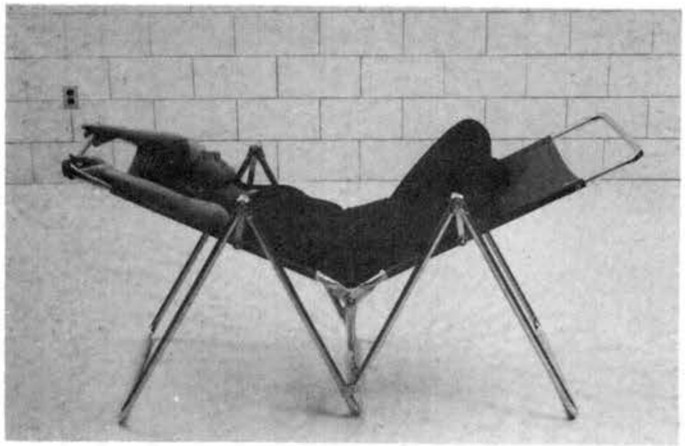
Yogi Exercise

The Yogi Exercise is illustrated in Figure 24. The starting position was the same supine position used in the Basic Exercise, except the knees were fully flexed and the legs crossed "Indian style" (Figure 24-A). To perform the exercise the subject pushed down with the feet and arched the back which resulted in the ends of the cot being forced downward and the center upward (Figure 24-B and -C). This action created hyperextension in the back and extension in the hip joints. The prime movers appeared to be the hip extensor muscles during the early phase of the effort, but the power for the latter portion of the effort phase seemed to be derived from the back extensor muscles. This was attributed to the poor leverage of the hip extensors.

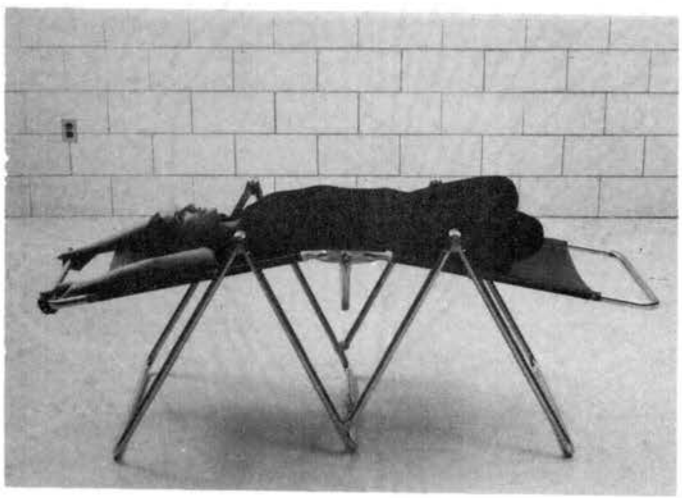
The recovery phase was accomplished by slowly decreasing the pressure being applied by the back and hip extensor muscles. This decreased pressure (eccentric contraction) enabled the gravitational pull to return the subject to the starting position (Figure 24-A).

Flank Exercise

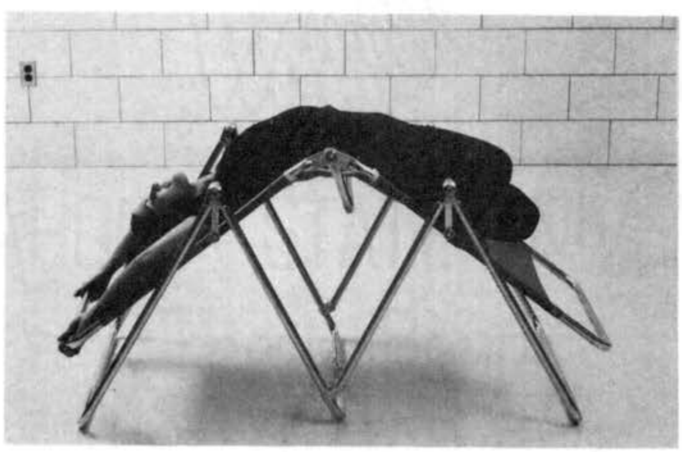
The Flank Exercise for the right side is illustrated in Figure 25.



A

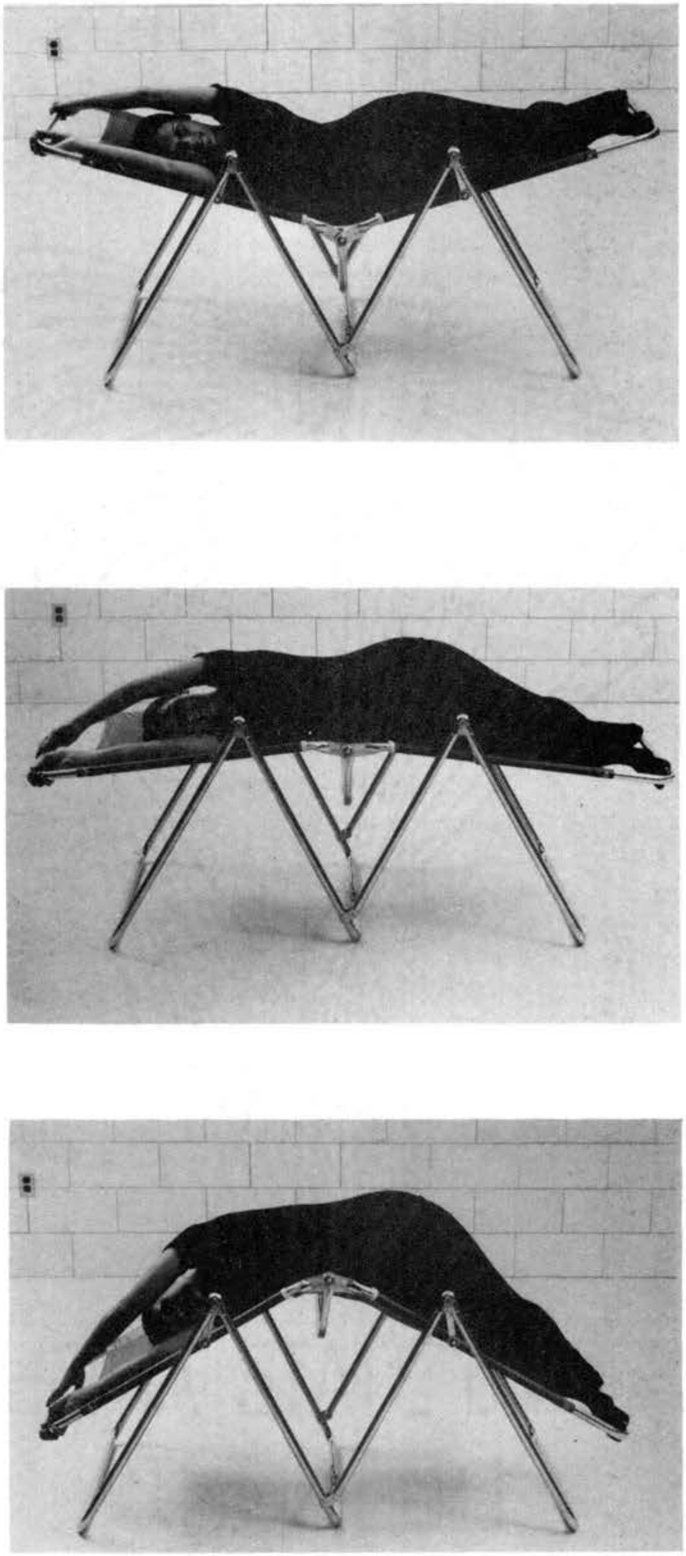


B



C

Figure 24. Yogi Exercise



A

B

C

Figure 25. Flank Exercise

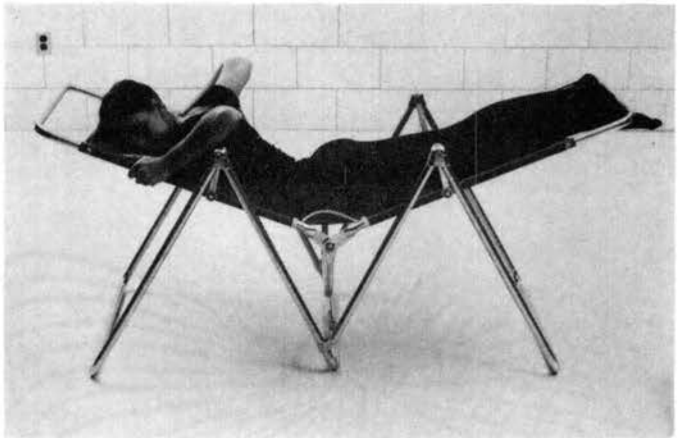
This particular exercise was performed on the right side and then on the left side with an equal amount of exercise time devoted to each side. The joint actions described in this analysis were only concerned with the right side exercise; however, the reverse actions were applicable to the left side exercise.

To perform the right side exercise, the subject assumed a right side lying position on the bed of the exerciser with the navel located at the center hinges. The arms were extended over the head with the hands grasping the end crossbar, the right hand anterior to the left hand. The knees were flexed slightly so the feet could be placed against the opposite end crossbar with the right foot positioned anterior to the left foot (Figure 25-A). To execute the effort phase of the exercise the subject pushed downward with the feet which resulted in extension of the knee joint by the knee extensor muscles. Paralleling the pushing effort by the feet was right hip abduction which was assumed to be created by the left hip adductors and lateral spinal flexors (Figure 25-B). During the later part of the effort phase there appeared to be some lateral flexion of the trunk, but this appeared to be the result of the bending upward of the center of the cot rather than the contraction of the lateral spinal flexor muscles (Figure 25-C).

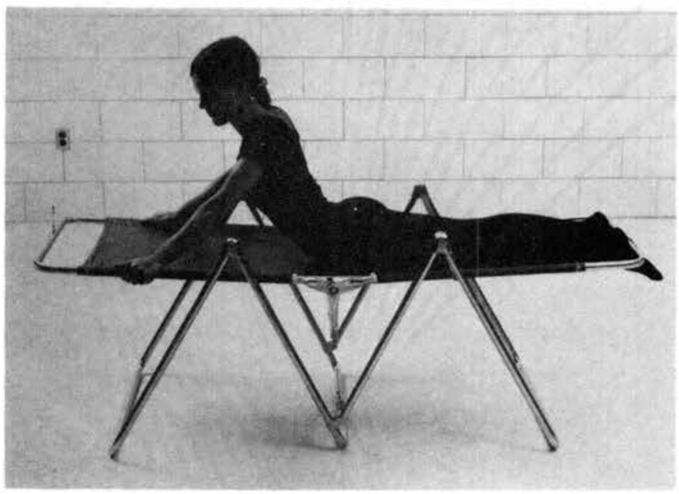
The recovery phase of the exercise was accomplished by eccentric contraction of the hip and knee muscles, and gravitational pull.

Push-Up Exercise

The Push-Up Exercise is illustrated in Figure 26. To perform the exercise, the subject first assumed a prone position on the exerciser bed with the hips located at the level of the center hinges and the head



A



B

Figure 26. Push-Up Exercise

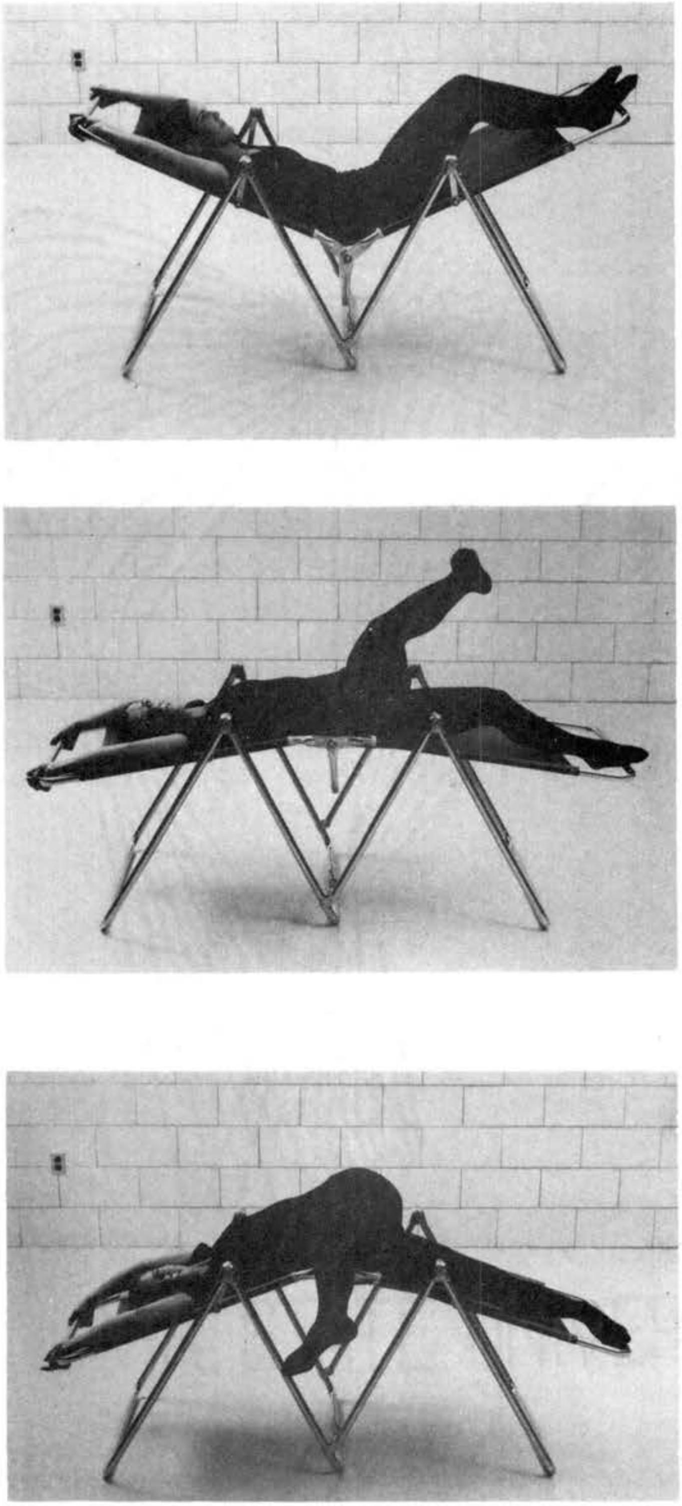
turned to one side. The shoulders were horizontally abducted with the elbow joints flexed so the hands could grasp the side bars of the exerciser at chin level. The legs were extended with the ankles plantar flexed so the soles of the feet were under the end crossbar (Figure 26-A).

Performance of the exercise entailed doing a push-up by horizontal flexion adduction of the shoulders and extension of the elbows. The movement created by the push-up elevated the subject's upper trunk and moved the exerciser bed to a position parallel with the floor. This movement created some hyperextension in the lumbar region of the spine (Figure 26-B). The prime moving muscles for the effort phase of the push-up were assumed to be the elbow extensors and the horizontal flexor adductors. To complete the exercise and return to the starting position (Figure 26-A), the subject used an eccentric contraction in the horizontal flexor adductor muscles and the elbow extensor muscle.

Saddle Bend Exercise

The Saddle Bend Exercise is illustrated in Figure 27. This exercise was performed with the left leg and then with the right leg; therefore, an equal amount of exercise time was devoted to each side of the body. Only the joint actions involved in the exercise with the left leg were included in this analysis; however, the same actions were applicable to the exercise involving the right leg.

The starting position for the exercise was the supine position described in the discussion of the Basic Exercise (Figure 27-A). To perform the Saddle Bend the subject pressed downward on the end crossbar with the right foot until the exerciser bed was parallel with the floor. At the same time she lifted the extended left leg upward and to the right across the body (Figure 27-B) so the toe pointed toward the floor on the right side of the cot or as far as physical limits would allow the leg to move (Figure 27-C). The force created by the right leg and foot appeared to be derived from the hip extensor muscles, while the elevation of the left leg was probably due to the hip flexors until the leg started to move across the body. Then the gravitational pull on the



A

B

C

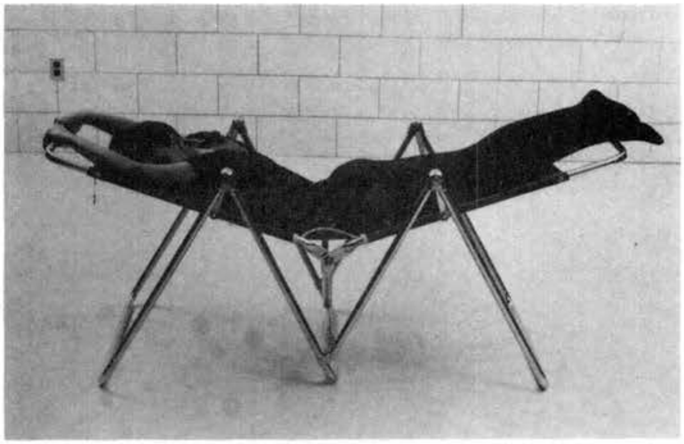
Figure 27. Saddle Bend Exercise

leg and an eccentric contraction by the hip abductors appeared to be responsible for this movement. The twisting of the lower trunk appeared to be caused by the weight of the left leg, but the oblique abdominal muscles could have assisted somewhat in this movement.

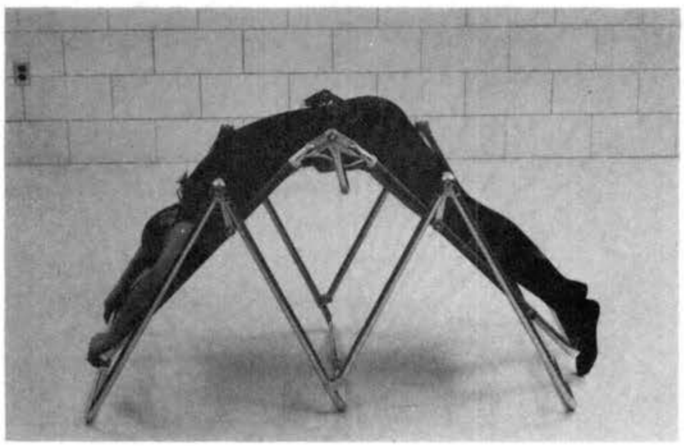
The recovery phase of the exercise was accomplished by returning the extended left leg to the initial position and gradually reducing the pressure applied by the right foot and leg. The abductors of the left hip and the abdominal muscles appeared to be the prime movers in the elevation of the left leg, but gravity, with the aid of an eccentric contraction from the hip flexors, were responsible for the final lowering of the extended leg to the cot bed. An eccentric contraction, by the hip extensors of the right leg, enabled gravitational pull to act on the weight of the subject and thus return the exerciser bed to the starting position (Figure 27-A).

Relaxation Exercise

The final exercise, Relaxation, is illustrated in Figure 28. Prior to performing the exercise, the subject assumed a relaxed prone position on the exerciser bed with the navel level located at the center hinges and the head turned to one side. The arms were extended overhead with the elbows slightly flexed so the hands draped across the end crossbar. The legs were extended so the ankles rested on the opposite end crossbar (Figure 28-A). To perform the effort phase of the exercise, the subject pressed downward with the legs, causing the ends of the exerciser to go downward and the center section to rise (Figure 28-B). This movement resulted in flexion of the body trunk at the waist level with the assumed prime movers being the hip flexors and possibly the abdominal



A



B

Figure 28. Relaxation Exercise

muscle group.

To complete the recovery phase of the exercise, the subject gradually released the pressure applied by the legs which permitted the pull of gravity to return the exerciser bed to the original starting position (Figure 28-A). This decreased pressure was accomplished by an eccentric contraction in the hip flexor muscle group.

Discussion of the Analysis

The kinesiological analysis of the nine exercises revealed that the force for the majority of the exercises was derived from the hip extensors, hip flexors, shoulder horizontal adductors, and elbow extensors. Seven of the nine exercises utilized either the hip extensors or hip flexors to move the exerciser while two exercises utilized extension of the elbows for their main source of force.

The important thing the analysis made evident was that the nine exercises performed utilized only a limited number of muscle groups. This raises a serious question as to the actual value of the exercises, since the Home Exercise Course manual stated that each of the different exercises would produce change (trim or strengthen) the body in different regions. (The stated claims for each exercise were presented in Chapter I, pages 4 and 5.) The question is, "How is this type of change possible when the same muscle groups were utilized to perform the different exercises." From the analysis, it would seem logical to expect the hip extensors and hip flexors to display an increase in strength level since one or the other was utilized in seven of the nine exercises. However, it would not seem logical to expect other muscle groups to exhibit an increased strength level when they were not used in performing work. Still another point is that muscle strength increases only when the muscle is placed in a situation where overload exists (overload principle). The kinesiological analysis indicated that force for the majority of the exercises came from the hip extensors, hip flexors, shoulder horizontal adductors, and elbow extensors. These muscle groups had the opportunity to increase in strength if the workload for the exercises was at the overload level. The data from the strength tests should provide some assistance in coping with these questions; however, these hypotheses cannot be answered until an electromyographic study of the exercises has been performed. The information revealed by this analysis provides a basis for such an investigation.

The utilization of the hip extensors and/or the hip flexors as prime movers in seven of the exercises indicated that the hip and pelvic girdle region was being consistently stretched during movement. Thus, it would seem logical that this area should show an increase in flexibility. The flexibility tests should provide data to substantiate and/or disprove this hypothesis.

CHAPTER V

ANALYSIS OF DATA

The statistical analyses of the data are presented in this chapter. The Student t-values and the Fisher F-ratios for each of the nine variables of investigation are shown and those significant at the .05 level of confidence are noted. The pre test and post test fitness classification and maximum oxygen intake levels of the subjects involved in the Aerobic Capacity research are presented. In addition, graphs illustrating the heart rates of the subjects who were monitored during exercise are presented.

Statistical Procedures

The mathematical computations of the data were accomplished on an IBM 360 Computer utilizing the BMD X70-t Program which computed the t-value and F-ratio. The t-value was utilized to test the significance of difference between the means of the control group and the experimental group while the F-ratio was employed to test the significance of difference between the variance of the control group and the experimental group. The t-value was only based on the one score (in this instance the mean) where the F-ratio was based on all scores; hence, utilizing the t-value and the F-ratio provided a more comprehensive analysis of the data. Both the t-value and the F-ratio were expressed in probability of its reoccurrence should the investigation be replicated. For example, if a mean (or variance) was found to be significant at the .05 level of confidence (the acceptable level of confidence for this study), it would mean that in 95 times out of 100 replications the same results could be expected.

This investigation was designed to determine if the experimental group changed significantly more in the variables under study than the control group changed. These results were obtained by computing the mean changes within the experimental group and the mean changes within the control group and then testing these means for the significance of difference utilizing Student's t-value and Fisher's F-ratio. Utilizing the results of these computations, the eight hypotheses for this investigation were tested.

The t-values and F-ratios were also computed: (1) between the pre test and post test measurements within the control group and within the experimental group and (2) between the post test measurements of the control and experimental groups. These computations appear in Appendix E because they were not of value in testing the hypotheses for this investigation.

Subjects

The investigation initially began with sixty adult female volunteers as subjects. Thirty were randomly assigned to the experimental group and thirty to the control group. At the conclusion of the study, the experimental group contained twenty-five subjects and the control group contained twenty-seven subjects. The number of subjects, from each group, who were involved in the various tests and data collection are indicated in Table II.

TABLE II

NUMBER OF SUBJECTS INVOLVED IN EACH TEST

Test	Experimental Group	Control Group
Body Girth	25	27
Subcutaneous Fat	25	27
Strength	11	13
Flexibility	25	27
Aerobic Capacity	10	13
Vital Capacity	25	27
Resting Cardiovascular Fitness	10	13
Maximum Breathing Capacity	25	27

In addition to the mathematical computations regarding the eight variables of investigation, the means and standard deviations were calculated for age, height, and pre and post test weight of the subjects in the experimental group and control group. These data appear in Table III.

Results of Between Group Tests for Mean Change

The difference between the pre test mean and the post test mean (mean change) was calculated for all variable measurements in the control group and the experimental group. The difference in changes between the two groups was tested for significance in mean change and variability (variance). The t-values and F-ratios appear in Table IV. The acceptable confidence level for this investigation was the .05 level.

TABLE III

MEANS AND STANDARD DEVIATIONS OF AGE, HEIGHT AND WEIGHT

Group	Mean	S.D.
Experimental		
A. Age	28.92 yrs.	8.11
B. Height	63.07 in.	1.55
C. Pre Study Weight	127.98 lbs.	18.33
D. Post Study Weight	127.84 lbs.	18.64
Control		
A. Age	26.78 yrs.	7.96
B. Height	63.23 in.	2.18
C. Pre Study Weight	126.49 lbs.	15.96
D. Post Study Weight	126.72 lbs.	15.86

Body Girth

H_1: There would be no significant difference between the mean change in body girth for the members of the experimental group

TABLE IV

t-VALUES, AND F-RATIOS OF THE MEAN CHANGES BETWEEN THE EXPERIMENTAL AND CONTROL GROUPS

Test	F-Ratio	t-Value
Body Girth		
A. Right upper arm	1.27	0.58
B. Bust	1.32	0.60
C. Waist	1.07	-1.74*
D. Hips	2.33*	0.10
E. Right thigh	1.01	-2.02*
F. Right calf	3.02*	1.42
Subcutaneous Fat		
A. Right tricep	1.24	0.93
B. Upper chest	4.96*	-0.46
C. Abdomen	1.55	0.72
D. Right subscapular	4.00*	-0.47
E. Right thigh	2.27*	0.94
Strength		
A. Hip flexors	1.91	0.87
B. Abdominals	1.31	1.65
C. Shoulder extensors	1.12	-0.42
D. Back extensors	2.05	0.82
E. Shoulder adductors & elbow extensors	1.44	0.31

*Significant at .05 level

TABLE IV (Continued)

Test	F-Ratio	*t*-Value
Flexibility		
A. Trunk extension	1.79	-0.20
B. Right lateral flexion	1.01	-2.12*
C. Spinal rotation	1.11	2.22*
Aerobic Capacity	1.14	3.15*
Resting Cardiovascular Fitness	1.82	0.93
Vital Capacity	1.58	-1.81*
Maximum Breathing Capacity	1.54	0.48

*Siginficant at the .05 level

and the mean change in body girth for the members of the control group.

The six body girth measurements revealed only two significant *t*-values, waist girth and right thigh girth. In both instances, the experimental group improved (decreased) in these girth measurements significantly more than the control group. This decrease might be attributed to participation in the exercise program.

Hypothesis one (H_1) was accepted in body girth of the right upper arm, bust, hips and right calf; however, it was rejected in waist and right thigh because significant changes were revealed.

Significant F-ratios were revealed in hip and right calf body girth. These significant ratios indicated the variance of the two groups were significantly different from one another. This difference in variances might be the result of a dual effect by the experimental conditions, one that was not revealed by the t-value.[1]

Subcutaneous Fat

H_2: There would be no significant difference between the mean change in subcutaneous fat of the members of the experimental group and the mean change in subcutaneous fat for the members of the control group.

Non-significant t-values were revealed in all five of the subcutaneous fat measurements; thus, hypothesis two (H_2) was accepted in relation to the subcutaneous fat of the right tricep, upper chest, abdomen, right subscapular, and right thigh. These results would indicate that the subcutaneous fat levels were not significantly decreased by participation in the exercise program. Since none of the subcutaneous fat landmarks revealed a significant difference, it might be assumed that fat reduction did not occur at any of the five landmarks.

Significantly different variances were revealed in the upper chest, right subscapular, and right thigh subcutaneous fat measurements.

Strength

H_3: There would be no significant difference between the mean change in the strength of the members of the experimental group and the mean change in strength for the members of the control group.

---

[1] Runyon and Haber, Fundamentals of Behavioral Statistics, pp. 199-200.

All five of the strength tests revealed non-significant t-values; hence, hypothesis three (H_3) was accepted in strength of the hip flexors, abdominals, shoulder extensors, back extensors, and shoulder adductors and elbow extensors.

Non-significant F-ratios were also revealed when the variances of the five strength tests were statistically tested for a significance of difference.

Flexibility

H_4: There would be no significant difference between the mean change in flexibility of the members of the experimental group and the mean change in flexibility for the members of the control group.

Significant t-values were revealed in right lateral flexion and spinal rotation flexibility, but a non-significant t-value was found in trunk extension flexibility. Improvement in the right lateral flexion of the control group was significantly greater than the improvement made by the experimental group; the opposite was true in spinal rotation flexibility. The experimental group improved significantly more than the control group on the spinal rotation test. Therefore it may be assumed the exercise program did not effect right lateral flexion and trunk extension flexibility even though it apparently did significantly improve spinal rotation flexibility. Thus, hypothesis four (H_4) was accepted in trunk extension flexibility, but rejected in right lateral flexion flexibility and spinal rotation flexibility.

Non-significant F-ratios were revealed in all three of the flexibility tests which indicated the variances of the control group and the experimental group were not significantly different from one another.

Aerobic Capacity

H_5: There would be no significant difference between the mean change in aerobic capacity of the members of the experimental group and the mean change in aerobic capacity for the members of the control group.

A significant *t*-value was revealed in aerobic capacity. The experimental group showed improvement that was significantly greater than the improvement made by the control group. Based upon this it may be assumed that the exercise program did significantly improve aerobic capacity; thus, hypothesis five (H_5) was rejected. A significant difference between the mean changes in aerobic capacity was shown to exist.

The F-ratio was not significant at the .05 level of confidence; hence, the variability of the scores for the two groups were not significantly different.

Resting Cardiovascular Fitness

H_6: There would be no significant difference between the mean change in Schneider Index scores of the members of the experimental group and the control group.

The *t*-value for cardiovascular fitness was not significant, so hypothesis six (H_6) was accepted because the mean change of the experimental group was not significantly different from the mean change of the control group.

The F-ratio was also non-significant which revealed that the variances of the two groups did not significantly differ.

Vital Capacity

H_7: There would be no significant difference between the mean change in vital capacity of the members of the experimental group and the mean change in vital capacity for the members of the control group.

A significant t-value was revealed in vital capacity. The t indicated the improvement of the control group was significantly greater than the improvement of the experimental group. Therefore it may be assumed the exercise program did not effect vital capacity and that hypothesis seven (H_7) would be rejected because a significant difference in mean change was revealed.

The F-ratio was not significant; thus, the variance of the experimental group was not significantly different than the variance of the control group.

Maximum Breathing Capacity

H_8: There would be no significant difference between the mean change in maximum breathing capacity of the experimental group and the mean change in maximum breathing capacity for the members of the control group.

The t-value was found to be non-significant in maximum breathing capacity; thus, the mean change of the control group and the experimental group was not significantly different. Hypothesis eight (H_8) was accepted.

The F-ratio was also found to be non-significant, indicating the variances of the two groups were not significantly different.

Fitness Classifications and Predicted Oxygen Intake Levels

The fitness classification and predicted oxygen intake at crest load were determined for each subject who participated in the Aerobic Capacity research. These results appear in Table V.

The pre-test fitness classifications of all subjects ranged from "below very poor" to "fair," which the great majority (19 of 23) falling in the "poor" classification and below. The lowest pre-test predicted maximum oxygen intake at crest load was 23 ml/kg/min., while the highest predicted level was 38 ml/kg/min. The control group had a mean predicted oxygen intake of 29.28 ml/kg/min., while the experimental had a slightly lower mean of 28.0 ml/kg/min.

In the post-test fitness classification, the control and experimental subjects ranged from three in the "very poor" class to one in the "excellent" category; however, sixteen subjects still fell in the "poor" classification and below. The post-test predicted maximum oxygen intakes at crest load ranged from a low of 25 ml/kg/min. to a high of 52 ml/kg/min. The mean predicted oxygen intake for the control group was 33.0 ml/kg/min.; however, the mean for the experimental group was 36.8 ml/kg/min., which was a significantly greater improvement than the improvement of the control group. This improvement shown by the experimental group is in keeping with the significant improvement in Aerobic Capacity of the experimental group. It might be assumed that the improvement illustrated by the experimental group can be attributed to participation in the exercise program.

TABLE V

THE PRE TEST AND POST TEST FITNESS CLASSIFICATION AND PREDICTED OXYGEN INTAKES AT CREST LOAD

Subject	Pre Test Control Group Fitness Classification	Predicted Oxygen Intake	Post Test Control Group Fitness Classification	Predicted Oxygen Intake
		ml/kg/min.		ml/kg/min.
2	Very Poor	26	Very Poor - Poor	30
3	Poor - Fair	35	Fair - Good	40
8	Very Poor	26	Poor	31
18	Below Very Poor	23	Poor	33
23	Poor	33	Very Poor	26
26	Good - Very Good	45	Very Good	48
32	Very Poor	25	Very Poor - Poor	30
34	Very Poor	26	Poor	31
36	Below Very Poor	23	Very Poor	25
41	Poor	28	Poor	28
44	Poor	31	Fair	38
46	Very Poor	28	Poor	33
52	Poor	33	Poor	36
		$\bar{x}$ = 29.38		$\bar{x}$ = 33.0
	Experimental Group		Experimental Group	
4	Very Poor	28	Very Poor - Poor	30
7	Below Very Poor	23	Poor	33
17	Very Poor	26	Poor	33
22	Below Very Poor	20	Very Poor	28
25	Poor - Fair	35	Fair - Good	40
30	Poor	31	Very Good	46
35	Poor	31	Good - Very Good	45
37	Fair	38	Excellent	52
40	Below Very Poor	22	Very Poor - Poor	30
43	Very Poor	26	Poor	31
		$\bar{x}$ = 28.0		$\bar{x}$ = 36.8

Exercise Heart Rates

The heart rates of three experimental subjects were monitored while they performed the entire exercise program. These heart rates were recorded on two different occasions during the period of the fourth and fifth weeks of the program. The resting rate, the exercise rate for each exercise, and the post exercise recovery rate were determined for each subject and plotted on a graph. The individual heart rates appear in Figures 29, 30 and 31.

The graphs illustrate that all three subjects' heart rates rose above 100 beats per minute after participating in the first exercise of the exercise program. In all subjects, a pulse count above 130 beats per minute was reached during either the third or fourth exercise; however, the heart rate immediately decreased in all instances, except one, during the fifth exercise and generally increased again during the sixth exercise, which was performed on the right side and the left side. In the seventh and eighth (performed on right side and left side) exercises, the individual heart rates varied from a high of 126 beats per minute to a low of 108 beats per minute. The ninth exercise, which was the V-Push, resulted in an increase in the heart rate of all subjects, with subject "17" reaching a rate of 150 beats per minute during the first monitored session. This heart rate, the highest recorded during all of the monitored sessions, was obtained only in this one instance. The next highest recording among the three subjects was 138 beats per minute. This particular heart rate was attained at one time or another by all three of the subjects. During exercises, ten, eleven, and twelve, the subjects' heart rates fluctuated between 114 and 138 beats per minute, but generally stayed above 120 beats per minute. Beginning with

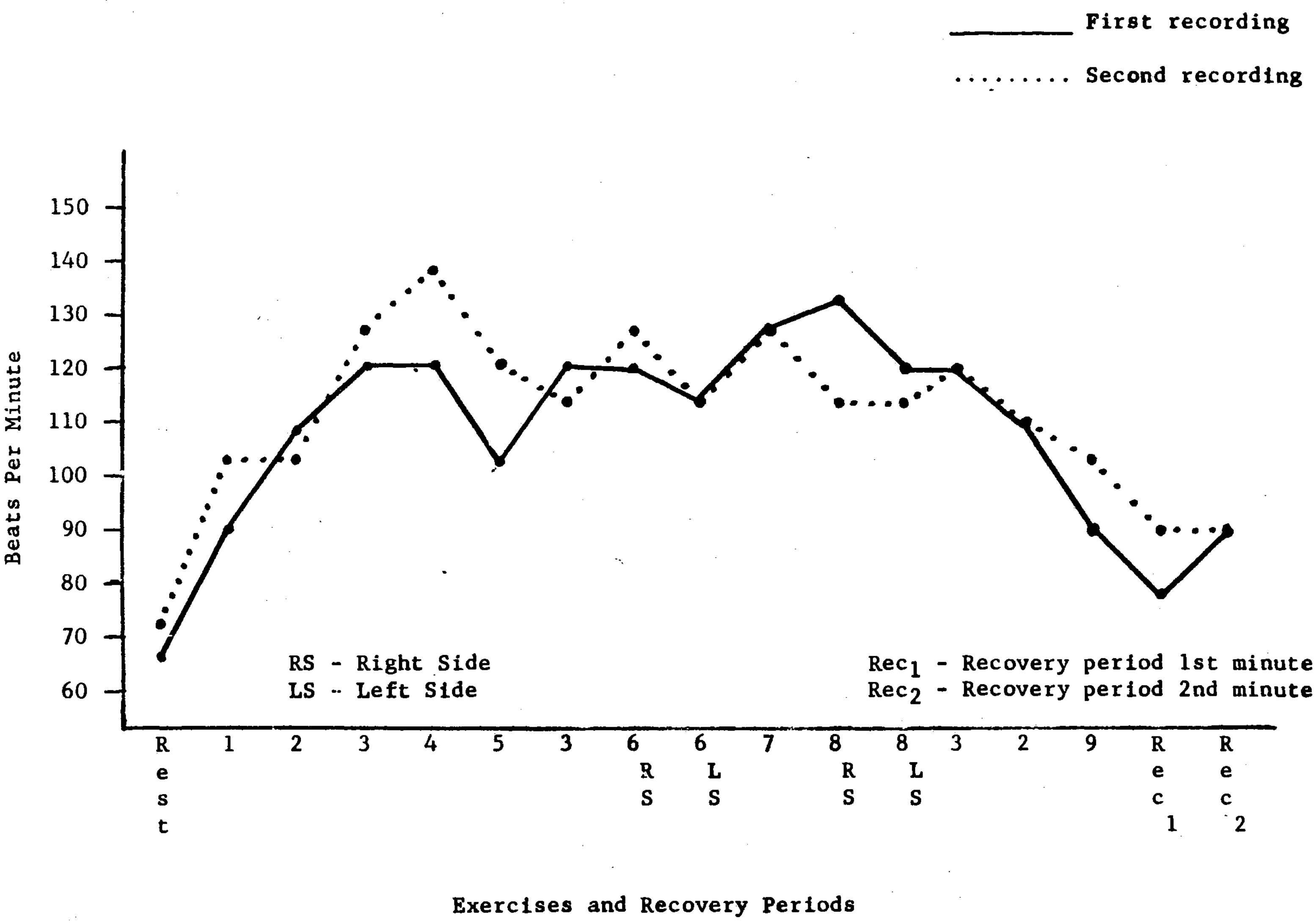


Figure 29. Exercise Heart Rate - Subject 16

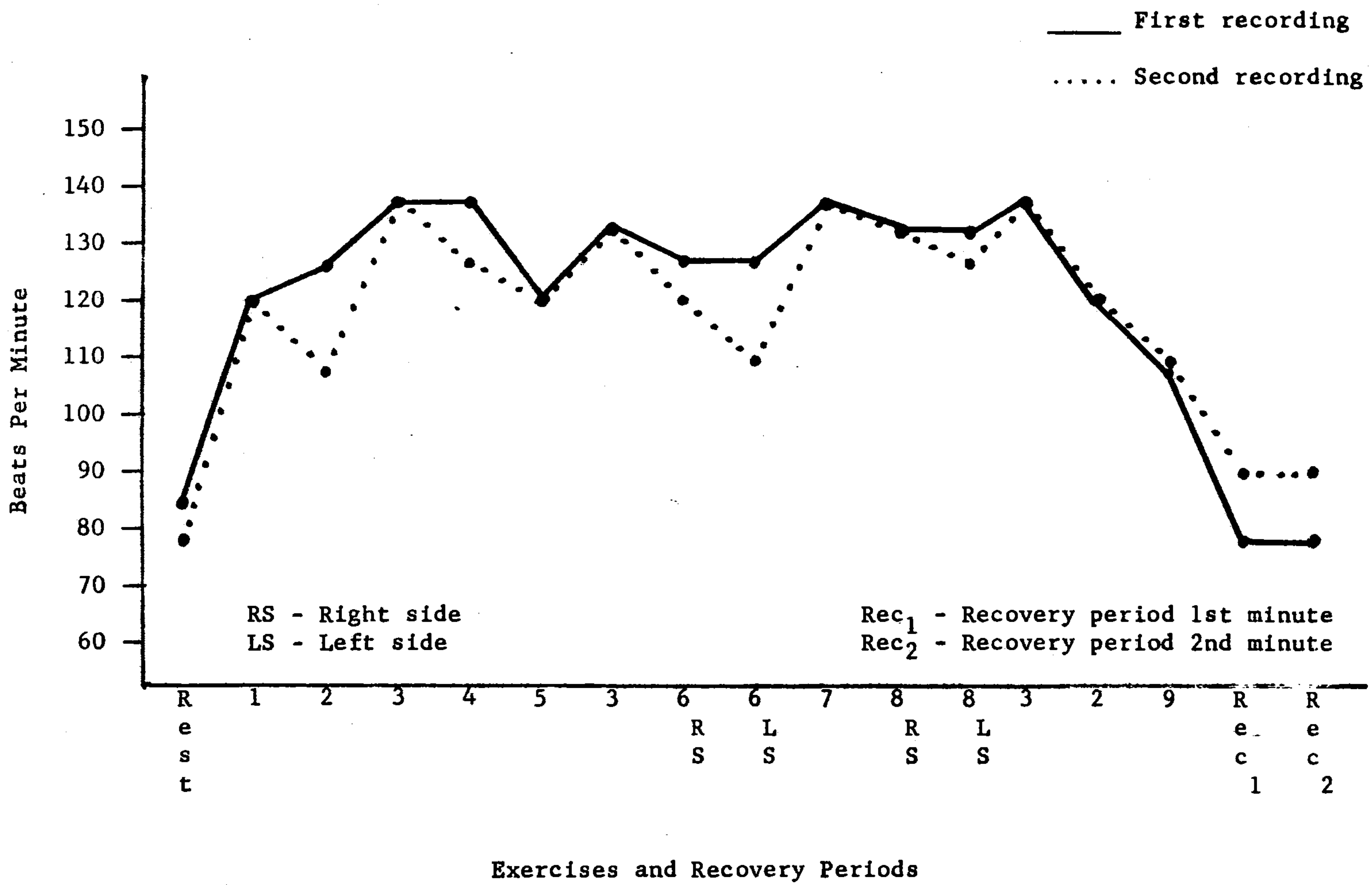


Figure 30. Exercise Heart Rate - Subject 25

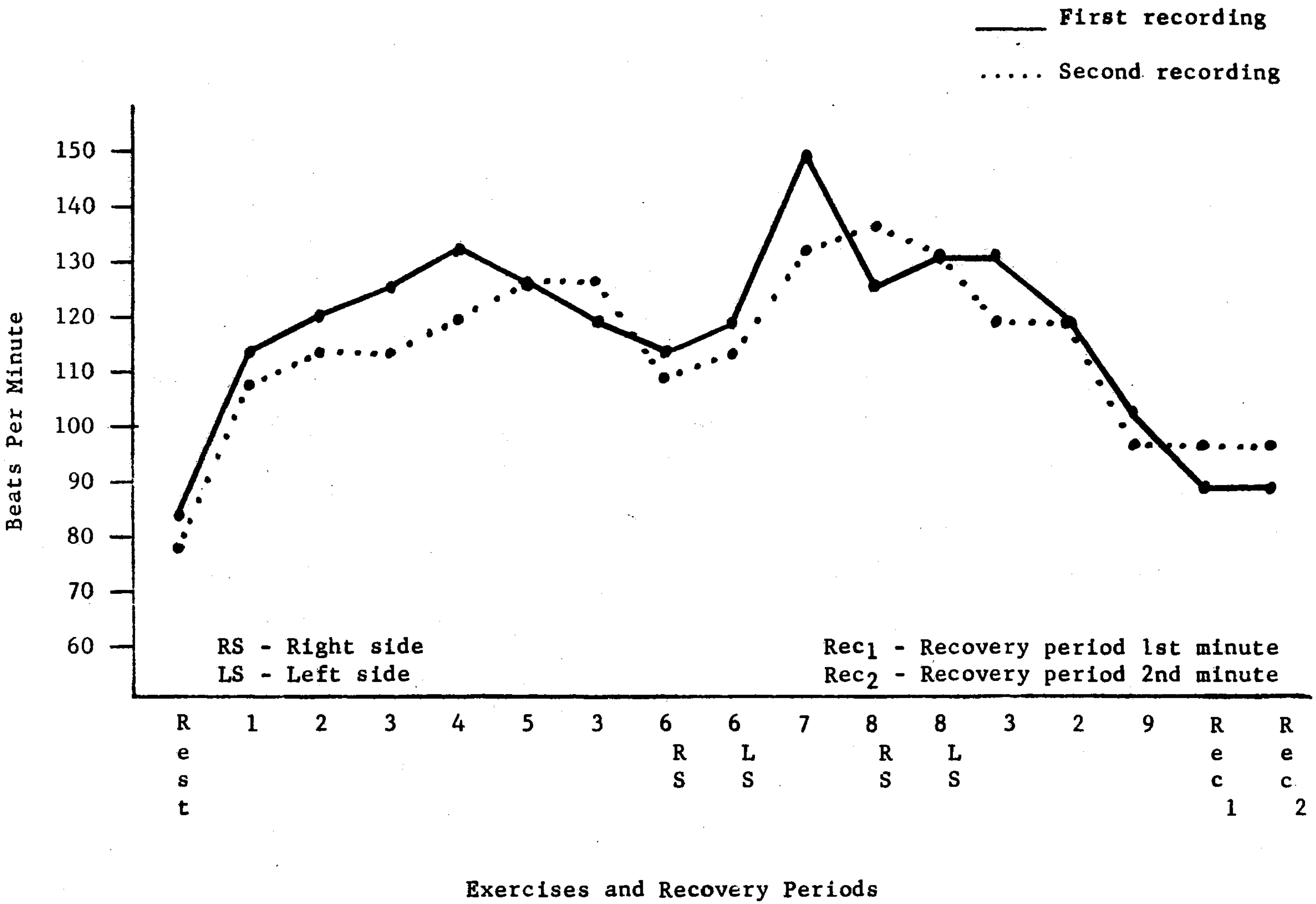


Figure 31. Exercise Heart Rate - Subject 17

the thirteenth exercise the heart rate of all three subjects started decreasing and continued to do so during the fourteenth and final exercise. In all instances, the subjects' heart rates had returned to 96 beats per minute or less by the end of the two minute recovery period.

For comparative purposes, the two individual heart rate recordings for each subject were averaged to obtain an average exercise heart rate for each exercise for each subject. These three exercise heart rates were then plotted on a graph (Figure 32) to illustrate the individual heart rate responses to each exercise.

The averaged heart rates of all three subjects displayed heart rate patterns that were similar in that by the third exercise the heart rates had attained the level of 120 beats per minute or above. From the third exercise until after completion of the twelfth exercise the subjects' heart rates fluctuated between 110 and 138 beats per minute; however, none of the subjects maintained a rate of 120 beats per minute or more for a span of ten minutes, as is frequently recommended for cardiovascular conditioning. Following the twelfth exercise, and during the thirteenth and fourteenth exercises, the subjects' heart rates started to decrease until they had all returned to 96 beats per minute or below by the end of the two minute recovery period.

The fluctuating exercise heart rates displayed by the three experimental subjects were indicative of an exercise program that would not meet the criteria for a cardiovascular program such as the Pulse Test which is advocated by exercise physiologist, Dr. Laurence Morehouse.[2] He states that an exercise program must do two things if it is going to

---

[2]Laurence E. Morehouse, "The Pulse Test—New Way to Fitness," Reader's Digest (October, 1971), 78.

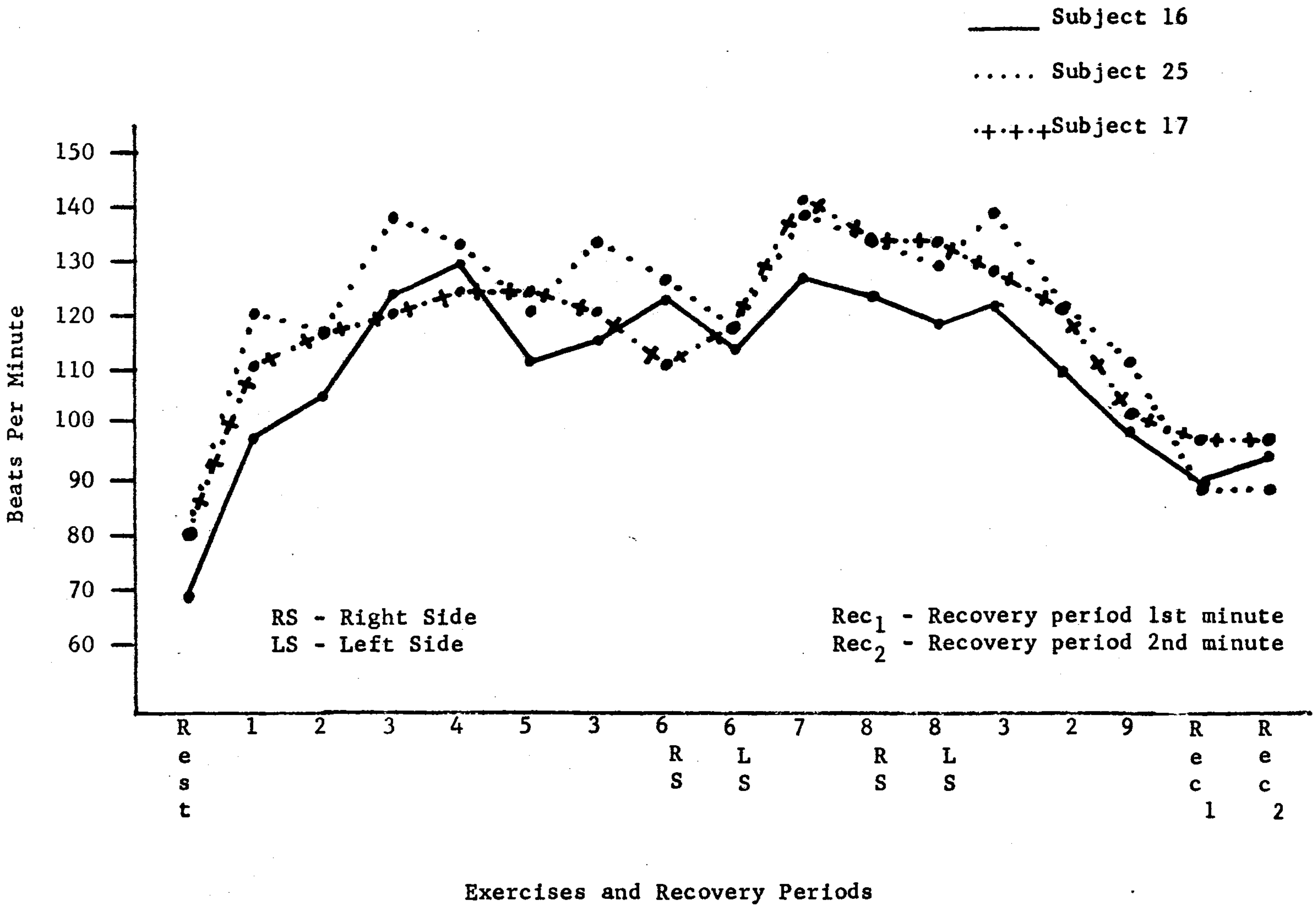


Figure 32. Averaged Heart Rates - Subjects 16, 25, & 17

be of value in improving the condition of the heart: (1) the exercise must be strenuous enough so the heart rate reaches 120 beats per minute or higher and (2) the 120 beats per minute rate must be maintained for a minimum of ten minutes.

Dr. Kenneth Cooper's aerobics program is based on similar criteria.[3] A heart rate of 150 beats per minute must be sustained for a minimum of twelve minutes for cardiovascular fitness to improve. Should a lower heart rate (120 to 150) be sustained during exercise the work period must be continued for longer than twenty minutes.

The Inch Master Exercise Program utilized during this investigation did not appear to fulfill the requirements stated by Dr. Morehouse and Dr. Cooper; hence, it might be assumed the program was not of value for improving the condition of the heart.

The monitored rates revealed that the most strenuous exercises were the V-Push and Push-Up. Both of the exercises derived their primary source of force from the elbow extensors which generally are not a powerful muscle group in women, and which are usually not as strong as the leg muscles. This lower strength level resulted in the muscle group working and was reflected by the higher heart rates.

The least vigorous exercise appeared to be the last one, Relaxation. This particular exercise revealed the lowest heart rate level recorded during the exercise program.

Discussion of the Results

Computation and statistical testing of the data revealed results

---

[3]Kenneth H. Cooper, Aerobics (New York: Bantam Books, 1968), p. 23.

which deserve comment. The body weight of both groups (control and experimental) did not change, even a pound, from the beginning of the study until its conclusion. This maintenance might be expected by the control group since they did not participate in any exercise program, but not by the experimental group since they participated in a six week exercise program. This type of results might indicate the exercise program was not very strenuous and that the exercise alone was not a sufficient means of reducing weight, or perhaps appetite increased.

Testing of the eight hypotheses for the study revealed additional information which raised serious question as to the value of the Inch Master Exerciser and the exercises performed on the exerciser. Since the distributor of the Inch Master claims the instrument will "spot reduce," it was interesting to find that mean change for subcutaneous fat in the experimental group was not significantly different from the mean change for subcutaneous fat in the control group. Based on these results, it appears that the Inch Master Exerciser does not "spot reduce" subcutaneous fat.

The experimental group was significantly decreased in waist girth and right thigh girth. A reduction in girth without a reduction in subcutaneous fat would apparently indicate that the underlying musculature was changed, which resulted in the girth reduction. Non-significant mean differences were revealed in right arm girth, bust girth, hip girth, and right calf girth. These non-significant changes also create a question as to the value of the Inch Master Exerciser. The *Home Exercise Course* manual indicated that inches would be lost (bust - increased) in these body regions.

Another result worth noting was the non-significant *t*-values revealed in all five of the strength tests. Apparently the Inch Master Exerciser was not of value in increasing strength even though the Inch Master distributor claims the instrument will increase strength.

The significant t-value revealed in Aerobic Capacity indicated the experimental group had a significantly greater improvement on the Balke Treadmill Test than the control group. This appeared to indicate that the exercise program was beneficial in increasing the efficiency of the cardio-pulmonary system. However, the investigator feels that part of this improvement was due to the fact that most women do not usually engage in an activity which requires them to work in continuous movement for twenty-five minutes. Just engaging in walking for twenty-five minutes would probably produce similar results. The point is that the continuous movement for an extended period of time was probably more responsible for the increased Aerobic Capacity than the specific exercises performed on the Inch Master. This view is supported by Dr. Morehouse, an exercise physiologist, who has been cited earlier in this chapter.

Even though the experimental group showed a significant improvement in Aerobic Capacity, a significant t-value was not revealed in the Resting Cardiovascular Fitness Test (Schneider Index Scores). This may indicate one of two things: (1) the Schneider Index could be measuring aspects of the cardio-pulmonary system different from those measured by the Balke Treadmill Test, or (2) the test may not be a valid and reliable measuring instrument.

Statistical analysis of the other variables under investigation revealed that in some instances the experimental group had significant improvement, while in other cases the control group showed significant improvement.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The purpose of this investigation was to determine the effect of a six week exercise program, using the Inch Master Exerciser, on body girth, subcutaneous fat and the following physiological variables of adult women (20-48 years): strength, flexibility, aerobic capacity, vital capacity, cardiovascular fitness, and maximum breathing capacity. Sixty adult female volunteers were randomly assigned to one of two groups: experimental (30) or control (30). The experimental group participated in a six week, thirty session exercise program using the Inch Master Exerciser, while the control group did not engage in any exercise program. Fifty-two subjects completed the six week investigation period: experimental (25) and control (27). The subjects' pretest and post-test data were statistically analyzed, utilizing a computer and the MBCX70 *t* program, to determine if the experimental group was effected significantly by the exercise program. A kinesiological analysis of the nine exercises was completed to determine the prime moving muscle groups for each exercise.

Summary

The mean changes (increase or decrease) for the experimental group and the control group were computed and statistically tested, utilizing Student's *t* test, for significance of difference at the .05 level of confidence. The following information was revealed.

(1) Body Weight - The body weight of the two groups did not change, even a pound, from beginning of the study until its conclusion.

(2) Body Girth - The experimental group improved significantly more than the control group in loss of inches in waist girth and right thigh girth (only the right arm and leg were measured for body girth and subcutaneous fat). There were no significant differences between the two groups in right upper arm girth, bust girth, hip girth, and right calf girth.

(3) Subcutaneous Fat - There was no significant difference between the experimental and control group on loss of fat as measured by decreases in skinfold thickness.

(4) Strength - There was no significant difference between the groups on strength in any of the five strength tests.

(5) Flexibility - The control group scored significantly higher than the experimental group on the right lateral flexion flexibility test, but the experimental group had significantly greater improvement in spinal rotation flexibility. The two groups did not differ significantly in trunk extension flexibility.

(6) Aerobic Capacity - The experimental group showed a significantly greater improvement in aerobic capacity than the control group.

(7) Resting Cardiovascular Fitness - There was no significant difference between the experimental and control groups on the Schneider Index test.

(8) Vital Capacity - The vital capacity of the control group was significantly greater than the vital capacity of the experimental group.

(9) Maximum Breathing Capacity - The mean changes of the experimental group and the control group did not differ significantly from one another.

(10) Kinesiological Analysis - Analysis of the nine exercises revealed that the force for the majority of the exercises was derived from the hip extensors, hip flexors, shoulder horizontal adductors, and elbow extensors. The hip extensors or hip flexors were utilized to move the exerciser in seven of the nine exercises.

(11) Heart Rate - The heart rates of three subjects fluctuated between 110 and 138 beats per minute during the exercise program; however, none of the subjects maintained a rate of 120 beats per minute for a span of ten minutes. The subjects' heart rates had returned to 96 beats per minute or below by the end of the two minute recovery period.

Conclusions

Based on the results of this investigation, the following conclusions were drawn.

(1) The Inch Master Exerciser program apparently created significant changes of improvement in waist girth, right thigh girth, spinal rotation flexibility, and aerobic capacity.

(2) The exerciser program did not produce significant changes of improvement in right upper arm girth, bust girth, right calf girth, subcutaneous fat, strength, trunk extension flexibility, resting cardiovascular fitness (as measured by the Schneider Index), and maximum breathing capacity.

(3) The distributors' claim that the Inch Master Exerciser would

increase muscle strength level is not valid because the experimental group did not significantly improve on any of the five strength tests.

(4) The claim that the V-Push exercise will trim the upper arm is not valid because non-significant changes were revealed in upper arm girth and subcutaneous fat.

(5) The Inch Master Exerciser program did increase body circulation because the monitored heart rates fluctuated between 110 and 138 beats per minute during the exercise program. The claim for increased circulation is valid.

(6) The significant increase in Aerobic Capacity by the experimental group indicated the fitness level of the cardiovascular system did improve even though the exercise program did not meet Morehouse's criteria for a cardiovascular exercise.

Recommendations

At the completion of this investigation the following recommendations are made.

(1) Additional studies involving "fitness" and/or so-called "reducing" gadgets should be conducted because of the apparent lack of research regarding the effectiveness of this equipment.

(2) Exercise equipment studies should be conducted utilizing men as well as women subjects.

A SELECTED BIBLIOGRAPHY

Anderson, C. L. Health Principles and Practice. 2d ed; St. Louis, Mo.: The C. V. Mosby Company, 1970.

Balke, Bruno, and R. T. Clark. "Cardio-Pulmonary and Metabolic Effects of Physical Training." Health and Fitness in the Modern World, n.p.: The Athletic Institute, 1961, 83.

Billings, Charles E., Jr., Joseph F. Tomashefski, Earl T. Carter, and William F. Ashe. "Measurement of Human Capacity for Aerobic Muscular Work." Journal of Applied Physiology, XV (November, 1960), 1001-06.

Carper, Jean. "Beware Those 'Quick-Reducing' Gadgets." Reader's Digest, XCIX (September, 1971), 60.

Chrietzberg, Agnes L. "The Effects of Mechanical Vibration on Spot Reduction of College Women." Unpublished Master's thesis, Florida State University, 1963.

Clarke, H. Harrison, L. Richard Geser, and Stanley B. Hundsdon. "Comparison of Upper Arm Measurements by Use of Roengenogram and Anthropometric Techniques." Research Quarterly, XXVII (December, 1956), 384.

Conger, Patricia R., and Ross B. J. Macnab. "Strength, Body Composition, and Work Capacity of Participants and Nonparticipants in Women's Intercollegiate Sports." Research Quarterly, XXXVIII (May, 1967), 184-91.

Consolazio, C. Frank, Robert E. Johnson, and Louis J. Pecora. Physiological Measurements of Metabolic Functions in Man. New York: McGraw-Hill Book Company, 1963.

Cooper, Kenneth H. Aerobics. New York, New York: Bantam Books, Inc., 1968.

Detamore, Trent. "A Study of Flexibility and Cardiovascular Fitness on the Inch Master Exerciser." Unpublished HPER Research Paper, Oklahoma State University, 1970.

de Vries, Herbert A. Laboratory Experiments in Physiology of Exercise. Dubuque, Iowa: Wm. C. Brown Company Publishers, 1971.

de Vries, Herbert A. Physiology of Exercise for Physical Education and Athletics. Dubuque, Iowa: Wm. C. Brown Company Publishers, 1966.

Dixon, W. J., ed. BMD Biomedical Computer Programs, Vol. III. Los Angeles: University of California Press, 1969.

Domke, Arnold Edward, Jr. "Conditioning Effects of Work Performed on an Exercise Machine." Unpublished Master's thesis, University of Illinois, 1955.

"Exercise Equipment: The Good, the Bad, and the Ugly." Fitness for Living, V (March-April, 1971), 25.

Exercycle. New York: Exercycle Corporation, 1965.

Fleishman, Edwin A. The Structure and Measurement of Physical Fitness. Englewood Cliffs, New Jersey: Prentice-Hall, 1964.

Fries, E. Corinne. "Some Physiologic Effects of Passive and Active Exercises." Archives of Physical Therapy, XXV (September, 1944), 540-44.

Fries, E. Corinne. "Some Physiologic Effects of Passive and Active Exercise: Training Effects on the Strength of Specific Muscle Groups." Archives of Physical Therapy, XXV (September, 1944), 546-49.

Hayden, Francis Joseph. "The Physique and Motor Fitness Effects of Machine Exercise." Unpublished Master's thesis, University of Illinois, 1958.

Herden, Everett Leslie, Jr. "The Effects of the Health-Walker Dynamic Exercise Machine on the Physical Fitness of Two Adult Men." Unpublished Master's thesis, University of Illinois, 1956.

Hernlund, Vernon, and Arthur H. Steinhaus. "Do Mechanical Vibrators Take Off or Redistribute Fat?" Journal of Association for Physical and Mental Rehabilitation, XI (March, 1957), 96.

Inch Master Home Exercise Course. Phoenix: Homex Corporation, 1970.

Jensen, Amelis Strange. "The Metabolic Cost of Riding an Exercycle." Unpublished Master's thesis, University of Illinois, 1952.

Jones, Lavetta Sue. "The Effect of a Progressive Program of Exercise, Using the Exercycle, on the Anthropometric Measurements of College Women." Unpublished Master's thesis, University of Washington, 1963.

Kuntzleman, Charles T. "The Truth About Spot Reducing." Fitness for Living, V (November-December, 1971), 80.

Karpovich, Peter V., and Sinning, Wayne E. Physiology of Muscular Activity. 7th ed. Philadelphia: W. B. Saunders Company, 1971.

Lundegren, Herberta M. "Changes in Skinfold and Girth Measures of Women Varsity Basketball and Field Hockey Players." Research Quarterly, XXXIX (December, 1968), 1020-24.

Mathews, Donald K. Measurement in Physical Education, 2nd ed. Philadelphia: W. B. Saunders Company, 1963.

Mathews, Donald K., and Edward L. Fox. The Physiological Basis of Physical Education and Athletics. Philadelphia: W. B. Saunders Company, 1971.

Meyers, Carlton R., and T. Erwin Blesh. Measurement in Physical Education. New York: The Ronald Press Company, 1962.

Mohr, Dorothy R. "Changes in Waistline and Abdominal Girth and Subcutaneous Fat Following Isometric Exercises." Research Quarterly, XXXVI (May, 1965), 168-73.

Morehouse, Laurence E. "The Pulse Test--New Way to Fitness." Reader's Digest (October, 1971), 78.

Morris, Arlene Marie. "The Effect of a Progressive Program of Exercise, Using the Exercycle, on the Strength of College Women." Unpublished Master's thesis, University of Washington, 1963.

Obesity and Health. Washington, D. C.: U. S. Department of Health, Education and Welfare, No. 1485.

Olson, Arne L., and Elliott Edelstein. "Spot Reduction of Subcutaneous Adipose Tissue." Research Quarterly, XXXIX (October, 1968), 647-52.

Pascale, L. R., Morton I. Grossman, Harry S. Sloane, and Toby Frankel. "Correlations Between Thickness of Skinfolds and Body Density in 88 Soldiers." Human Biology, XXVIII (1956). Cited in Consolazio, C. Frank, Robert E. Johnson, and Louis J. Pecora. Physiological Measurements of Metabolic Functions in Man. New York: McGraw-Hill Book Company, 1963, 256.

Pollack, Michael Lee. "The Metabolic Cost of the Exercycle and Resistance Bicycle on Middle-Aged Women." Unpublished Master's thesis, University of Illinois, 1961.

Price, Reginald L. "A Study of the Effects of the Inch Master on Body Girth, Subcutaneous Fat, and Vital Capacity." Unpublished HPER Research Paper, Oklahoma State University, 1970.

Progressive Resistance Exercise Technic. n.p.: Elgin Exercise Appliance Co., n.d.

Rasch, Philip J., and Roger K. Burke. Kinesiology and Applied Anatomy. 2nd ed. Philadelphia: Lea & Febiger, 1963.

Ricci, Benjamin. Physiological Basis of Human Performance. Philadelphia: Lea & Febiger, 1967, 127-28.

Riendeau, R. P. "The Metabolic Effects of Exercising on Certain Machines." Unpublished Master's thesis, University of Illinois, 1956. Cited by Hayden, Francis Joseph. "The Physique and Motor Fitness Effects of Machine Exercise." Unpublished Master's thesis, University of Illinois, 1958.

Roby, Fred B. "Effect of Exercise on Regional Subcutaneous Fat Accumulations." Research Quarterly, XXXIII (May, 1962), 273-78.

Rony, Hugo R., M. D. "Can You Lose Fat Where You Want To?" Science Digest, XXVI (December, 1949), 59-63.

Runyon, Richard P., and Audrey Haber. Fundamentals of Behavioral Statistics. 2nd ed. Reading, Massachusetts: Addison-Wesley Publishing Company, 1971.

The Inch Master Story. Phoenix: Homex Corporation, 1970.

The Slim-Gym Home Exercise Course. West Los Angeles, California: The Relaxaway Corporation, 1969.

Thomas, Judith Carol. "The Effect of a Progressive Program of Exercise, Using the Exercycle, on the Development of Cardiorespiratory Endurance of College Women." Unpublished Master's thesis, University of Washington, 1963.

Saunders, J. A. "The Metabolic Cost of Passive Cycling Movements." Journal of Physiology, CVIII (May, 1949), 353-358.

Schade, Maja, F. A. Hellebrandt, Joan C. Waterland, and Marie L. Carns. "Spot Reducing in Overweight College Women: Its Influence on Fat Distribution as Determined by Photography." Research Quarterly, XXXIII (October, 1962), 361-71.

Skinner, James Stanford. "The Metabolic Cost of the Vibrating Table and a Program of Free Exercise on Middle-Aged Women." Unpublished Master's thesis, University of Illinois, 1960.

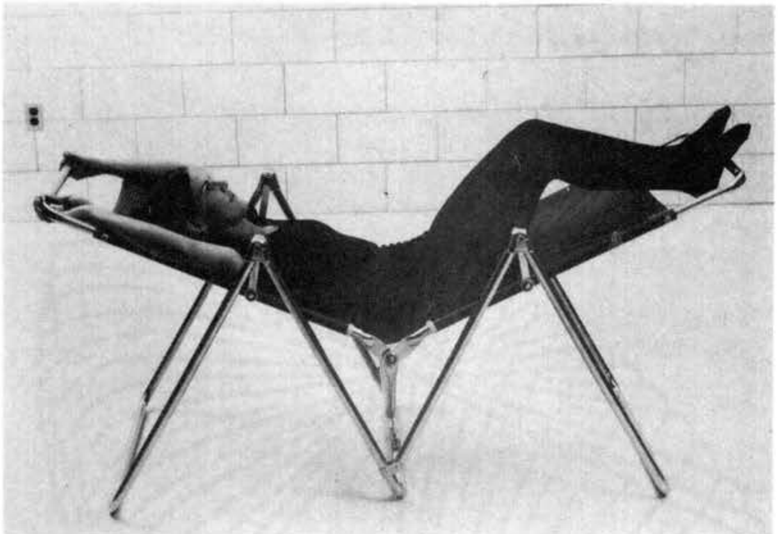
Stuart, D. G., and W. D. Collings. "Comparison of Vital Capacity and Maximum Breathing Capacity of Athletes and Non-Athletes." Journal of Applied Physiology, XIV (July, 1959), 507-9.

Willgoose, Carl E. Evaluation in Health Education and Physical Education. New York: McGraw-Hill Book Company, Inc., 1961.

Wright, Ernestine. "An Investigation of the Energy Cost of a Basic Exercise Conducted on the Inch Master." Unpublished HPER Research Paper, Oklahoma State University, 1970.

APPENDIX A

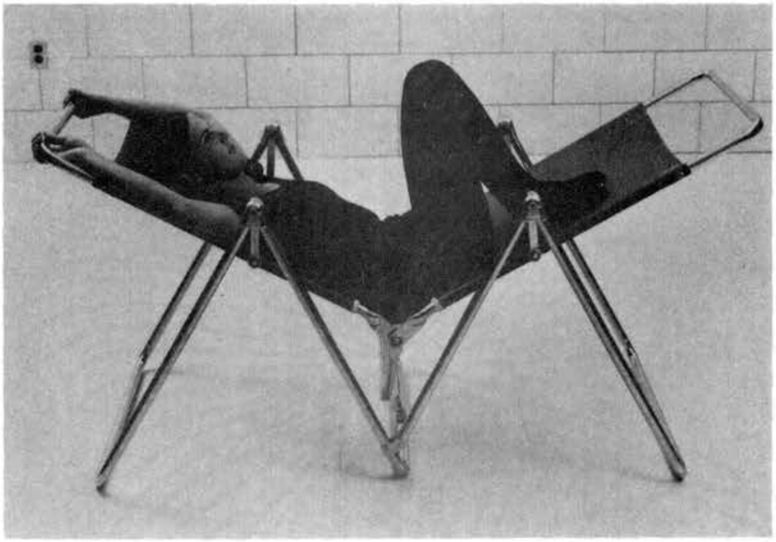
NINE EXERCISE POSITIONS



Side View

Front View

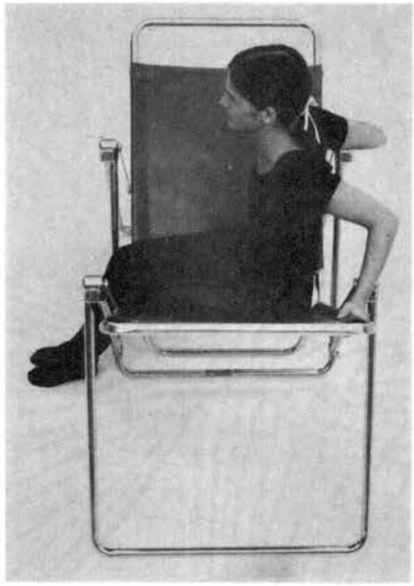
Figure 33. Basic Exercise Position



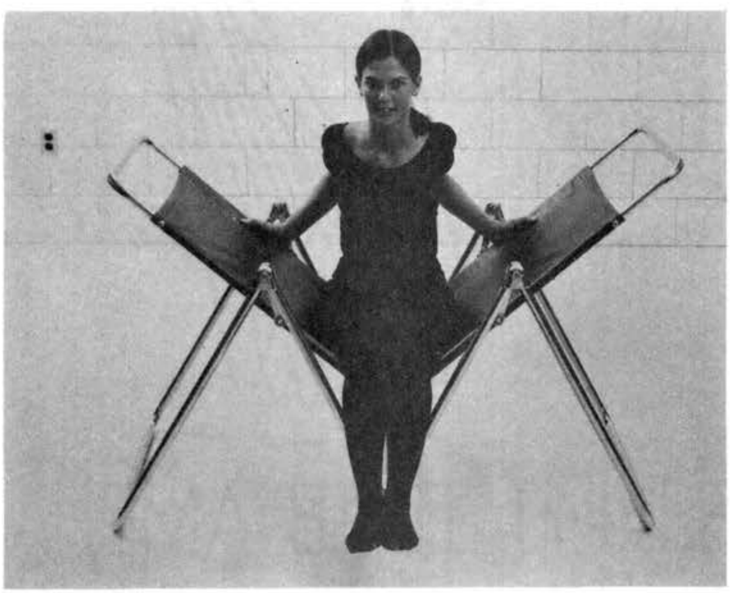
Side View

Front View

Figure 34. Thigh Exercise Position

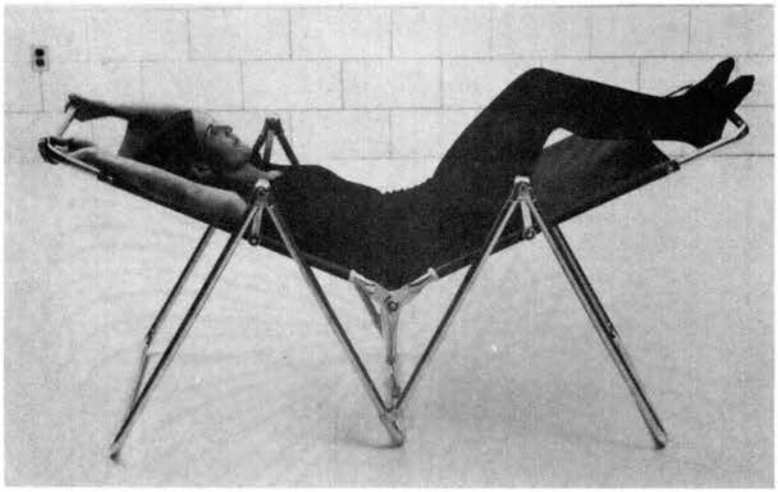


Side View



Front View

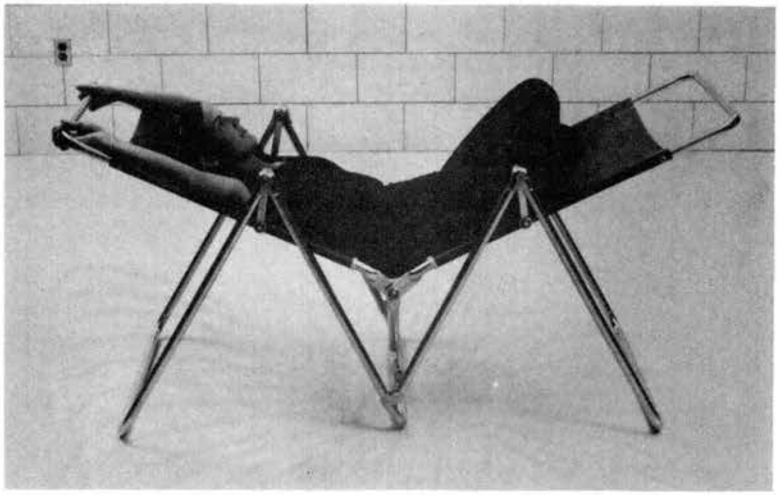
Figure 35. V-Push Exercise Position



Side View

Front View

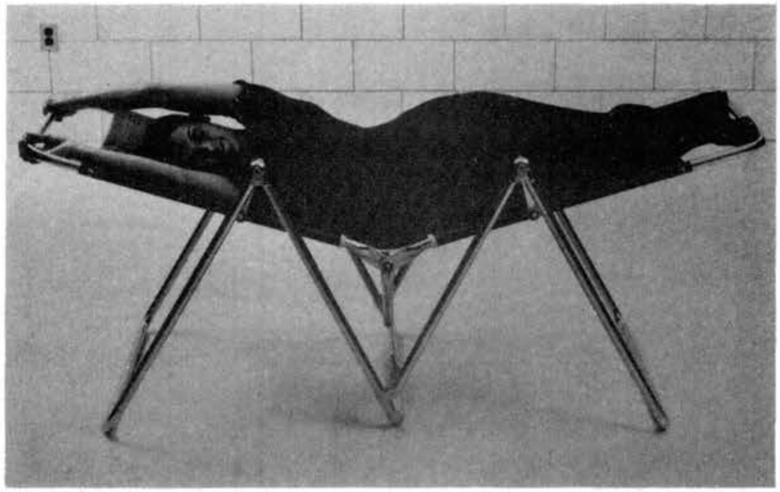
Figure 36. Alternating Leg Push Position



Side View

Front View

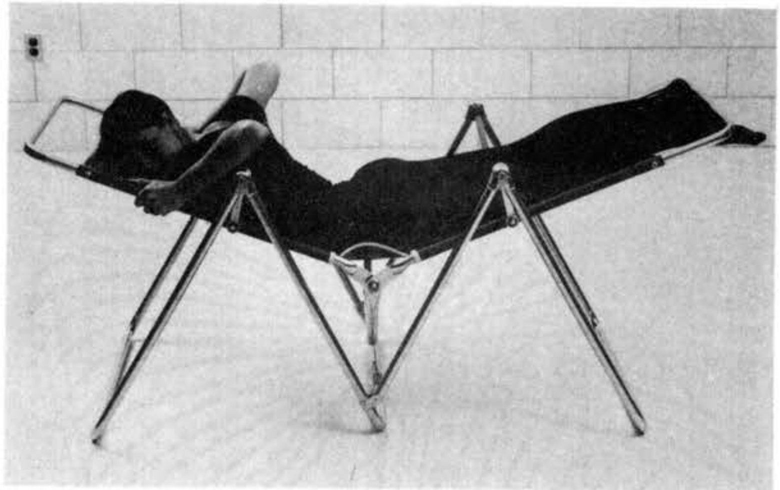
Figure 37. Yogi Position



Side View

Front View

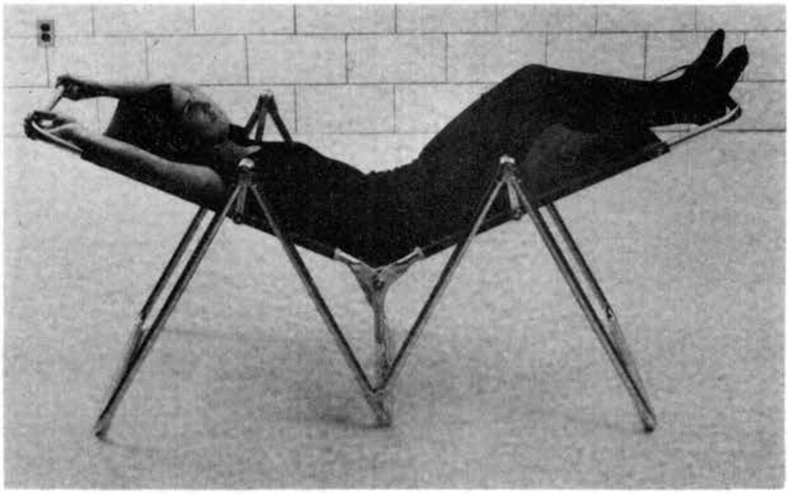
Figure 38. Flank Position



Side View

Rear View

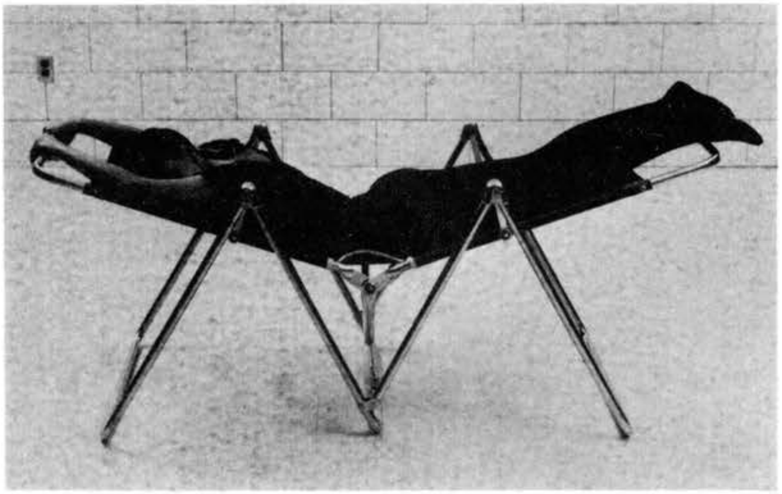
Figure 39. Push-Up Position



Side View

Front View

Figure 40. Saddle Bend Position



Side View

Rear View

Figure 41. Relaxation Position

APPENDIX B

SCHNEIDER INDEX SCORE SHEET

Name____________________________________ Date________________ Schneider Index

OBSERVATIONS

Lying Position: Pulse Rate________ Systolic BP_______ Diastolic BP____________

Standing Position: Pulse Rate________ Systolic BP_______ Diastolic BP__________

STEP EXERCISE (5 steps - chair 20" high): Pulse Rate Immediately After Exercise_____

Pulse Rate After Exercise: 30 sec._____ 60 sec.______ 90 sec.______ 120 sec.________

SCORING TABLE

A. Reclining Pulse Rate		B. Pulse Rate Increase on Standing				
Rate	Points	0-10	11-18	19-26	27-34	35-42
41-50	4	4	4	3	2	1
51-60	3	3	3	2	1	0
61-70	3	3	2	1	0	-1
71-80	2	3	2	0	-1	-2
81-90	1	2	1	-1	-2	-3
91-100	0	1	0	-2	-3	-3
101-110	-1	0	-1	-3	-3	-3

C. Standing Pulse Rate		D. Pulse Rate Change Immediately After Exercise				
Rate	Points	0-10	11-20	21-30	31-40	41-50
51-60	4	4	4	3	2	1
61-70	3	3	3	2	1	0
71-80	3	3	3	2	0	0
81-90	2	3	2	1	0	-1
91-100	1	2	1	0	-1	-2
101-110	1	1	0	-1	-2	-3
111-120	0	1	-1	-2	-3	-3
121-130	0	0	-2	-3	-3	-3
131-140	-1	0	-3	-3	-3	-3

E. Return of Pulse Rate to Standing Normal after Exercise

Seconds	Points
0-30	3
31-60	2
61-90	1
91-120	0
After 120 2-10 beats Above normal	-1
After 120 11-30 Above normal	-2

F. Standing Systolic B. P. Compared with Reclining Systolic B. P.

Change in Millimeters	Points
Rise 30 and more	-2
Rise 21 to 30	-1
Rise 16 to 20	0
Rise 11 to 15	1
Rise of 6 to 10	2
No rise greater than 5	3
Fall of 6 to 10	2
Fall of 11 to 15	1
Fall of 16 to 20	0
Fall of 21 to 25	-1
Fall of 26 and more	-2

APPENDIX C

COMPUTATIONAL PROCEDURES

$$\text{Mean } \bar{X}_{jkl} = \frac{1}{n_{jkl}} \sum_i X_{ijkl}$$

$$\text{Variance } S^2_{jkl} = \frac{1}{n_{jkl-1}} \left(\sum_i X^2_{ijkl} - \frac{(\sum_i X_{ijkl})^2}{n_{jkl}} \right)$$

$$\text{Standard deviation } S_{jkl} = \sqrt{S^2_{jkl}}$$

$$\text{Standard error (of mean) } SE_{jkl} = \frac{S_{jkl}}{\sqrt{n_{jkl}}}$$

$$F_{j1} = \frac{S^2_{j11}}{S^2_{j21}} \quad \text{if } (S^2_{j11} \geq S^2_{j21})$$

or

$$F_{j1} = \frac{S^2_{j21}}{S^2_{j11}} \quad \text{if } (S^2_{j11} < S^2_{j21})$$

Degrees of freedom - pooled variance estimate

$$D_p = \max(n_{j11}-1,0) + \max.(n_{j21}-1,0)$$

$$T_p = \frac{\bar{X}_{j11} - \bar{X}_{j21}}{\sqrt{(\frac{1}{n_{j11}} + \frac{1}{n_{j21}}) \left[S^2_{j11}(n_{j11}-1) + S^2_{j21}(n_{j21}-1)\right]/D_p}}$$

APPENDIX D

RAW DATA

Subject	Age	Height	Weight Pre	Weight Post	Body Girth Right Upper Arm Pre	Body Girth Right Upper Arm Post	Body Girth Bust Pre	Body Girth Bust Post	Body Girth Waist Pre	Body Girth Waist Post
1	20	60	116.50	121.25	26.6	26.7	83.	84.5	67.5	73.2
2	22	64.75	112.25	115.25	23.2	23.8	85.	85.5	65.8	66.1
3	21	64.	122.	121.	23.6	23.	89.2	88.	72.3	73.8
4	23	64.	121.	118.	22.5	22.2	87.9	88.1	71.2	70.2
5	38	64.	142.	140.	26.5	27.5	94.8	96.2	74.7	70.8
6	23	64.5	130.	128.	26.4	26.3	87.5	87.	74.3	75.5
7	20	64.5	142.	143.	28.5	27.3	91.5	91.2	77.5	74.4
8	26	63.5	120.	121.5	25.1	23.8	84.6	86	73.3	68.3
9	46	64.75	181.	181.	34.2	32.3	109.5	109.7	110.3	98.9
10	20	67.	149.	151.	27.3	25.3	97.6	96.6	83.3	86.2
11	46	62.25	113.	113.	23.	24.5	86.6	86.3	70.5	76.5
12	24	62.	122.	120.	26.2	36.6	85.1	84.	69.9	74.2
13	41	61.	150.5	151.	29.5	30.	96.5	95.	79.	82.
14	23	62.25	104.75	102.	22.5	21.9	79.5	78.5	64.5	63.5
15	20	62.5	117.	115.	22.4	22.5	91.6	89.	69.	70.5
16	20	62.25	105.	106.	22.	21.3	80.2	79.8	65.	69.
17	28	64.75	136.75	136.	26.8	26.9	91.	93.4	81.8	78.3
18	41	62.	140.	141.	28.6	28.6	94.5	93.5	79.3	80.6
19	22	52.5	113.	113.	22.8	22.9	93.	92.1	65.5	68.
20	25	63.5	115.75	116.	24.	23.8	83.	83.	63.	62.2
21	24	61.5	117.	114.	22.9	23.1	84.6	85.5	73.8	70.8
22	29	63.5	125.	121.	25.1	25.7	92.8	93.	78.4	72.1
23	20	61.25	117.	116.	25.6	25.	91.5	90.2	74.2	71.5
24	26	62.	121.25	121.	24.5	24.6	92.5	88.1	77.	74.6
25	24	62.25	118.75	116.75	23.	23.6	82.4	84.5	67.5	67.
26	20	60.5	122.	123.	27.	27.5	87.4	85.	74.3	72.2
27	39	61.5	116.	118.5	24.	24.5	87.	87.1	72.1	70.3
28	20	67.25	144.75	144.	26.5	26.3	96.	95.8	71.5	76.
29	24	60.5	111.	114.	24.2	25.	86.9	86.2	69.2	74.
30	29	65.	139.	138.	26.5	26.9	92.	91.5	77.8	81.

Subject	Age	Height	Weight Pre	Weight Post	Body Girth Right Upper Arm Pre	Body Girth Right Upper Arm Post	Body Girth Bust Pre	Body Girth Bust Post	Body Girth Waist Pre	Body Girth Waist Post
31	29	63.5	132.5	134.5	24.5	25.5	90.	95.6	79.5	85.
32	48	61.5	159.	160.25	29.1	27.7	107.5	108.2	96.	99.5
33	24	64.25	145.	142.	25.2	25.2	98.	94.	78.	77.5
34	22	64.	115.25	118.	21.5	22.	89.1	89.	74.6	73.4
35	23	60.5	115.5	115.5	23.	23.4	89.5	87.5	74.	74.5
36	21	63.	142.	138.	25.	24.7	99.	97.5	83.	82.
37	20	64.	124.	122.	24.5	24.7	88.	86.4	71.3	73.8
38	35	63.	148.	150.	28.	28.2	93.9	94.5	78.2	77.3
39	39	62.75	113.5	117.25	25.	25.	79.6	81.	74.9	68.9
40	26	60.	145.	149.	31.6	32.8	98.7	101.	87.1	88.7
41	28	61.5	108.75	106.	24.	24.3	83.1	81.2	66.	69.4
42	22	62.	103.	103.5	21.	21.4	82.	81.	62.5	66.3
43	22	63.	105.	107.	22.	22.8	80.3	81.9	62.3	66.2
44	22	65.	119.	118.5	24.4	24.5	93.	88.5	67.	71.5
45	27	62.5	127.5	127.	24.5	24.4	85.	84.3	70.3	69.5
46	36	60.	124.	122.75	26.3	25.3	96.	95.	89.	83.8
47	39	66.75	147.75	149.75	25.2	25.5	94.	95.2	82.	86.4
48	34	68.	167.	168.	28.	27.9	104.	102.4	90.	86.2
49	24	65.5	130.	130.	25.5	25.9	94.1	92.5	74.7	70.2
50	42	61.5	108.	109.25	24.3	24.5	88.5	85.5	75.3	73.5
51	23	65.	132.25	129.	27.	26.5	93.7	94.5	72.5	71.7
52	37	64.5	117.5	120.	23.2	23.1	81.5	84.	63.5	68.2

Subject	Body Girth Hips Pre	Body Girth Hips Post	Body Girth Right Thigh Pre	Body Girth Right Thigh Post	Body Girth Right Calf Pre	Body Girth Right Calf Post	Skinfold Thickness Right Tricep Pre	Skinfold Thickness Right Tricep Post	Skinfold Thickness Right Subscapular Pre	Skinfold Thickness Right Subscapular Post
1	84.2	90.7	48.7	52.8	33.5	33.4	18	17	9	10
2	90.2	90.1	48.	48.3	31.4	32.3	17	16	9	9
3	88.5	89.5	48.7	48.2	33.	34.	10	10	7	7
4	92.3	90.7	50.3	51.	33.3	33.	13	12	8	8
5	101.5	100.2	53.	51.	35.3	36.1	20	20	16	16
6	90.2	90.8	57.7	52.	34.9	36.2	8	7	5	4
7	97.	95.3	56.7	57.2	35.3	36.	17	14	17	14
8	93.5	92.9	52.5	51.3	32.5	32.6	12	12	7	8
9	109.5	108.6	61.	57.2	39.2	39.8	30	31	26	27
10	103.	101.4	53.5	50.8	36.7	36.6	19	14	11	10
11	91.6	89.2	49.	48.	32.5	31.3	11	12	5	7
12	93.8	93.5	50.5	52.6	33.3	32.3	22	21	15	14
13	102.	102.3	60.	57.9	37.9	38.5	22	21	12	11
14	88.5	86.3	45.9	44.3	29.3	28.8	14	12	9	9
15	81.1	88.4	49.	46.7	32.4	32.9	13	13	9	9
16	89.8	89.2	44.7	44.	32.4	31.3	12	11	8	6
17	97.3	96.5	53.5	52.5	36.2	35.6	18	19	14	13
18	99.5	100.9	51.2	50.5	33.3	34.5	23	20	17	13
19	87.1	88.	46.	46.5	32.	31.8	13	13	9	8
20	92.	86.5	51.2	52.1	33.6	33.4	14	13	8	7
21	90.3	91.8	48.5	48.9	32.6	32.4	10	10	10	9
22	95.3	93.2	51.2	50.4	30.5	30.5	19	19	10	10
23	91.3	89.8	52.8	52.3	32.6	32.2	13	12	10	9
24	92.	90.9	51.3	51.	32.9	33.2	16	13	12	13
25	92.2	92.5	53.8	50.5	32.5	33.	13	12	7	7
26	97.5	94.2	55.1	55.7	35.5	36.3	18	15	11	10
27	84.3	94.5	52.2	51.3	32.9	33.3	13	13	5	5
28	95.7	95.9	50.5	51.1	36.	36.1	20	20	12	11
29	88.5	90.5	52.	48.9	31.1	31.1	14	12	10	10
30	96.7	95.5	51.4	50.1	33.5	34.3	19	15	10	11

Subject	Body Girth Hips Pre	Body Girth Hips Post	Body Girth Right Thigh Pre	Body Girth Right Thigh Post	Body Girth Right Calf Pre	Body Girth Right Calf Post	Skinfold Thickness Right Tricep Pre	Skinfold Thickness Right Tricep Post	Skinfold Thickness Right Subscapular Pre	Skinfold Thickness Right Subscapular Post
31	95.	98.9	49.	52.1	31.	31.7	13	15	10	11
32	106.8	105.8	53.6	56.5	34.	32.8	23	21	28	28
33	98.8	100.9	54.	52.	32.9	33.7	14	13	15	13
34	93.	94.	47.	48.8	32.	32.1	14	12	8	9
35	93.	91.7	55.	49.6	33.2	33.2	14	15	10	12
36	104.	103.2	58.	55.4	35.9	35.4	17	14	18	16
37	88.8	91.3	50.9	50.8	34.	34.2	13	11	7	7
38	105.	106.6	56.5	55.7	38.8	39.	16	15	10	9
39	87.9	87.	50.8	50.3	32.5	34.8	13	13	7	6
40	100.	102.7	57.5	56.	34.3	35.6	38	39	19	20
41	98.4	88.	47.5	46.1	32.4	31.6	13	12	10	9
42	82.4	83.2	46.6	45.8	30.2	31.5	7	8	6	5
43	87.8	86.9	49.8	47.2	31.9	31.8	12	12	6	7
44	90.	88.9	47.1	47.5	34.2	34.3	19	17	10	10
45	93.	94.7	52.4	51.4	34.8	36.	16	16	8	7
46	90.5	88.7	49.	48.	32.9	32.8	12	11	14	12
47	100.1	101.3	50.	52.1	35.	35.3	14	14	10	10
48	106.2	106.9	54.9	55.8	37.2	37.	20	20	15	17
49	93.2	91.8	49.8	47.	41.8	37.	13	13	9	9
50	86.3	85.5	47.2	45.3	30.2	30.	12	12	8	7
51	92.5	91.9	49.	50.	33.3	33.6	17	16	19	16
52	86.3	90.5	47.9	47.9	33.9	34.7	12	12	7	7

Subject	Skinfold Thickness Abdomen		Skinfold Thickness Upper Chest		Skinfold Thickness Right Thigh		Strength Hip Flexors		Strength Abdominal	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	11	9	4	4	16	19	16	7	23	24
2	11	10	3	3	18	17	18	12	30	35
3	7	5	3	3	9	8	20	32	41	41
4	8	8	4	4	20	19	--	--	--	--
5	15	16	5	5	29	28	--	--	--	--
6	5	4	3	3	15	15	30	38	39	48
7	16	15	8	6	25	26	25	35	33	43
8	7	8	4	4	19	20	--	--	--	--
9	26	25	10	8	32	36	--	--	--	--
10	14	11	3	3	17	19	21	28	22	34
11	4	5	3	3	14	12	20	12	31	24
12	13	9	6	5	26	24	17	13	25	30
13	14	14	7	7	28	30	--	--	--	--
14	11	10	5	5	20	20	16	16	23	32
15	11	11	6	5	24	22	10	13	23	32
16	6	5	3	3	18	19	--	--	--	--
17	20	21	7	6	22	22	--	--	--	--
18	14	13	5	5	21	22	--	--	--	--
19	15	13	4	5	18	18	--	--	--	--
20	11	8	4	4	17	16	--	--	--	--
21	10	7	5	5	16	14	9	9	30	29
22	12	12	5	5	30	26	7	14	28	34
23	13	11	5	5	15	17	--	--	--	--
24	10	6	8	5	17	12	--	--	--	--
25	8	7	3	3	21	21	30	28	42	46
26	9	7	5	4	22	22	34	44	52	52
27	12	9	5	4	20	20	--	--	--	--
28	9	10	3	3	18	19	--	--	--	--
29	11	9	4	4	13	14	--	--	--	--
30	14	14	4	5	18	25	--	--	--	--

Subject	Skinfold Thickness Abdomen Pre	Post	Skinfold Thickness Upper Chest Pre	Post	Skinfold Thickness Right Thigh Pre	Post	Strength Hip Flexors Pre	Post	Strength Abdominal Pre	Post
31	16	17	8	7	29	26	--	--	--	--
32	45	41	8	7	41	40	--	--	--	--
33	15	16	9	9	26	28	20	23	40	46
34	5	6	4	4	18	20	21	15	24	24
35	10	6	6	4	20	22	--	--	--	--
36	27	18	4	4	23	21	--	--	--	--
37	5	7	4	4	20	19	--	--	--	--
38	7	8	6	6	26	27	22	23	29	30
39	6	4	3	3	18	17	--	--	--	--
40	17	18	5	5	35	36	15	28	32	38
41	12	13	4	3	20	22	--	--	--	--
42	5	5	3	3	14	16	18	12	30	27
43	5	5	3	3	15	18	28	29	44	44
44	11	10	6	5	26	23	--	--	--	--
45	14	13	4	4	21	28	17	14	20	27
46	14	15	7	6	14	13	--	--	--	--
47	13	14	4	4	25	23	18	30	32	44
48	14	13	5	5	30	28	24	37	38	42
49	11	5	5	5	15	12	--	--	--	--
50	15	9	3	4	22	21	19	17	32	30
51	16	12	7	7	19	18	--	--	--	--
52	8	9	3	3	16	15	--	--	--	--

Subject	Strength Shoulder Flexors Pre	Strength Shoulder Flexors Post	Strength Back Extensors Pre	Strength Back Extensors Post	Strength Shoulder Adduction & Elbow Extensors Pre	Strength Shoulder Adduction & Elbow Extensors Post	Flexibility Trunk Extension Pre	Flexibility Trunk Extension Post	Flexibility Right Lateral Flexion Pre	Flexibility Right Lateral Flexion Post
1	21	23	38	44	57	73	15.	16.	16.5	16.5
2	23	21	28	28	56	60	19.5	21.	13.5	13.5
3	19	21	21	19	69	76	19.	19.5	13.	13.
4	--	--	--	--	--	--	23.5	26.	10.5	8.5
5	--	--	--	--	--	--	15.5	18.	15.5	16.
6	36	39	38	38	87	82	18.	21.	14.5	13.5
7	19	22	23	33	64	63	17.5	21.	18.	16.
8	--	--	--	--	--	--	17.	16.5	13.	14.
9	--	--	--	--	--	--	16.	16.5	16.5	16.
10	18	26	24	36	46	58	21.	20.5	15.5	16.
11	25	24	22	36	55	53	13.	15.5	14.	16.
12	21	16	22	18	43	49	16.5	18.	14.5	14.5
13	--	--	--	--	--	--	15.	16.	15.5	16.
14	13	19	13	26	57	48	13.5	12.5	16.5	16.5
15	21	21	12	32	48	56	18.5	21.5	15.5	15.
16	--	--	--	--	--	--	15.	16.	16.5	15.
17	--	--	--	--	--	--	18.5	20.5	16.5	16.
18	--	--	--	--	--	--	13.5	13.	16.	16.
19	--	--	--	--	--	--	18.5	18.5	13.5	14.
20	--	--	--	--	--	--	17.	18.5	15.5	15.
21	17	20	16	10	38	47	15.5	17.	14.	14.5
22	28	25	36	29	57	64	16.	18.5	14.	14.
23	--	--	--	--	--	--	15.	17.	15.	15.
24	--	--	--	--	--	--	18.5	18.	13.	13.
25	32	32	33	42	56	74	17.5	19.5	13.5	14.
26	42	41	49	52	100	100	17.5	20.	13.5	13.5
27	--	--	--	--	--	--	16.5	18.	15.5	15.
28	--	--	--	--	--	--	19.	19.	14.5	14.5
29	--	--	--	--	--	--	16.5	17.5	14.	13.5

Subject	Strength Shoulder Flexors Pre	Strength Shoulder Flexors Post	Strength Back Extensors Pre	Strength Back Extensors Post	Strength Shoulder Adduction & Elbow Extensors Pre	Strength Shoulder Adduction & Elbow Extensors Post	Flexibility Trunk Extension Pre	Flexibility Trunk Extension Post	Flexibility Right Lateral Flexion Pre	Flexibility Right Lateral Flexion Post
30	--	--	--	--	--	--	18.5	18.	14.	14.
31	--	--	--	--	--	--	17.	17.	16.	16.
32	--	--	--	--	--	--	11.	14.5	18.	15.
33	28	31	43	50	90	100	21.5	18.	14.	15.
34	20	26	25	37	34	69	17.	21.5	13.	14.
35	--	--	--	--	--	--	14.	14.5	13.	13.
36	--	--	--	--	--	--	17.5	22.	14.	14.
37	--	--	--	--	--	--	15.	17.	13.	12.
38	23	18	22	25	56	50	13.	14.5	17.5	15.5
39	--	--	--	--	--	--	15.	17.5	15.	14.
40	19	24	19	24	64	72	12.	15.	14.5	14.
41	--	--	--	--	--	--	13.5	15.	13.	13.
42	26	28	37	26	78	63	15.	16.	14.5	15.
43	20	27	44	45	60	71	16.	16.5	14.5	14.5
44	--	--	--	--	--	--	16.	18.	16.	16.
45	22	20	16	30	34	44	16.	18.	16.5	16.
46	--	--	--	--	--	--	14.	18.	16.5	16.5
47	36	34	24	40	54	81	18.5	17.5	17.	15.
48	31	32	36	50	72	65	15.5	16.5	17.	17.5
49	--	--	--	--	--	--	16.5	18.	15.5	16.
50	30	28	26	32	74	76	17.5	19.	13.	14.
51	--	--	--	--	--	--	19.5	20.5	15.5	15.5
52	--	--	--	--	--	--	14.	15.5	17.	17.5

Subject	Flexibility Spinal Rotation Pre	Flexibility Spinal Rotation Post	Aerobic Capacity Pre	Aerobic Capacity Post	Vital Capacity Pre	Vital Capacity Post	Cardiovascular Fitness Pre	Cardiovascular Fitness Post	Maximum Breathing Capacity Pre	Maximum Breathing Capacity Post
1	136	132	--	--	2.5	2.8	--	--	137	160
2	133	142	9	11	2.9	2.9	10	8	122	195
3	138	142	14	17	3.6	3.4	14	12	180	185
4	165	165	10	11	3.7	3.8	15	15	225	220
5	129	128	--	--	3.0	3.1	--	--	147	222
6	133	145	--	--	3.3	3.4	--	--	217	235
7	117	120	7	13	2.7	2.9	11	11	130	135
8	128	153	9	12	3.0	2.9	17	16	100	165
9	117	115	--	--	3.3	3.4	--	--	182	165
10	126	143	--	--	3.8	3.9	--	--	184	210
11	117	125	--	--	3.1	3.0	--	--	167	182
12	124	117	--	--	2.5	2.7	--	--	94	145
13	140	143	--	--	2.6	2.6	--	--	118	175
14	122	137	--	--	1.9	1.6	--	--	109	150
15	117	112	--	--	2.9	2.6	--	--	72	160
16	111	147	--	--	2.3	2.2	--	--	100	95
17	115	125	9	13	3.6	3.6	12	9	182	210
18	97	121	7	13	3.0	3.0	11	7	161	171
19	118	151	--	--	3.4	3.2			143	192
20	125	117	--	--	3.2	3.2			193	175
21	152	138	--	--	219	310	--	--	197	215
22	143	148	4	10	2.9	2.8	13	15	113	140
23	143	133	13	9	2.8	2.8	13	10	91	167
24	118	119	--	--	3.7	3.9	--	--	218	203
25	149	138	14	17	2.5	216	11	12	155	137
26	165	165	20	22	3.5	3.4	17	13	180	220
27	137	161	--	--	3.0	3.0	--	--	213	203
28	134	126	--	--	3.3	3.9	--	--	124	135
29	136	134	--	--	2.8	2.9	--	--	143	135
30	130	132	12	21	3.5	3.5	18	15	223	275

Subject	Fleixibility Spinal Rotation Pre	Fleixibility Spinal Rotation Post	Aerobic Capacity Pre	Aerobic Capacity Post	Vital Capacity Pre	Vital Capacity Post	Cardiovascular Fitness Pre	Cardiovascular Fitness Post	Maximum Breathing Capacity Pre	Maximum Breathing Capacity Post
31	143	162	--	--	2.8	2.9	--	--	130	125
32	105	123	8	11	2.8	2.8	2	5	130	158
33	163	165	--	--	3.5	3.7	--	--	212	192
34	126	134	9	12	3.3	3.3	7	10	140	160
35	113	137	12	20	3.0	3.4	12	14	120	185
36	146	135	7	8	2.6	2.8	6	9	190	202
37	146	160	16	24	3.8	3.5	13	13	113	205
38	119	129	--	--	3.6	3.2	--	--	64	110
39	121	128	--	--	3.4	3.1	--	--	202	225
40	91	132	6	11	2.9	2.9	11	12	90	137
41	135	152	10	10	3.0	3.1	10	9	110	150
42	152	143	--	--	3.2	3.2	--	--	184	170
43	123	144	9	12	3.0	2.9	11	13	187	175
44	128	107	12	16	2.9	2.9	13	14	88	130
45	116	135	--	--	2.0	2.4	--	--	200	175
46	133	154	10	13	2.7	2.7	10	10	95	132
47	93	126	--	--	3.3	3.2	--	--	105	145
48	116	116	--	--	4.1	3.9	--	--	100	192
49	122	122	--	--	3.2	3.2	--	--	220	222
50	147	160	--	--	2.9	2.7	--	--	135	205
51	123	138	--	--	2.5	2.5	--	--	158	175
52	127	149	13	13	2.5	2.8	11	9	157	178

APPENDIX E

t-VALUES AND F-RATIOS OF

(1) PRE-TEST AND POST-TEST DIFFERENCES WITHIN EXPERIMENTAL GROUP

(2) PRE-TEST AND POST-TEST DIFFERENCES WITHIN CONTROL GROUP

(3) POST-TEST DIFFERENCES BETWEEN EXPERIMENTAL AND CONTROL GROUPS

t-VALUES AND F-RATIOS OF THE POST-TEST DIFFERENCES BETWEEN THE EXPERIMENTAL AND CONTROL GROUPS

Test	F-Ratio	t-Value
Body Girth		
A. Right upper arm	2.79*	0.65
B. Bust	1.11	0.06
C. Waist	1.00	-0.41
D. Hips	1.11	0.24
E. Right thigh	1.63	0.20
F. Right calf	2.05*	0.60
Subcutaneous Fat		
A. Right tricep	2.80*	1.37
B. Upper chest	1.29	1.00
C. Abdomen	1.88	0.22
D. Right subscapular	1.19	0.15
E. Right thigh	1.28	2.11*
Strength		
A. Hip flexors	2.58	0.17
B. Abdominal	2.05	0.37
C. Shoulder flexors	1.96	-0.84
D. Back extensors	3.60*	-0.36
E. Shoulder adductors & elbow extensors	1.90	-0.85

*Significant at .05 level

(Continued)

Test	F-Ratio	t-Value
Flexibility		
A. Trunk extension	1.46	0.23
B. Right lateral flexion	1.79	-1.03
C. Spinal rotation	1.15	0.08
Aerobic Capacity	1.77	1.31
Vital Capacity	1.99*	-1.16
Resting Cardiovascular Fitness	2.27	2.52*
Maximum Breathing Capacity	1.76	0.25

*Significant at .05 level

t-VALUES AND F-RATIOS OF THE PRE-TEST AND POST-TEST DIFFERENCES WITHIN THE EXPERIMENTAL GROUP

Test	F-Ratio	t-Value
Body Girth (N=25)		
A. Right upper arm	1.06	-0.09
B. Bust	1.05	0.10
C. Waist	1.43	0.29
D. Hips	1.01	-0.06
E. Right thigh	1.29	1.27
F. Right calf	1.22	-0.44
Subcutaneous Fat (N=25)		
A. Right tricep	1.15	0.36
B. Upper chest	1.98*	0.79
C. Abdomen	1.10	0.67
D. Right subscapular	1.04	0.50
E. Right thigh	1.27	-0.26
Strength (N=11)		
A. Hip flexors	1.24	-1.14
B. Abdominal	1.19	-1.84*
C. Shoulder flexors	1.67	-0.25
D. Back extensors	2.00	-2.23*
E. Shoulder adductors & elbow extensors	1.54	-1.41

*Significant at .05 level

(Continued)

Test	F-Ratio	t-Value
Flexibility (N=25)		
A. Trunk extension	1.25	-1.83*
B. Right lateral flexion	1.09	0.90
C. Spinal rotation	1.33	-2.76*
Aerobic Capacity (N=10)	1.79	2.72*
Vital Capacity (N=25)	1.01	0.22
Resting Cardiovascular Fitness (N=10)	2.02	0.48
Maximum Breathing Capacity (N=25)	1.43	-2.26*

*Significant at .05 level

t-VALUES AND F-RATIOS OF THE PRE-TEST AND POST-TEST DIFFERENCES WITHIN THE CONTROL GROUP

Test	F-Ratio	t-Value
Body Girth (N=27)		
A. Right upper arm	1.27	0.07
B. Bust	1.09	0.28
C. Waist	1.13	-0.47
D. Hips	1.06	-0.01
E. Right thigh	1.12	0.34
F. Right calf	1.56	0.10
Subcutaneous Fat (N=27)		
A. Right tricep	1.32	0.88
B. Upper chest	1.30	0.59
C. Abdomen	1.25	0.68
D. Subscapular	1.12	0.35
E. Right thigh	1.08	0.12
Strength (N=13)		
A. Hip flexors	4.16*	-0.28
B. Abdominal	1.24	-0.65
C. Shoulder flexors	1.25	-0.43
D. Back extensors	1.76	-0.75
E. Shoulder adductors & elbow extensors	1.50	-0.71

*Significant at .05 level

(Continued)

Test	F-Ratio	_t_-Value
Flexibility (N=27)		
A. Trunk extension	1.15	-2.23*
B. Right lateral flexion	1.23	-0.20
C. Spinal rotation	1.05	-0.98
Aerobic Capacity (N=13)	1.08	-1.40
Vital Capacity (N=27)	1.16	-0.60
Resting Cardiovascular Fitness (N=13)	2.02	0.48
Maximum Breathing Capacity (N=27)	1.88	-2.43*

*Significant at .05 level

VITA

Reginald Lee Price

Candidate for the Degree of

Doctor of Education

Thesis: THE EFFECT OF THE INCH MASTER EXERCISER ON BODY GIRTH, SUBCUTANEOUS FAT, AND SELECTED PHYSIOLOGICAL VARIABLES OF ADULT WOMEN

Major Field: Higher Education

Biographical:

Personal Data: Born in Jacksonville, Illinois, January 21, 1942, the son of Mr. and Mrs. Glendyn L. Price.

Education: Graduated from White Hall High School, White Hall, Illinois, in May, 1960; received Bachelor of Science degree in Physical Education from MacMurray College, Jacksonville, Illinois, in May, 1964; received Master of Arts degree in Physical Education from the Ohio State University, Columbus, Ohio, in June, 1967; completed requirements for the Doctor of Education degree at Oklahoma State University in May, 1973.

Professional Experience: Director of Boy's Physical Education and Wrestling Coach, Ohio State School for the Blind, Columbus, Ohio, in 1964-66; graduate teaching assistant in Department of Physical Education, The Ohio State University, 1966-67; Instructor and Wrestling Coach on the faculty of Hiram College, Hiram, Ohio, in 1967; Assistant Professor in 1970; graduate assistant in Department of Health, Physical Education and Recreation, Oklahoma State University, 1970-72; Assistant Professor of Physical Education and Wrestling Coach, MacMurray College, 1972. Member of the American Association of Health, Physical Education and Recreation, National College Physical Education Association for Men, American School Health Association, and National Wrestling Coaches Association.