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EFFECTS OF TWO SELECTED ROLLER SKATING PROGRAMS UPON ANTHROPOMETRIC, PHYSIOLOGICAL, AND ATTITUDINAL PARAMETERS IN COLLEGE-AGED STUDENTS

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EFFECTS OF TWO SELECTED ROLLER SKATING PROGRAMS UPON ANTHROPOMETRIC, PHYSIOLOGICAL, AND ATTITUDINAL PARAMETERS IN COLLEGE-AGED STUDENTS

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ABSTRACT

EFFECTS OF TWO SELECTED ROLLER SKATING PROGRAMS UPON ANTHROPOMETRIC, PHYSIOLOGICAL, AND ATTITUDINAL PARAMETERS IN COLLEGE-AGED STUDENTS

by Ernest Arthur White

This study was designed to investigate the effects roller skating programs would have on physical fitness, body composition, leg strength and flexibility, and attitude of 56 college students. Treadmill tests were performed to determine cardiorespiratory fitness; in addition, laboratory tests were performed to determine body composition, leg strength and flexibility. The Kenyon scale was administered to determine the attitude of 56 college students. A unique dimension was included in the study in that a leisure-time activity index was used to determine if outside activity had any bearing on test results. A two-way analysis of variance with repeated measures was used to determine if any significant changes occurred. Duncan's multiple range was used to determine if posttest differences existed.

The statistical findings indicated that only pre/post main effects occurred in selected variables; and that because the control group was included in this pre/post

effects no changes could be attributed to the experimental programs. It was noted that one leg strength variable, knee extension, demonstrated a trend toward increased strength from continuous skating.

The implications for teaching were: first, that in order for roller skating to be a part of a physical fitness program it must be supplemented with additional aerobic activities; and, second, the equating of student activity levels should be a part of a complete physical exercise prescription.

ACKNOWLEDGEMENTS

I would like to express my deepest appreciation to the many individuals who contributed to the completion of this work.

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To my family I would like to express my appreciation for all your support, and to Uncle Jack and Aunt Irene thank you. Without your support none of this would have been possible.

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Ernie White

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Chapter 1

STATEMENT OF THE PROBLEM

> Physical educators have long been concerned with promoting and developing the quality of "physical fitness" among the populus. This subject has received considerable attention from both researchers and teachers. Although no single definition of physical fitness has ever been universally accepted, many exercise physiologists have come to consider the oxygen transport capacity or maximal oxygen consumption to represent a factor of major importance within the definition of physical fitness.[1]

Cooper indicated exercises that stimulate the heart and lungs for a period of time long enough to produce a training effect will produce physical fitness. He called these aerobic exercises and listed running, swimming, cycling, and jogging as aerobic activities. These activities have been supported in the literature as excellent means of training for cardiorespiratory fitness. They were not, however, the only ones that will contribute to cardiorespiratory fitness; any activity that makes an individual work hard and demands plenty of oxygen will

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[1]Carl Foster, "Physiological Requirements of Aerobic Dancing," Research Quarterly, XLVI (March, 1975), 120.

produce an aerobic effect, including many popular sports.[2]

Phillips, in The Complete Book of Roller Skating, cited Novich who stated, ". . . one more point--it's a life-time skill and should be utilized for this purpose. Don't lay off and you will be rewarded with a sound heart beat for a lifetime."[3] This claim was further emphasized by Straus and Sturges who stated:

> To strengthen the heart and lung efficiencies, stress must be applied to the body. Less strenuous sports may burn only 100 to 200 calories per hour, whereas roller skating will burn approximately 360 calories per hour--a very significant difference.[4]

Although these claims were not supported by any scientific data, there was reason to believe they were based in truth. This basis was obtained from Cureton:

> All rhythmical type activities, done 30 minutes to an hour per day, 5 or 6 days per week, with emphasis upon adequate breathing methods, are the best possibilities, including swimming, walking, jogging, skating, skiing, etc.[5]

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[2]Kenneth H. Cooper, The New Aerobics (New York: Bantam Book Co., 1970), p. 16.

[3]Ann-Victoria Phillips, The Complete Book of Roller Skating (New York: Workman Publishing, 1979), p. 70.

[4]Hal Straus and Marilou Sturges, Roller Skating Guide (Mountain View, California: World Publications, Inc., 1979), p. 148.

[5]Thomas K. Cureton, "The Relative Value of Various Exercise Conditioning Programs to Improve Cardiovascular Status and to Prevent Heart Disease," Journal of Sports Medicine and Physical Fitness, V (1965), 55.

PURPOSE OF THE STUDY

This study was conducted to ascertain the effects of endurance and traditional skating upon cardiorespiratory fitness, body composition, selected leg strength and flexibility measures, and attitude toward physical education of 56 college students enrolled in roller skating.

Specifically, this study purported to: (1) add clarity to existing reports and contribute further to the body of knowledge that roller skating is an effective means of developing cardiorespiratory fitness; (2) ascertain if a training program of three days per week of thirty-minutes duration at a heart rate between 70 to 80% of maximum will positively alter cardiorespiratory fitness, body composition, selected leg strength and flexibility variables, and selected attitudinal variables; and (3) provide reference results that may be used by college instructors involved in roller skating to plan and implement an aerobic roller skating program.

The study assumed a unique dimension in that determinants for maximum oxygen consumption, body composition, leg strength and flexibility, as well as attitude, were investigated for college students engaged in roller skating. The study was also unique in that it used a modified leisure-time physical activity questionnaire to determine if out-of-class leisure activities created differences between the test groups.

IMPLICATIONS FOR TEACHING

Physical educators are constantly seeking new means of improving their discipline or reinforcing tried methods. In this constant effort to provide the populus with varied means of obtaining the desirable effects of physical education, many new methods are attempted and older ones are modified.

This study was designed to provide answers leading to an effective physical conditioning program by means of an existing physical education activity. Because many individuals seek a means of physical fitness and are not suited for the traditional activities, alternative forms should be investigated. Traditionally, physical education activities are taught by the tried methods of the past and little emphasis is placed on physical fitness, if it is not already there. By modifying an existing program (roller skating), it may be possible to provide the profession with a new method of developing fitness through an established activity. Although the proponents of roller skating have long intimated that roller skating will benefit fitness, no programs have been developed to indicate to what extent this fitness may be gained.

DEFINITIONS OF TERMS

For the purposes of this study, the following terms were defined.

Anthropometric Dimensions

Anthropometric dimensions were the numerical values for measurements which included circumferential, diametrical, and skinfold assessments.

Body Composition

Body composition was determined by the total body weight derived from the sum of lean body weight plus fat body weight.

Cardiorespiratory Fitness

Cardiorespiratory fitness was determined as a person's ability to maximally utilize oxygen during exhaustive work.[6]

College-age Students

College-age students included male and female students within the 17-26 age classification.

Continuous Roller Skating

Continuous roller skating was skating at an uninterrupted submaximal aerobic pace which resulted in a

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[6] Donald K. Mathews, Measurement in Physical Education (Philadelphia: W. B. Saunders Co., 1978), p. 253.

heart rate approximately equal to 70 to 80% of an individual's maximal heart rate, 30 minutes per day, three days per week.

Flexibility

Flexibility was the moving of articulating segments of the body about a joint and could, therefore, be used to describe movement from a position of extension to that of flexion or the opposite movement.[7]

Lean Body Weight

Lean body weight was that portion of fat-free weight of an individual's total body composition.

Leisure-time Activity

Leisure-time activity was any non-work activity engaged in by the subjects which was assigned a numerical value based on intensity, frequency, and duration.

Percent Body Fat

Percent body fat was the adipose tissue component of body composition determined by subtracting the ratio of lean body weight to total body weight from unity.

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[7] Henry J. Montoye, An Introduction to Measurement in Physical Education (Boston: Allyn and Bacon, Inc., 1978), p. 122.

Strength

Strength was determined as the mean of two voluntary isometric contractions, using Clarke's methods and measured by a strain gauge.[8]

Traditional Roller Skating

Traditional roller skating was roller skating once per week with technique instruction, practice periods, and periodic breaks for a duration of 1 hour and 30 minutes.

LIMITATIONS OF THE STUDY

The study was limited to 40 students from two roller skating classes and 16 students who volunteered from three effective living classes during the spring semester of 1981. It was assumed that these students were typical of college students within the age range of 17-26 years.

HYPOTHESES

The following null hypotheses were tested:

H_1: Traditional roller skating will not result in significant changes in cardiorespiratory fitness.

H_2: Continuous roller skating will not result in significant changes in cardiorespiratory fitness.

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[8]H. Harrison Clarke, "Improvement of Objective Strength Tests of Muscle Groups by Cable-Tension Methods," Research Quarterly, XXI (December, 1950), 399-419.

H_3: Traditional roller skating will not result in significant changes in body composition.

H_4: Continuous roller skating will not result in significant changes in body composition.

H_5: Traditional roller skating will not result in significant changes in selected leg strength measures.

H_6: Continuous roller skating will not result in significant changes in selected leg strength measures.

H_7: Traditional roller skating will not result in significant changes in joint flexibility.

H_8: Continuous roller skating will not result in significant changes in joint flexibility.

H_9: Traditional roller skating will not result in significant changes in attitude.

H_{10}: Continuous roller skating will not result in significant changes in attitude.

H_{11}: Out-of-class recreational activities will not differ significantly among the three groups.

Chapter 2

REVIEW OF RELATED LITERATURE

The literature pertaining to the effects of roller skating on cardiorespiratory fitness, body composition, leg strength and flexibility, and attitude as it pertained to college-age students was so limited that it forced examination of the literature in related activities. Examination of literature pertaining to running, cycling, rope-jumping, dancing, and circuit training as it affected the aforementioned variables was used to develop a parallel with roller skating. Each of these activities was reviewed with regard to the manner in which duration, frequency, and intensity had an effect on cardiorespiratory fitness, body composition, and leg strength, and to what extent similar programs of roller skating might have the same effect. The use of heart rate was reviewed as a means of determining stress and the percentage of maximum work that was most desirable to obtain a training effect. A discussion regarding training and joint flexibility and training and attitudinal changes was also included.

CARDIORESPIRATORY FITNESS

Cureton indicated that since 1941 programs have sought to assess the relative values of various physical education programs to improve cardiovascular functioning and prevent heart disease.[1] Skinner and others indicated a need to determine whether or not a program of increased physical activity, that could be performed by the majority of adult men, could provide protection against coronary heart disease.[2]

Scheuer and Tipton stated the extent of physical training or detraining also obviously has profound implications with regard to the ability of normal persons to participate comfortably, safely, and successfully in recreational activities. The authors further indicated that this was important when activity by middle-aged men and women increased.[3]

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[1]Thomas K. Cureton, "The Relative Value of Various Exercise Conditioning Programs to Improve Cardiovascular Status and to Prevent Heart Disease," Journal of Sports Medicine and Physical Fitness, V (1965), 55.

[2]James S. Skinner, John O. Holloszy, and Thomas K. Cureton, "Effects of a Program of Endurance Exercise on Physical Work," The American Journal of Cardiology, XIV (December, 1964), 747.

[3]James Scheuer and Charles M. Tipton, "Cardiovascular Adaptations to Physical Training," Annual Review of Physiology, XXXIX (1977), 224.

FREQUENCY OF TRAINING

Much has been written regarding the frequency of exercise necessary in order for it to produce beneficial effects on cardiorespiratory fitness. Milesis indicated that, in order to produce significant gains in cardiorespiratory function, endurance activities such as running, bicycling, and swimming must be performed three to five days per week.[4]

Scheuer and Tipton stated that, in general, a program of three or four sessions per week will regularly improve cardiorespiratory performance or fitness.[5] In an attempt to determine which frequency was best for adult men participating in a fitness program, Pollock found "adult men participating in endurance training of 2 or 4 days per week improve significantly in working capacity and cardiovascular fitness."[6] Jackson likewise found that training two or three times a week may be as beneficial as training five

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[4]Chris A. Milesis, "Effects of Different Durations of Physical Training on Cardiorespiratory Function, Body Composition, and Serum Lipids," Research Quarterly, XLVII (December, 1976), 717.

[5]Scheuer and Tipton, p. 224.

[6]Michael L. Pollock, "Effects of Frequency of Training on Work Capacity, Cardiovascular Function, and Body Composition of Adult Men," Medicine and Science in Sports, I (June, 1969), 74.

times per week.[7] In a comprehensive study Pollock again demonstrated improvement in cardiovascular function with a program of exercise of two days per week and forty-five minutes in duration.[8] A two-day-per-week program was also used by Girandola and Katch with similar results. They reported significant changes in both body composition and maximum oxygen consumption from a twice-per-week program lasting nine weeks.[9]

The two- or three-day frequency was not used, however, when rope skipping was the means of developing cardiorespiratory fitness. Both Jones[10] and Baker[11] reported improvement in cardiovascular efficiency when a five-day-per-week regimen was implemented.

Hickson and Rosenkoetter found that aerobic power that was developed using a six-times-per-week frequency

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[7]J. H. Jackson, "Cardiorespiratory Adaptations to Training at Specified Frequencies," Research Quarterly, XXXIX (May, 1968), 300.

[8]Michael L. Pollock, "Effects of Training Two Days Per Week at Different Intensities on Middle Aged Men," Medicine and Science in Sports, IV (Winter, 1972), 197.

[9]Robert N. Girandola and Victor Katch, "Effects of Nine Weeks of Physical Training on Aerobic Capacity and Body Composition in College Men," Archives of Physical Medicine and Rehabilitation, LIV (October, 1973), 522.

[10]Merritt D. Jones, "Effect of Rope Skipping on Physical Work Capacity," Research Quarterly, XXXIII (May, 1962), 237.

[11]John A. Baker, "Comparison of Rope Skipping and Jogging as Methods of Improving Cardiovascular Efficiency of College Men," Research Quarterly, XXXIX (May, 1968), 241.

could be maintained by using only a twice-per-week frequency with no significant reduction.[12]

Frequencies from two to six-times-per-week have been demonstrated as sufficient to enhance cardiorespiratory fitness. It was concluded, then, that a three-times-per-week frequency would be most appropriate as it blended with academic scheduling and individual preference.

INTENSITY OF EXERCISE

As with frequency, information regarding intensity of exercise to attain a training effect varied from researcher to researcher.

Faria cited Karvonen who stated:

> . . . that to improve the exercise tolerance of the cardiovascular system the heart rate during the exercise bout must be increased at least 60% of the difference between the resting and maximal rate.[13]

This was not fully supported by other investigators, although it has been used as somewhat of a benchmark. Burke stated

> The finding of this study along with those of earlier studies seem to give rise to a theory that working

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[12]Robert C. Hickson and Maureen A. Rosenkoetter, "Reduced Training Frequencies and Maintenance of Increased Aerobic Power," Medicine and Science in Sports and Exercise, XIII (1981), 16.

[13]Irvin E. Faria, "Cardiovascular Response to Exercise as Influenced by Training of Various Intensisties," Research Quarterly, XLI (March, 1970), 45.

> around 75% of heart rate maximum is the most efficient means of training for "average" individuals.[14]

This was supported and put into terms of number of heart beats per minute by Yeager who indicated that, in order for an overload to be placed on the heart, the training program should elicit a heart rate of 70 to 80% of its maximum. A rate of 144 beats per minute was within this range.[15] Sharkey supported this thesis in his studies when he indicated the need for exertion prompting heart rates above 150 beats per minute.[16] Pollock indicated only a need for moderate to high intensity.[17]

Intensity was relative to each individual, yet it appeared that for the "average" individual a work intensity that elicited 150 beats per minute was sufficient to promote cardiovascular improvement if maintained for a reasonable duration.

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[14]Edmund J. Burke and B. Don Franks, "Changes in VO_2 Max Resulting from Bicycle Training at Different Intensities Holding Total Mechanical Work Constant," Research Quarterly, XLVI (March, 1975), 36.

[15]Susan A. Yeager and Paul Brynteson, "Effects of Varying Training Periods on the Development of Cardio-vascular Efficiency of College Women," Research Quarterly, XLI (December, 1970), 590.

[16]Brian J. Sharkey and John P. Holleman, "Cardiorespiratory Adaptations to Training at Specific Intensities," Research Quarterly, XXXVIII (December, 1967), 703.

[17]Pollock, "Effects of Training Two Days Per Week at Different Intensities on Middle Aged Men," p. 197.

DURATION OF EXERCISE

Similar to other training variables the duration of the exercise has been examined as to its importance in developing cardiorespiratory fitness, and similar to other variables the data are inconclusive.

Faria found that a duration only long enough to raise the heart rate to a pre-assigned training rate, a given percentage of maximum heart rate, was sufficient to produce a training effect in a four-week program.[18]

Yeager found in groups involved in bicycling that, although all three groups (10-, 20-, and 30-minute duration) improved, ". . . it would appear that a 30 minute training session would give more consistent, overall cardiovascular improvement than a shorter training period."[19] This was supported by Milesis who found greater changes were noted in the thirty-minute group; therefore, if time were not a critical factor, a thirty-minute program might be preferable.[20]

The second element of duration was the time span the program should last. For an individual a fitness program should be a lifetime activity that is carried on

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[18] Faria, p. 46.

[19] Yeager and Brynteson, p. 591.

[20] Milesis, p. 724.

indefinitely. For an institution this is not practical, and it should be determined if fitness levels can be altered in the normal time span of a physical education class.

Several researchers have attempted to determine how quickly the body adapted to exercise programs, and the results have been interesting. Durnin and others found that measurable increases in fitness could be found in a group of men within ten days after beginning a program of walking 20 kilometers per day.[21]

Scheuer and Tipton indicated that within as few as three weeks of a strenuous program detectable effects on maximum oxygen consumption could be elicited and that a progressive increase in cardiovascular fitness occurred over a five-week period.[22] When using heart rate as an indicator of improved fitness, Clausen, Jensen, and Lassen stated, "Within a few days after the start of a physical conditioning program, a substantial reduction of the heart rate at a given submaximal work load is observed."[23]

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[21]J. V. Durnin, J. M. Brockway, and H. W. Whitcher, "Effects of a Short Period of Training Varying Severity on Some Measurements of Physical Fitness," Journal of Applied Physiology, XV (1960), 165.

[22]Scheuer and Tipton, p. 224.

[23]J. P. Clausen, J. Trap-Jensen, and N. A. Lassen, "The Effects of Training on the Heart Rate During Arm and Leg Exercise," The Scandinavian Journal of Clinical and Laboratory Investigation, XXVI (November, 1970), 295.

Hickson, Bomze, and Holloszy observed that in a program of six days per week, 35 minutes of running or bicycling, the average maximum oxygen consumption of the group increased significantly during the first week of training, and within two weeks all the subjects showed an increase in maximum oxygen consumption.[24]

In a separate study, Hickson noted further that cardiovascular and mitochondrial adaptations occurred rapidly in humans; however, it was further noted that, unless the training stimuli are continually increased, a daily high intensity program becomes a maintenance program, without any further increase in maximum oxygen consumption, after three weeks.[25]

BODY COMPOSITION

Obesity, as indicated by Moody, has long been recognized as a major health problem in the United States. However, Moody also indicated that exercise has been

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[24] R. C. Hickson, H. A. Bomze, and J. O. Holloszy, "Linear Increase in Power Induced by a Strenuous Program of Endurance Exercise," Journal of Applied Physiology, XLII (March, 1977), 373.

[25] R. C. Hickson, "Time Course of the Adaptive Response of Aerobic Power and Heart Rate to Training," Medicine and Science in Sports and Exercise, XII (1981), 20.

demonstrated to be an effective agent in both the treatment and prevention of obesity.[26]

Carter and Phillips found in a longitudinal study covering a two-year period that significant changes in body composition were elicited by subjects who participated in an exercise program three-times-per-week for the duration of one hour.[27] Effects replicating Carter and Phillips' study have been sought with mixed results in similar experiments of shorter duration. In a study comparing the effects of exercise on body composition on groups who exercised 15, 30, and 45 minutes, Melisis found that only percent fat differed significantly among the training groups and that the 45-minute group reduced significantly more than the 15-minute group. All three groups had total skinfold fat and percent fat reductions significantly greater than the control group, thus indicating that exercise can affect body composition and that a longer duration may have a greater effect.[28] Wilmore similarly indicated that participants in

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[26]Dorothy L. Moody, "The Effects of a Jogging Program on the Body Composition of Normal and Obese High School Girls," Medicine and Science in Sports, IV (Winter, 1972), 210.

[27]J. E. Lindsay Carter and William H. Phillips, "Structural Changes in Exercising Middle-Aged Males During a 2-yr. Period," Journal of Applied Physiology, XXVII (December, 1969), 787-793.

[28]Milesis, p. 720.

a 10-week, three times per week, jogging program demonstrated small but significant alterations in body composition. This was based on the data that body weight decreased slightly while lean body weight remained the same.[29]

Similarly, in a 20-week walking program Pollock found a reduction in total body weight and percent body fat, and they were generally reported as 0-3 kilograms in total body weight and 0-3 percent in fat.[30] The fact that Pollock was not able to obtain similar results in a twice-per-week walking program lent support for three-times-per-week training sessions.[31] The final justification for training to enhance body composition was made by Igbanugo and Gutin who stated,

> In addition to the benefits of a strengthened cardiovascular system, there is evidence that endurance training has a favorable effect on body composition, either with or without a change in body weight.[32]

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[29]Jack H. Wilmore, "Body Composition Changes with a 10-Week Program of Jogging," Medicine and Science in Sports, II (Fall, 1970), 114.

[30]Michael L. Pollock, "Effects of Walking on Body Composition and Cardiovascular Function of Middle-Aged Men," Journal of Applied Physiology, XXX (January, 1971), 129.

[31]Pollock, "Effects of Training Two Days Per Week at Different Intensities on Middle Aged Men," p. 196.

[32]Veronica Igbanugo and Bernard Gutin, "The Energy Cost of Aerobic Dancing," Research Quarterly, XLIX (October, 1978), 309.

HEART RATE AS A MEANS OF DETERMINING TRAINING LOAD

Heart rate has traditionally been used as a means of determining work load and training rate. Because of the ease by which heart rate can be monitored, it has served as a useful means of determining approximate work loads; the fact that heart rate may not always be measured as accurately as is preferable, particularly in the field, has been one major drawback. Astrand and Rhyming indicated that a heart rate of 154 beats per minute for men and 164 beats per minute for women are the average numbers estimated for work load of 70% of capacity.[33] Although Pollock conceded that the use of heart rate as a measure of training rate has drawbacks, he also indicated ". . . that the post exercise heart rate can be a good estimator of training heart rate when it occurs at a rate above 80% of maximum."[34] McArdle also found that a 10-second reading, immediately upon cessation of work, approximated the exercise heart rate with a less than three percent error, when dealing with subjects

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[33] P. O. Astrand and Irma Rhyming, "A Monogram for Calculation of Aerobic Capacity (physical fitness) from Pulse Rate During Submaximal Work," Journal of Applied Physiology, VII (September, 1954), 218.

[34] Michael L. Pollock, "Validity of the Palpation Technique of Heart Rate Determination and Its Estimation of Training Heart Rate," Research Quarterly, XLIII (March, 1972), 80.

whose heart rate had ranged between 170-190 beats per minute.[35] It was further indicated by McArdle that the error of measure increased as the working heart rate was lowered, 7.6% for heart rate of 140 beats per minute.[36]

STRENGTH AND FLEXIBILITY

"The idea that strength and hypertrophy together result from a strenuous exercise is firmly rooted in popular and medical thought. Physiologically, this dual effect is included in the general term, work-hypertrophy."[37] Whether this theory of general work-hypertrophy was accurate was examined in this portion of the review of literature.

Hettinger, in Physiology of Strength, expounded some basic fundamentals regarding strength when he indicated that in order to improve performance (in strength) the training stimulus must be greater than the normal daily stress requirement upon the system being strained,[38] and that

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[35]William D. McArdle, "Validity of the Postexercise Heart Rate as a Means of Estimating Heart Rate During Work of Varying Intensities," Research Quarterly, XL (October, 1969), 523.

[36]Ibid., p. 527.

[37]Edward E. Gordon, Kasimierz Kowalski, and Martha Fritts, "Adaptations of Muscle to Various Exercises," Journal of the American Medical Association, CIXC (January 9, 1967), 103.

[38]Theodor Hettinger, Physiology of Strength (Springfield, Illinois: Charles C. Thomas Co., 1961), p. 5.

greater work-effort rather than longer duration of effort is the effective factor in increasing muscle strength.[39]

Guyton supported this position when he indicated that strength can be developed in muscle much more rapidly when "resistive" or "isometric" exercises were used rather than simply prolonged mild exercise.[40]

Holloszy and Booth stated that the nature of the exercise stimuli determines the type of adaptation. One type of adaptation involved hypertrophy of the muscle with an increase in strength; this was exemplified by body builders. The second type of adaptation involved an increase in the capacity of muscle for aerobic metabolism which is characteristic of long- and middle-distance runners. Although many types of physical activity can bring about varying degrees of adaptation in the same muscle, it does appear that these adaptations can occur quite independently.[41]

Hellenbrandt and Houtz concluded that strength and endurance increase when repetitive exercise is performed against heavy resistance and that mere repetition of

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[39] Ibid., p. 20.

[40] Arthur C. Guyton, Textbook of Medical Physiology (Philadelphia: W. B. Saunders Co., 1976), p. 145.

[41] John O. Holloszy and Frank W. Booth, "Biochemical Adaptations to Endurance Exercise in Muscle," Annual Review of Physiology, XXXVIII (1976), 273.

contractions which place no stress on the neuro-muscular system has little effect on the functional capacity of the skeletal muscle.[42]

The specificity of exercise was demonstrated throughout the literature. Gordon indicated that forceful static effort and dynamic forceful effort both represent maximal or near maximal effort and evoke increase in strength.[43] Gordon and others indicated that forceful exercises develop strength which depends upon concentration of actomyosin filaments as measured in rats.[44] Allen likewise found that in a 12-week circuit weight training program significant strength improvement occurred.[45]

Specificity was demonstrated equally as well for endurance type activities: "The adaptations that occur in response to a vigorous program of prolonged exercise, such

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[42] F. A. Hellenbrandt and Sara Jane Houtz, "Mechanisms of Muscle Training in Man: Experimental Demonstration of the Overload Principle," The Physical Therapy Review, XXXVI (June, 1956), 382.

[43] Edward E. Gordon, "Anatomical and Biochemical Adaptations of Muscle to Different Exercise," Journal of the American Medical Association, CCI (September 4, 1967), 756.

[44] Gordon, Kowalski, and Fritts, p. 107.

[45] T. Earl Allen, "Hemodynamic Consequences of Circuit Weight Training," Research Quarterly, XLVII (October, 1976), 303.

as long distance running or swimming, manifest themselves in functional terms as an increase in endurance."[46]

In a study in which men exercised one leg and not the other, Morgan found that endurance training was accompanied by increased oxidative capacities of trained muscle, and an enhanced capacity to synthesize glycogen and triglyceride.[47] Specificity was further documented by Barnard, Edgerton, and Peter who, when working with guinea pigs, found that prolonged low-resistance exercise in the form of treadmill running produced significant increases in the yield of mitochondria and oxidative capacity.[48]

The conclusions for specificity of training as it affected muscle tissue were best made by Gordon who stated,

> In short, endurance-provoking exercises of repetition resulted in elevation of energy-liberating systems, while strength-provoking, forceful effort developed more contractile protein per unit of muscle fiber.[49]

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[46]J. O. Holloszy, "Biochemical Adaptations to Endurance Exercise in Skeletal Muscle," Muscle Metabolism During Exercise, ed. Bergt Pernow (New York: Plenum Press, 1971), p. 51.

[47]T. E. Morgan, "Effects of Long-Term Exercise on Human Muscle Mitochondria," Muscle vetabolism During Exercise, ed. Bergt Pernow (New York: Plenum Press, 1971), p. 94.

[48]James R. Barnard, V. Reggie Exerton, and J. B. Peter, "Effect of Exercise on Skeletal Muscle I. Biochemical and Histochemical Properties," Journal of Applied Physiology, XXVII (June, 1970), 766.

[49]Gordon, p. 757.

Flexibility was for years considered a good measure of fitness. Can you touch your palms to the floor while holding your knees straight? This type of question was considered a valid measure of fitness.[50] The reason for this type of questioning was that ability to complete such a task was considered a demonstration of general flexibility, and one either possessed such ability or one did not. Hupprich and Sigerseth tested flexibility in girls and determined no evidence of the appreciable role of a factor that can be designated general flexibility. Flexibility was not some general quality which caused all tests of it to vary alike. Each major joint had a high degree of specific condition all its own.[51] Dickinson further supported this position when he stated, "In most cases flexibility is not only specific to the joint but also to the individual movements of the joint.[52]

Further inquiries pertaining to flexibility have examined the relationship between body type and flexibility, muscle hypertrophy and flexibility, and sport team

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[50] Thomas K. Cureton, "Flexibility as an Aspect of Physical Fitness," Research Quarterly, XII (May, 1941), 381.

[51] Florence Hupprich and Peter O. Sigerseth, "The Specificity of Flexibility in Girls," Research Quarterly, XXI (March, 1950), 28.

[52] R. V. Dickinson, "The Specificity of Flexibility," Research Quarterly, XXXIX (October, 1968), 793.

membership and flexibility with the following results: Laubach and McConville found that correlations between flexibility measurements and anthropometric measurements were low and insignificant. The lone exception was that persons with greater amounts of body fat had a smaller range of motion in certain joints.[53] Massey and Chaudet, in their attempt to clarify existing thought regarding muscle-boundness, found that participation in systematic, heavy resistive exercise did not result in an overall reduction in range of movement of the joints throughout the body.[54] Sigerseth and Haliski did, however, find that football players were less flexible in 13 of 21 measurements than members of a college service course.[55] DeVries found that flexibility could be significantly improved by means of static and ballistic stretching.[56]

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[53] Lloyd Laubach and John T. McConville, "Relationships Between Flexibility, Anthropometry, and the Somatotype of College Men," Research Quarterly, XXXVII (May, 1966), 246.

[54] Benjamin H. Massey and Norman L. Chaudet, "Effects of Systematic, Heavy Resistive Exercise on Range of Joint of Movement in Young Male Adults," Research Quarterly, XXVII (March, 1956), 50.

[55] Peter O. Sigerseth and Chester C. Haliski, "The Flexibility of Football Players," Research Quarterly, XXI (December, 1950), 398.

[56] Herbert A. DeVries, "Evaluation of Static Stretching Procedures for Improvement of Flexibility," Research Quarterly, XXXIII (May, 1962), 228.

ATTITUDE

Physical educators use evaluative tools constantly to determine what effects their programs are having on their students. For the most part the evaluative tools are used to determine physiological changes. Baumgartner and Jackson cited Messick, who warned that evaluation procedures are needed to consider all possible outcomes, not just those intended, and especially those germane to the affective domain. The evaluation of physical education programs must take into account the interests, appreciations, attitudes, and values of the program's consumers--the students.[57] This sentiment was supported by Adams who stated, "Their prime purpose is, of course, to provide a means for assessing individual and group attitudes toward physical education and after retesting to indicate the direction and extent of any change."[58]

Several instruments have been developed by different investigators as means of measuring students' attitudes. Many of these investigators found it necessary to develop their own instruments due to a paucity of existing tools.

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[57]Ted A. Baumgartner and Andrew S. Jackson, Measurement for Evaluation in Physical Education (Boston: Houghton Mifflin Co., 1975), p. 249.

[58]R. S. Adams, "Two Scales for Measuring Attitude Toward Physical Education," Research Quarterly, XXXIV (March, 1963), 91.

McPherson and Yuhasz developed an inventory to determine intensity of attitudes toward exercise and physical activity before an exercise program, and to determine whether changes in attitudes occurred after a 24-week program. They reported a r of 0.947 on a split-half correlation for their inventory.[59]

Richardson determined that attitude was an ongoing process and that changes could be measured over time. He used a modified Thurston scale that provided a logical means of appraising attitudes of college students prior to and following instruction. Using a test, retest procedure, reliability for the modified scale was reported as .83 and for a parallel test procedure a r of .87 was established.[60]

Kenyon reported that a sizable proportion of contemporary Western people, whether active themselves or not, believed that physical activity had the capacity to enhance personal health.[61] He further stated that this measure of belief was not enough and thus developed an instrument to measure attitudes in six physical education

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[59]D. B. McPherson and M. S. Yuhasz, "An Inventory for Assessing Men's Attitudes Toward Exercise and Physical Activity," Research Quarterly, XXXIX (March, 1968), 219.

[60]Charles E. Richardson, "Thurston Scale for Measuring Attitudes of College Students Toward Physical Fitness and Exercise," Research Quarterly, XXXI (October, 1960), 642.

[61]Gerald S. Kenyon, "A Conceptual Model for Characterizing Physical Activity," Research Quarterly, XXXIX (March, 1968), 99.

domains.[62] The reliabilities for the six subdomains ranged from a low of .68 on the social experience for women scale to a high of .89 on the pursuit of vertigo scale for men.[63]

The purpose of such attitude scales may best be expressed by Baumgartner and Jackson who stated, "It is our opinion that the evaluation of affective behavior is most useful for examining the program. . . ."[64]

LEISURE-TIME ACTIVITY

The assessment of an individual's physical activity has been used primarily for health purposes. Anderson and others stated, "It is important now to determine whether exercise apart from work, and particularly in leisure, has any protective value against coronary heart diseases."[65]

Buskirk indicated that merely classifying individuals as sedentary, moderately active or active, if the vast majority of subjects were moderately active, was not enough and that caloric expenditure must be considered to determine activity levels.[66]

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[62]Ibid., p. 98.

[63]Ibid., p. 103.

[64]Baumgartner and Jackson, p. 250.

[65]S. Yasin, "Assessment of Habitual Physical Activity Apart from Occupation," British Journal of Preventive Social Medicine, XXI (1967), 163.

[66]E. R. Buskirk, "Comparison of Two Assessments of Physical Activity and a Survey Method for Calorie Intake," The American Journal of Clinical Nutrition, XXIV (September, 1971), 1119.

Taylor developed a formula for classfying activity by intensity. Using intensity codes, which correlate to workload based on heart rate r .303 to .516 and multiplying them with frequency and duration, the sum of an individual's total activity was identified.[67]

The equating of experimental groups by developing numerical values for their total leisure-time activity was deemed an appropriate means of comparing and analyzing statistical differences between groups.

ALTERNATIVE PROGRAMS

The fact that jogging, walking, cycling, and swimming may not appeal to all individuals has led physical educators on a search for alternatives to these activities that will provide the same benefits. The following activities have been reported to have positive effects and lend support to the search for additional programs.

Vrijens reported that circuit training enhanced the physical fitness of adolescents if it were sufficiently intensive.[68] Gettman found that in a 20-week program, administered three times per week, of circuit weight

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[67]Henry L. Taylor, "A Questionnaire for the Assessment of Leisure Time Physical Activities," Journal of Chronic Disorders, XXXI (1978), 747.

[68]Jacques Vrijens, "The Influence of Interval Circuit Weight Training on Strength, Cardiorespiratory Function, and Body Composition of Adult Men," Medicine and Science in Sports, X (Fall, 1978), 176.

training most specific improvement was made in muscular strength and changes in body composition and that only small aerobic effects could be measured.[69] Wilmore indicated, though with differing results for men and women, that circuit weight training does appear to be an efficient mode of training for altering body composition, strength, endurance time to exhaustion, and, to a limited extent, flexibility.[70]

Positive effects on the cardiovascular system were reported by Garrett in volleyball[71] and Igbanugo and Gutin in dance. Garrett, however, was inconclusive on exactly what variable was the contributor to the improvement, whereas Igbanugo and Gutin reported, ". . . the results show that the medium and high intensity aerobic dance routines can provide adequate cardiovascular stress to influence the efficiency of the system."[72] In a further attempt to find alternative forms of exercise for fitness, Wilmore compared

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[69]Larry Gettman, "The Effect of Circuit Weight Training on Strength, Cardiorespiratory Function, and Body Composition of Adult Men," Medicine and Science in Sports, X (Fall, 1978), 176.

[70]Jack H. Wilmore, "Physiological Alterations Consequent to Circuit Weight Training," Medicine and Science in Sports, X (Summer, 1978), 83.

[71]Leon Garrett, "Four Approaches to Increasing Cardiovascular Fitness During Volleyball Instruction," Research Quarterly, XXXVI (December, 1965), 469.

[72]Igbanugo and Gutin, p. 309.

two popular activities, bicycling and tennis, with jogging and found that bicycling was as effective as jogging in the development of cardiorespiratory fitness when intentisy, frequency, and duration are held constant for both modes and that tennis appeared to have provided modest benefits.[73]

The most complete information regarding alternative programs deals with rope-skipping and is reported by Jones who found that five minutes of rope-skipping daily for four weeks produced significant improvement in physical work capacity in untrained individuals.[74] Baker similarly stated, "A ten minute daily program of rope skipping is as efficient as a 30 minute daily program of jogging for improving cardiovascular efficiency."[75]

Straus and Sturges discussed roller skating as an aerobic exercise and indicated that, to obtain aerobic benefits, an individual must perform at a pulse rate roughly 70% of the quantity 22, minus the individual's age, and that this pulse rate should be maintained during exercise to gain the maximum benefits available.[76] Phillips added that

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[73]Jack H. Wilmore, "Physiological Alterations Consequent to 20-week Conditioning Programs of Bicycling, Tennis, and Jogging," Medicine and Science in Sports and Exercise, XII (1980), 7.

[74]Jones, p. 309.

[75]Baker, p. 236.

[76]Hal Straus and Marilou Sturges, Roller Skating Guide (Mountain View, California: World Publications, Inc., 1979), p. 149.

roller skating can enhance fitness if an individual will skate enough to obtain 30 points per week on the Cooper aerobic point system.[77] Rose stated that roller skating at a speed approaching one mile in six minutes for a period of at least twelve minutes would be comparable to the training effect from jogging. He further indicated in a personal recommendation that roller skating was the best and least risky road to physical condition for either sex, at any age.[78]

In the first comprehensive testing done on roller skaters to date, Dunne found improvements in oxygen consumption, body composition, and leg strength in skaters who participated in a four-times-per-week program of one hour of skating per time. They reported a 17.6% improvement in maximum oxygen consumption ($P < .001$), a 17% improvement in leg strength, and a significant improvement of 6.2% ($P < .05$) for women on body composition measures. He concluded that roller skating can be an effective fitness training program with beneficial adaptations comparable to other aerobic activities.[79]

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[77]Ann-Victoria Phillips, The Complete Book of Roller Skating (New York: Workman Publishing, 1979), p. 70.

[78]Kenneth Rose, "Roller Skating Blends Fitness with Fun," Roller Skating Rink Operators Association Publication, Lincoln, Nebraska, 1981, p. 1.

[79]M. F. Dunne, "Physiological Profile of a Roller-skating Training Program," Medicine and Science in Sports and Exercise, XIII (1981), 103.

These results lend support to a continued search for alternative programs of which roller skating, because of its increasing popularity and limited data, should be one.

Chapter 3

METHOD AND PROCEDURES

This study was conducted to ascertain the effects of endurance and traditional skating upon cardiorespiratory fitness, body composition, selected leg strength and flexibility measures, and attitude of 56 college students who were enrolled in roller skating. In order to investigate these effects the following procedures were included in the study: (1) selection of subjects, (2) collection of data, (3) training regimens, and (4) analysis of data.

SUBJECTS

During the first class meetings of roller skating, HPERS sections 1226 and 1227, students were asked to volunteer to participate in an experimental study. A verbal description of the study, describing its purposes and content, was given to all students meeting the first class period. The students in HPER section 1226 were given an explanation of the continuous roller skating program, as well as the pretest and posttest procedures. The students in HPER section 1227 were provided an explanation of the traditional roller skating program and the pretest and posttest procedures. From the students attending the first class meetings of HPERS sections 1226 and 1227, 21 students volunteered from 1226 to participate as the continuous roller skating group. Twenty volunteers were selected from section 1227 to participate as the traditional skating group, 19 of whom completed the entire program. A control group of 20 students was assembled from volunteers who were not participating in a physical education activity course during the spring semester of 1981. The students came from three effective living courses, sections 1079, 1081, and 1084. Sixteen members of the control group successfully completed both pretesting and posttesting.

Groups were identified as follow:

1. Continuous skating--those participants whose exercise prescription was continuous skating for thirty minutes, three times weekly.

2. Traditional skating--those participants who participated in a roller skating class once a week for one hour and thirty minutes. This time period included technique instruction, practice periods, and periodic breaks.

3. Control group--those participants who had no organized physical education class during the spring semester.

COLLECTION OF DATA

Data were collected during the pre-experimental period and repeated again following experimental conditioning. Data were collected by volunteer graduate and senior physical education majors. Each volunteer worker was assigned a testing station for pretesting and posttesting. The measurement and/or testing protocols were demonstrated by the investigator for each testing section and the volunteer testers were provided time to practice each procedure. One week prior to pretesting, a trial test was administered on four subjects not involved in the study. All testing procedures and results were checked by the investigator. The pretest procedures were repeated three days prior to posttesting with all testing procedures and results examined by the investigator.

All students were apprised of the extensiveness of the study and were requested to sign a waiver form exonerating Middle Tennessee State University and its staff from legal liability (see Appendix A).

Subjects were advised to avoid strenuous exercise and were instructed not to ingest any food or smoke cigarettes for a period of three hours prior to cardiovascular testing.

Pre-conditioning anthropometric assessments, strength and flexibility testing, attitude evaluation, and cardiorespiratory evaluation, were taken January 19 through January 23; posttesting evaluations were taken March 9 through March 13.

Aerobic Capacity

Aerobic capacity was measured by classic techniques as described by Consolazio.[1] Exercise expiratory air volumes were collected during the last minute of exercise once the subject's heart rate had reached a rate of 180 beats per minute. Exercise was terminated after this final minute. Expiratory gas was collected in a meteorological bag and diffused into a wet gasometer for minute-volume determination. Samples of expired gas were collected and temperature recorded during the final minute of exercise, using 60 cubic centimeter syringes. Concentrations of oxygen and carbon dioxide were determined on the Beckman E_2 oxygen and LB2 carbon dioxide analyzers. Prior to each test the oxygen and carbon dioxide analyzers were calibrated using gas mixture containing 5% carbon dioxide and 12.05% oxygen with a nitrogen balance. Laboratory temperature and barometric pressure were recorded during each testing session.

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[1]Frank C. Consolazio, Physiological Measurements of Metabolic Functions in Man (New York: McGraw-Hill Book Co., 1963), pp. 15-19.

Stress Test Protocol and Heart Rate Monitoring

While on the treadmill in the standing position, a pre-exercise heart rate was taken for one minute. Upon a given signal the participant performed up to five phases of the Bruce test on a Quinton Multi-stage, motor-driven treadmill. Stage one consisted of three minutes of walking at a 10% grade at a speed of 1.7 mph. Stage two consisted of three minutes of walking at a 12% grade at a speed of 2.5 mph. Stage three consisted of three minutes of walking at a 14% grade at a speed of 3.4 mph. Stage four consisted of three minutes of walking at a 16% grade at a speed of 4.2 mph.; and stage five consisted of walking at an 18% grade at a speed of 5 mph.[2] Exercise and recovery heart rates were taken the last fifteen seconds of each minute during exercise and for the first minute of recovery. Heart rates were monitored on an oscilloscope and an eclectrocardiograph recorder using lead II. Treadmill calibration was performed according to procedures described by Hellerstein in "Specifications for Exercise Testing Equipment."[3]

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[2] R. A. Bruce, "Exercise Testing of Patients with Coronary Heart Disease, Principles and Normal Standards for Evaluation," Annals of Clinical Research, III (December, 1971), 326.

[3] Herman K. Hellerstein, "Specifications for Exercise Testing Equipment," Circulation, LIX (April, 1979), 850A.

Body Composition and Measurement

Body dimensions were measured with a nylon anthropometric tape for circumferences, Lange skinfold calipers for skinfold measures, and shoulder calipers for diameters. Two independent measures were taken at each landmark, the mean of which was recorded. All measures were taken with the subject in a standing position. Height was taken with the subject standing flat-footed facing straight-forward, using a sliding measure; and weight was taken on a Toledo scale.

Skinfold, circumferences, and diameters were taken and described by Wilmore and Behnke[4] at the following sites: skinfolds--(1) scapula, (2) triceps, (3) thigh; circumferences--(1) neck, (2) abdominal; and diameters--(1) bi-illiac.

Leg Strength Measurement

Four isometric measures of leg strength were taken as suggested by Clarke:[5]

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[4]Jack H. Wilmore and Albert R. Behnke, "An Anthropometric Estimation of Body Density and Lean Body Weight in Young Women," American Journal of Clinical Nutrition, XXIII (March, 1970), 271; Jack H. Wilmore and Albert R. Behnke, "An Anthropometric Estimation of Body Density and Lean Body Weight in Young Men," Journal of Applied Physiology, XXVII (July, 1969), 30.

[5]H. Harrison Clarke, "Improvement of Objective Strength Tests of Muscle Groups by Cable-Tension Methods," Research Quarterly, XXI (December, 1950), 399-419.

1. Knee flexion--the subject was in a prone lying position with head resting in folded arms, the knee was flexed at 165^{o} and the straps were attached at mid-leg between the knee and ankle. The chest was held to the table during the pull.

2. Knee extension--the subject was seated with legs hanging free over the table edge. The arms were extended to the rear with the hands grasping the table. The dominant knee was positioned at 115^{o} of extension and the cable straps were placed around the leg midway between the knee and ankle. Precautions were taken to prevent flexion at the elbows and lifting of the buttocks during each trial.

3. Ankle dorsal flexion--subjects were placed in a supine lying position with the leg extended to 180^{o} and the heel of the foot at the edge of the bench. The ankle was at 125^{o} dorsal flexion with the straps placed at the center of the metatarsals. Precautions were taken to prevent flexion of the knee during each trial.

4. Ankle plantar flexion--in the supine position the subject placed crossed arms on the chest and the heel of the foot at the edge of the table. The leg was at 180^{o} of extension with the ankle at 90^{o} of plantar flexion. The cable strap was placed around the foot at the ball of the foot and attached to the bench near the subject's head. The subject's shoulders were braced and precautions were taken

to prevent raising of the leg. Subjects were given two voluntary maximum efforts using the dominant leg. Results for each trial were recorded on a strain gauge, the mean of which was used for analysis. The strain gauge was calibrated with a 50 lb. weight that was independently validated.

Leg Flexibility Measurement

Knee and ankle flexibility was measured using the Leighton flexometer. The use of the flexometer was described by Leighton as

> . . . the flexometer is strapped to the segment being treated. The dial is locked at one extreme position (i.e., full flexion of the elbow); the movement is made and the pointer locked at the other extreme position (i.e., full extension of the elbow). Then the direct reading of the pointer on the dial is the arc through which the movement has taken place.[6]

Measurement for knee and ankle flexion was taken as follows:

1. Knee flexion-extension--the subject was in the prone lying position with the knee and lower leg extended off the bench. The flexometer was attached to the ankle and the leg was moved as close to the buttock as possible, where the dial was locked. The leg was then moved forward and downward until the leg was forcibly extended and the pointer

[6] Jack R. Leighton, "An Instrument and Technic for the Measurement of Range of Joint Motion," Archives of Physical Medicine and Rehabilitation, XXXVI (August, 1955), 571-578.

was locked. Precautions were taken to prevent movement of the upper leg.

2. Ankle flexion-extension--with the subject in a sitting position the dominant leg was extended so that the foot projected over the end of the bench. The flexometer was attached to the inside of the foot and the foot was brought to full dorsal flexion and the dial was locked. The foot was then extended to full plantar flexion and the pointer was locked. Each subject was permitted one trial with the dominant leg. The reading taken from the flexometer was used for analysis.

Attitude Measurement

The Kenyon six-dimensional attitude scales for men and women were used as a means of measuring attitude.[7] (See Appendixes B and C.) The subjects completed the entire scale, 59 questions for men and 54 questions for women, as the final portion of the pretest and posttest regimens.

The subject's score was taken for each dimension and was not summed to provide an overall score. The questions were answered on a seven-point scale ranging from very strongly disagree (one point) to very strongly agree (seven points). Scores for negatively worded statements were

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[7]Gerald S. Kenyon, "A Conceptual Model for Characterizing Physical Activity," Research Quarterly, XXXIX (March, 1968), 96-105.

subtracted from the total number of categories plus one in order to reflect a degree of positive attitude.

Group means were established for six dimensions for six groups: traditional men and women; continuous men and women; and control men and women. Analysis of the means for each group in each dimension was performed to determine if any change in attitude existed from pretesting to posttesting for any group on any dimension. Comparisons were made only between groups of the same sex; no intersexual attitudinal comparisons were performed.

Leisure-time Activity Assessment

At the completion of the posttesting procedures subjects completed a leisure-time activity questionnaire (see Appendix D) that was developed by Taylor and others to assess the intensity of leisure-time activity. The subjects indicated what activities they had participated in during the six-week study period and at what frequency, numbers of times per week, duration, and length of time per session they engaged in the activity. The individual activities were assigned a numerical value based on duration, frequency, and intensity. The formula for determining these values was duration times frequency times intensity. Intensity values used were those provided by

Taylor and others.[8] A total activity index was determined for each subject by summing the numerical values for each activity. The means of the total activity indexes were used for analysis.

EXPERIMENTAL REGIMENS

The conditioning program consisted of two regimens described as continuous skating and in-class participation, or traditional skating, as well as a control group. Skating was done on a 135-yard indoor rink with a concrete surface. Rental skates with polyurethane wheels were provided for all students by the Hot Wheels Skating Rink.

Continuous Skating

The continuous skating program consisted of 30 minutes of continuous skating three times per week. The participants were instructed to skate at a pace fast enough to elevate the heart rate to between 150-170 beats per minute.

Heart rates for continuous skating were checked at 10 minutes, 20 minutes, and at termination, 30 minutes, using palpation techniques. At the assigned times a signal was given, using the skating rink public address system;

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[8] Henry L. Taylor and others, "A Questionnaire for the Assessment of Leisure Time Physical Activities," Journal of Chronic Diseases, XXXI (1978), 744.

the skaters completed the lap they were skating and stopped for ten seconds for a pulse reading. They then continued skating at the pace necessary to maintain the pulse rate between 150-170 beats per minute. Pulse rates were given to the administrator on the next skating lap and were recorded.

During the six weeks' experimental period, individual paces were adjusted to insure that a heart rate within the designated range was maintained.

Traditional Skating

The traditional skating program consisted of one hour and thirty minutes of skating once per week. During this period students had alternate periods of sitting for instruction, practice time, and free skating time, as well as one ten-minute break at approximately the half-way point of the class.

Control Group

The control group was instructed to make no changes in their normal life style and to participate in activities that they would normally participate in. Each control subject was asked to report to the administrator any changes in physical activity or health that might alter the study.

ANALYSIS OF DATA

The data were analyzed by two-way analysis of variance for repeated measures, adapted for use at Middle

Tennessee State University from Vanderbilt University. *F* ratios were computed for the following dependent variables: height, weight, bi-illiac diameter, abdominal circumference, neck circumference, thigh skinfold, scapula skinfold, triceps skinfold, fat body weight, lean body weight, percent fat, heart rate, maximum oxygen consumption (liters), maximum oxygen consumption (milliliters/kilogram/minute), pulmonary ventilation, treadmill time, knee flexion strength, knee extension strength, ankle dorsal flexion strength, ankle plantar flexion strength, knee flexibility, ankle flexibility, as well as attitudes toward social experience, health and fitness, pursuit of vertigo, aesthetic experience, catharsis, and ascetic experience. A one-way analysis of variance was used to analyze the data for leisure-time activities.

Chapter 4

RESULTS AND DISCUSSION

This study was conducted to ascertain the effects on continuous and traditional roller skating upon cardio-respiratory fitness, body composition, selected leg strength and flexibility measures, and attitude. In addition, an assessment of leisure-time activities was made for the two roller skating groups as well as the control group. In order to test the null hypotheses that roller skating had no significant effect on the previously mentioned parameters, data were collected before and after the completion of six weeks of experimental programs then analyzed using a two-way analysis of variance for repeated measures. A one-way analysis of variance was used to determine if significant differences existed for the groups when leisure-time activities were assessed. All means and standard deviations were reported; however, only when a significant $\underline{F}$ ratio was computed or when the data were germane to the discussion were the data for analysis of variance reported. Raw data are presented in Appendix E.

RESULTS

Body Composition

In addition to height and weight, measurements were determined for circumference at two sights: (1) neck and (2) abdomen; in addition, a single bi-illiac diameter was recorded. Skinfolds were assessed at three sights: (1) thigh, (2) scapula, and (3) triceps, and assays were determined for: (1) lean body weight, (2) fat body weight, and (3) percent fat. The means and standard deviations for these assessments are presented in Table 1.

Diameters and Girths

The results of the analysis of variance determined no significant changes for bi-illiac diameter or abdominal circumference. A significant $\underline{F}$ ratio for pre/post main effects was determined for neck circumference ($F=6.198$, df 1,53, $P<0.05$) indicating a decrease in neck circumference for all groups from pretesting to posttesting (see Table 2).

Skinfolds

The analysis of variance indicated a significant pre/post main effect increase for skinfold measures taken at three sites: (1) thigh ($F=5.820$, df 1,53, $P<0.05$), (2) scapula ($F=14.467$, df 1,53, $P<0.05$), and (3) triceps ($F=7.369$, df 1,53, $P<0.05$). (See Tables 3, 4, and 5).

Table 1

Means and Standard Deviations for Body Composition

Variable		Traditional pre	Traditional post	Continuous pre	Continuous post	Control pre	Control post
Height	$\bar{X}$	66.72	66.87	65.62	65.50	66.83	66.53
	SD	3.30	3.41	3.37	3.37	3.76	3.70
Weight	$\bar{X}$	147.36	149.55	140.69	140.99	139.34	139.11
	SD	30.92	30.23	21.58	19.11	30.48	19.70
Bi-illiac Diameter	$\bar{X}$	28.48	28.76	27.56	26.88	28.65	28.32
	SD	2.87	1.78	2.35	1.80	2.66	1.83
Abdominal Circumference	$\bar{X}$	79.98	76.41	74.88	74.27	73.62	74.47
	SD	10.63	10.79	8.33	7.66	11.53	9.98
Neck Circumference	$\bar{X}$	35.61	35.25	34.86	34.27	34.92	34.64
	SD	4.60	7.72	3.43	2.84	4.19	3.88
Thigh Skinfold	$\bar{X}$	15.82	17.75	19.05	23.79	15.88	17.78
	SD	5.60	7.72	12.23	13.43	4.87	8.78
Scapula Skinfold	$\bar{X}$	13.76	15.47	15.24	16.29	10.66	14.66
	SD	6.11	4.37	5.89	4.84	4.83	4.30
Triceps Skinfold	$\bar{X}$	13.00	14.55	15.88	18.41	11.47	13.88
	SD	5.68	4.49	8.26	8.31	5.76	5.82
Fat Body Weight	$\bar{X}$	32.75	34.62	31.86	33.31	28.54	30.90
	SD	10.87	10.82	8.52	7.88	8.91	8.54
Lean Body Weight	$\bar{X}$	114.29	114.62	108.54	107.58	110.52	107.92
	SD	21.12	20.22	15.36	13.24	22.44	21.71
Percent Fat	$\bar{X}$	21.83	22.76	22.47	23.48	20.19	22.03
	SD	3.36	3.09	3.91	3.47	3.18	2.28

Table 2

Analysis of Variance Results for Neck Circumference

Source	df	Mean Square	F-ratio	Prob.
Training Regimens	2	7.51		
Pre/Post	1	4.59	6.198	0.015
Interaction	2	0.23		
Within Error	53	0.74		

Table 3

Analysis of Variance Results for Thigh Skinfold

Source	df	Mean Square	F-ratio	Prob.
Training Regimens	2	261.69		
Pre/Post	1	225.39	5.820	0.018
Interaction	2	24.51		
Within Error	53	38.73		

Table 4

Analysis of Variance Results for Scapula Skinfold

Source	df	Mean Square	F-ratio	Prob.
Training Regimens	2	90.96		
Pre/Post	1	140.31	14.467	< 0.001
Interaction	2	22.12		
Within Error	53	9.70		

Table 5

Analysis of Variance Results for Triceps Skinfold

Source	df	Mean Square	F-ratio	Prob.
Training Regimens	2	199.96		
Pre/Post	1	129.11	7.369	0.009
Interaction	2	2.59		
Within Error	53	17.52		

Pre/Post Changes

With respect to changes in body composition, significant pre/post main effects were determined for: (1) lean body weight ($F=5.509$, df 1,53, $P<0.05$), (2) fat body weight ($F=35.363$, df 1,53, $P<0.05$), and (3) percent fat ($F=32.816$, df 1,53, $P<0.05$). (See Tables 6, 7, and 8.) Total body weight was not altered (Table 1).

Table 6

Analysis of Variance Results for Lean Body Weight

Source	df	Mean Square	F-ratio	Prob.
Training Regimens	2	90.39		
Pre/Post	1	7.48	5.509	0.021
Interaction	2	4.08		
Within Error	53	1.36		

Table 7

Analysis of Variance Results for Fat Body Weight

Source	df	Mean Square	F-ratio	Prob.
Training Regimens	2	31.99		
Pre/Post	1	20.53	35.363	< 0.001
Interaction	2	0.40		
Within Error	53	0.58		

Table 8

Analysis of Variance Results for Percent Fat

Source	df	Mean Square	F-ratio	Prob.
Training Regimens	2	32.74		
Pre/Post	1	44.10	32.816	< 0.001
Interaction	2	2.31		
Within Error	53	1.34		

Oxygen Consumption

Pretest and posttest responses for the six-week training regimen pertaining to oxygen consumption are shown in Table 9. Significant pre/post main effects changes were noted in four of the five areas. Those were: (1) pulmonary ventilation (F=11.526, df 1,53, P<0.05), (2) maximum oxygen consumption as expressed in liters/minute (F=7.811, df 1.53, P<0.05), (3) maximum oxygen consumption as expressed in milliliters/kilogram/minute (F=6.872, df 1,53, P<0.05), and (4) treadmill time (F=82.732, df 1,53, P<0.05). (See Tables 10, 11, 12, and 13.)

Table 9

Means and Standard Deviations for Oxygen Consumption

Variable		Traditional pre	Traditional post	Continuous pre	Continuous post	Control pre	Control post
Heart Rate	$\bar{X}$	187.42	184.58	185.48	186.43	184.38	183.31
	SD	5.72	3.17	4.55	3.32	2.67	5.25
Max. VO_2 L/Min	$\bar{X}$	2.53	2.72	2.22	2.34	2.20	2.70
	SD	0.98	1.20	0.60	0.70	0.85	0.86
Max. VO_2 ML/KG/Min	$\bar{X}$	37.32	39.62	35.21	36.53	34.21	42.67
	SD	11.84	14.26	9.83	10.00	9.17	10.10
Pulmonary Ventilation	$\bar{X}$	64.33	76.49	62.30	65.57	54.08	69.69
	SD	28.25	37.75	16.13	19.66	19.15	24.49
Treadmill Time	$\bar{X}$	8.93	10.15	7.09	9.31	7.73	9.00
	SD	1.61	1.80	1.67	2.67	1.57	1.84

Table 10

Analysis of Variance Results for Pulmonary Ventilation

Source	df	Mean Square	F-ratio	Prob.
Training Regimens	2	731.13		
Pre/Post	1	2959.26	11.56	0.002
Interaction	2	373.80		
Within Error	53	256.75		

Table 11

Analysis of Variance Results for Maximum Oxygen
Consumption Liters Per Minute

Source	df	Mean Square	F-ratio	Prob.
Training Regimens	2	1.11		
Pre/Post	1	2.05	7.811	0.007
Interaction	2	0.39		
Within Error	53	0.26		

Table 12

Analysis of Variance Results for Maximum Oxygen
Consumption Milliliters/Kilogram/Minute

Source	df	Mean Square	F-ratio	Prob.
Training Regimens	2	82.06		
Pre/Post	1	447.92	6.872	0.011
Interaction	2	138.00		
Within Error	53			

Table 13

Analysis of Variance Results for Treatmill Time

Source	df	Mean Square	F-ratio	Prob.
Training Regimens	2	7.33		
Pre/Post	1	100.29	82.732	< 0.001
Interaction	2	2.77		
Within Error	53			

Termination of the treadmill test one minute after a 180 beats/minute heart rate was attained was such that no statistical differences were obtained for final heart rates. This result confirmed adherence to the experimental protocol.

Strength

Pre- and post-training means and standard deviations for four leg-strength variables are presented in Table 14. The analysis of variance results for repeated measures revealed a significant F ratio for one of the four variables, plantar flexion ($F=6.579$, df 1,53, $P<0.05$), indicating an overall decrease in strength in this area. (See Table 15.)

Table 14

Means and Standard Deviations for Leg Strength

Variable		Traditional pre	Traditional post	Continuous pre	Continuous post	Control pre	Control post
Knee Flexion	$\bar{X}$	125.16	129.57	114.82	122.22	123.01	122.19
	SD	44.24	41.16	36.60	33.83	37.35	34.32
Knee Extension	$\bar{X}$	55.41	55.75	45.21	49.99	54.03	47.98
	SD	16.05	20.24	12.36	16.04	18.41	21.72
Ankle Dorsal Flexion	$\bar{X}$	51.24	52.57	44.74	44.43	50.21	52.91
	SD	22.70	18.37	16.17	11.16	21.45	22.86
Ankle Plantar Flexion	$\bar{X}$	108.73	89.04	93.72	86.13	97.99	97.52
	SD	36.60	35.84	34.06	28.23	29.65	27.61

Table 15

Analysis of Variance Results for Plantar Flexion

Source	df	Mean Square	F-ratio	Prob.
Training Regimens	2	877.92		
Pre/Post	1	2365.10	6.579	0.013
Interaction	2	870.01		
Within Error	53			

Flexibility

Changes resulting from the six-week conditioning program relating to flexibility are presented in Table 16. The ankle flexibility assessment demonstrated a significant increase in degrees of motion when pre/post main effects were analyzed ($F=7.509$, df 1,53, $P<0.05$). (See Table 17.)

Table 16

Means and Standard Deviations for Flexibility

Variable		Traditional pre	Traditional post	Continuous pre	Continuous post	Control pre	Control post
Knee	$\bar{X}$	139.26	139.53	138.10	137.81	136.88	139.13
Flexibility	SD	15.93	15.87	19.00	11.49	10.93	12.47
Ankle	$\bar{X}$	63.74	70.47	71.62	74.00	67.56	70.38
Flexibility	SD	8.67	11.51	15.09	10.14	9.46	5.60

Table 17

Analysis of Variance Results for Ankle Flexibility

Source	df	Mean Square	F-ratio	Prob.
Training Regimens	2	311.91		
Pre/Post	1	437.27	7.509	0.008
Interaction	2	53.09		
Within Error	53			

Men's Attitude

Pretest and posttest means and standard deviations for men's attitude are presented in Table 18. No significant change resulted in five of the six attitudinal areas, the exception being aesthetic experience. For this attitudinal dimension the analysis of variance revealed a significant pre/post main effect decrease in attitude pertaining to physical activity as an aesthetic experience ($F=5.288$, df 1,18, $P<0.05$). (See Table 19.)

Table 18

Means and Standard Deviations for Men's Attitude

Variable		Traditional pre	Traditional post	Continuous pre	Continuous post	Control pre	Control post
Special Experience	$\bar{X}$	39.25	42.13	41.67	42.00	40.57	38.71
	SD	6.02	5.16	7.63	6.95	4.34	3.24
Health and Fitness	$\bar{X}$	41.50	41.13	42.00	41.17	37.29	36.57
	SD						
Pursuit of Vertigo	$\bar{X}$	34.75	37.00	38.50	40.83	35.86	34.00
	SD	6.55	7.31	13.79	14.79	8.89	10.65
Athletic Experience	$\bar{X}$	38.39	36.88	41.67	39.67	41.29	40.00
	SD	7.42	6.82	11.35	9.98	5.39	5.40
Catharsis	$\bar{X}$	37.39	36.88	35.00	34.00	34.57	33.14
	SD	6.20	6.58	8.71	6.38	3.41	4.70
Ascetic Experience	$\bar{X}$	36.75	38.50	39.33	39.17	37.14	33.71
	SD	10.78	10.81	6.47	9.01	8.06	8.70

Table 19

Analysis of Variance Results for Physical Activity as an Aesthetic Experience

Source	df	Mean Square	F-ratio	Prob.
Training Regimens	2	42.25		
Pre/Post	1	26.35	5.288	0.032
Interaction	2	0.46		
Within Error	18	4.98		

Women's Attitude

The analysis of variance for six dimensions of women's attitude, pretest and postest means, and standard deviations (Table 20), revealed significant F ratios for two of the six dimensions. Significant between-group differences existed for attitudes pertaining to health and fitness ($F=3.535$, df 2,32, $P<0.05$) and physical activity as an aesthetic experience ($F=4.330$, df 2,32, $P<0.05$) (Tables 21 and 23). Using between error variance, Duncan's multiple range revealed that a comparison group means determined the control group to have a significantly higher regard for activity for health and fitness than the traditional group (Table 22). The control group also viewed physical activity as more aesthetic than both the continuous and traditional

Table 20

Means and Standard Deviations for Women's Attitude

Variable		Traditional pre	Traditional post	Continuous pre	Continuous post	Control pre	Control post
Social Experience	$\bar{X}$	33.55	32.64	32.27	32.47	33.22	32.66
	SD	3.80	4.03	4.17	4.43	2.57	4.67
Health and Fitness	$\bar{X}$	38.73	38.09	41.13	39.80	44.89	44.89
	SD	3.98	5.05	7.46	7.44	6.41	5.06
Pursuit of Vertigo	$\bar{X}$	34.27	34.18	33.80	33.40	33.67	31.44
	SD	7.12	8.74	10.24	13.13	6.41	5.06
Aesthetic Experience	$\bar{X}$	36.82	34.64	34.33	35.07	41.44	41.11
	SD	4.06	3.36	6.19	9.21	3.77	5.53
Catharsis	$\bar{X}$	30.82	29.91	31.60	31.33	33.78	32.78
	SD	6.29	4.38	6.63	6.17	4.31	3.58
Ascetic Experience	$\bar{X}$	24.27	24.36	25.60	24.67	24.89	25.11
	SD	6.03	6.53	5.51	5.21	3.25	2.81

Table 21

Analysis of Variance Results for Physical Activity for Health and Fitness

Source	df	Mean Square	F-ratio	Prob.
Training Regimens	2	244.81	3.535	0.040
Pre/Post	1	7.22		
Interaction	2	2.48		
Between Error	32	69.25		

Table 22

Duncan's Multiple Range Results for Physical Activity for Health and Fitness Group Mean Differences

Training Regimens	Differences
Control - Traditional	= 6.48*
Control - Continuous	= 4.42
Continuous - Traditional	= 2.06

*p < .05

Table 23

Analysis of Variance Results for Physical Activity as an Aesthetic Experience

Source	df	Mean Square	F-ratio	Prob.
Training Regimens	2	279.62	4.330	0.021
Pre/Post	1	5.91		
Interaction	2	12.15		
Between Error	32	64.57		

skating groups (Table 24). Further comparisons using pretest and postest values indicated the control rated both dimensions higher than the other two groups in pretest and posttest assessments. (See Tables 25 and 26.)

Table 24

Duncan's Multiple Range Results for Physical Activity as an Aesthetic Experience Group Mean Differences

Training Regimens	Differences
Control - Continuous	= 6.58*
Control - Traditional	= 5.55*
Traditional - Continuous	= 1.03

*p < .05

Table 25

Duncan's Multiple Range Results for Physical Activity for Health and Fitness Posttest Mean Differences

Training Regimens	Differences
Control - Traditional	= 6.80*
Control - Continuous	= 5.09
Continuous - Traditional	= 1.71

*p < .05

Table 26

Duncan's Multiple Range Results for Physical Activity as an Aesthetic Experience Posttest Mean Differences

Training Regimens		Differences
Control	- Traditional	= 6.48*
Control	- Continuous	= 6.04
Continuous	- Traditional	= 0.43

*p < .05

Leisure-time Activity

The means and standard deviations for leisure-time activity are presented in Table 27. The one-way analysis of variance revealed no significant F ratios for numerical values assigned for leisure-time activity (see Table 28.)

Table 27

Means and Standard Deviations for Leisure-time Activity Assessments

Variable		Traditional	Continuous	Control
Leisure	$\bar{X}$	71.44	36.70	55.41
Activity	SD	49.60	17.98	36.72

Table 28

Analysis of Variance Results for Leisure-time Activity Assessments

Source	df	Mean Square	F-ratio	Prob.
Among Groups	2	4109.93	0.2906	16.8
Within Groups	53	14144.23		

DISCUSSION

Body Composition

The present study found that for abdominal circumference and bi-illiac diameter no significant changes occurred. These findings corroborated those of Moody who found that no significant changes occurred in girths for non-obese women participating in an exercise program.[1] Neck circumference demonstrated a pre/post main effect decrease. The reduction in neck circumference was compatible with a Wilmore study which indicated reductions in circumferences for joggers.[2]

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[1]Dorothy L. Moody, "The Effects of a Jogging Program on the Body Composition of Normal and Obese High School Girls," Medicine and Science in Sports, IV (Winter, 1972), 212.

[2]Jack H. Wilmore, "Body Composition Changes with a 10-Week Program of Jogging," Medicine and Science in Sports, II (Fall, 1970), 114.

All three skinfold assessments in the present study indicated significant pre/post main effect increases. These findings were contrary to those of Pollock, who indicated significant decreases for experimental walking groups; however, they are compatible with his findings for control groups who likewise demonstrated an increase in skinfold assessments.[3]

In a ten-week program of jogging, Wilmore found that small but significant decreases were elicited for thigh and scapula skinfolds but not for triceps.[4] These findings were not corroborated by the present study.

The analysis of variance indicated that body composition responses, similar to skinfold assessments, precipitated significant changes from pretesting and post-testing when means were compared. Fat body weight and percent fat increased while lean body weight decreased; this was incompatible with the findings of Wilmore.[5] Milesis

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[3]Michael L. Pollock, "Effects of Walking on Body Composition and Cardiovascular Function of Middle-Aged Men," Journal of Applied Physiology, XXX (January, 1971), 126-129.

[4]Wilmore, p. 115.

[5]Jack H. Wilmore, "Physiological Alterations Consequent to Circuit Weight Training," Medicine and Science in Sports (1978), 81.

reported percent fat reductions that were significantly greater for experimental groups than for control groups.[6]

The results that fat body weight and percent fat increased with a decrease in lean body weight and no subsequent change in total body weight indicated that body composition for the mean of all subjects failed to improve, and in fact worsened. These changes may be partially explained by Pollock who stated that changes tend to manifest themselves with weeks of training, i.e., programs of an eight- to ten-week duration generally result in less change than do extensive programs[7]; or by Moody who stated, "It is evident, however, that dietary modifications must also be a part of any comprehensive weight loss program. . . ."[8] No dietary controls were implemented in this program.

Oxygen Consumption

Scheuer and Tipton indicated that as few as three weeks of a strenuous program produced detectable effects on maximum oxygen consumption and a gradual and progressive increase in cardiovascular fitness occurred over a

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[6]Chris A. Milesis, "Effects of Different Durations of Physical Training on Cardiorespiratory Function, Body Composition, and Serum Lipids," Research Quarterly, XLVII (December, 1976), 721.

[7]Pollock, p. 129.

[8]Moody, p. 213.

five-week period.[9] The results for four measures of cardiorespiratory fitness in the present study corroborated these findings when pre/post main effects were analyzed.

These findings were not consistent with Sharkey who determined that subjects who trained at heart rates of 150-180 beats per minute (the range of the continuous skating group) had significant changes in milliliters/kilogram/minute, whereas the control group had no significant changes.[10] These findings were further supported by Hickson who found that maximum oxygen consumption (liters/minute) increased in three weeks when subjects worked at between 90-100% maximum oxygen consumption.[11] This was a rate slightly higher than that elicited by the subjects in the present study.

Girandola and Katch suggested that changes in aerobic capacity must be viewed as resulting from concommitant changes in body composition and not as basic

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[9] James Schueur and Charles M. Tipton, "Cardiorespiratory Adaptations to Physical Training," Annual Review of Physiology, XXXIX (1977), 224.

[10] Brian J. Sharkey and John P. Holleman, "Cardiovascular Adaptations to Training at Specific Intensities," Research Quarterly, XXXVIII (December, 1967), 700.

[11] R. C. Hickson, "Time Course of the Adaptive Response of Aerobic Power and Heart Rate to Training," Medicine and Science in Sports and Exercise, XIII (1981), 18.

alterations in the cardiorespiratory system.[12] This, in light of the gains made by the control group, was considered but refuted, as there were no significant changes in total body weight for any group; and, in fact, body composition was found to have been altered negatively with increases in total fat and percent fat.

It must be assumed, then, that the significant pre/post main effect increase must be attributed to factors other than the training regimens. The possibility that the control group failed to act as a control was evident. The analysis of leisure-time activity assessment indicated an equal amount of activity for all three groups (see Table 28) and may partially explain the control group increase. No restrictions regarding activity were placed on any group, and the results of the activity assessment indicated that all three groups participated in an equal amount of activity either within their training program or outside it, or both.

Although the significant increase in maximum oxygen consumption by the control group may not be fully explained, the lack of greater increase for the roller skating groups may in fact be partially determined. Allen found that, when weight lifters were exercised at tasks sufficient to

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[12] Robert N. Girandola and Victor Katch, "Effects of Nine Weeks of Physical Training on Aerobic Capacity and Body Composition in College Men," Archives of Physical Medicine and Rehabilitation, LIV (October, 1973), 523.

elevate their heart rates to 186 beats/minute, a level at which cardiorespiratory improvements were expected, they, in fact, did not obtain the expected improvements.[13] Holloszy explained this phenomenon by indicating that, during submaximal work, blood flow is lower in trained than in untrained subjects and that the decrease is compensated for by increased oxygen extraction.[14] Barnard found that low resistance exercise produced increases in the yield of mitochondria and oxidative capacity of adult guinea pigs.[15] This was in conjunction with a further statement by Holloszy that it would, therefore, appear that an increase in maximum oxygen consumption brought about by an increase in maximum cardiac output was the result of delivery of oxygen to a larger mass of working muscle rather than to delivery of more oxygen to the individual muscle cells.[16]

Thus, in this investigator's subjective opinion it may be determined that roller skating did not place a

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[13]Earl T. Allen, "Hemodynamic Consequences of Circuit Weight Training," Research Quarterly, XLVII (October, 1976), 305.

[14]J. O. Holloszy, "Biochemical Adaptations to Endurance Exercise in Skeletal Muscle," in Muscle Metabolism During Exercise, ed. Bengt Pernow (New York: Plenum Press, 1971), p. 53.

[15]James R. Barnard, "Effect of Exercise on Skeletal Muscle I. Biochemical and Histochemical Properties," Journal of Applied Physiology, XXVII (June, 1970), 766.

[16]John O. Holloszy and Frank W. Booth, "Biochemical Adaptations to Endurance Exercise in Muscle," Annual Review of Physiology, XXXVIII (1976), 281.

sufficient stress on the working muscles and, thus, inhibited sufficient mitochondrial development as to elicit significant changes in maximum oxygen consumption, even though heart rates from 150-180 beats/minute were elicited for skaters in the continuous skating group.

Strength

The absence of significant changes in strength was in accord with current state of the art of understanding of strength development. Hettinger indicated that an increase in muscle tension above that previously demanded of a muscle was the stimuli for an increase in muscle strength.[17] Guyton also indicated this when he stated, ". . . hypertrophy results mainly from very forceful muscle activity, though the activity might occur for only a few minutes each day."[18]

The slight but non-significant absolute gains in strength of the skating groups were in accord with findings by Gettman and Pollock who demonstrated increases, albeit non-significant, for runners after a 15-week program.[19]

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[17] Theodor Hettinger, Physiology of Strength (Springfield, Ill.: Charles C. Thomas Co., 1961), p. 20.

[18] Arthur C. Guyton, Textbook of Medical Physiology (Philadelphia: W. B. Saunders Co., 1976), p. 145.

[19] Larry R. Gettman, "The Effect of Circuit Weight Training on Strength, Cardiorespiratory Function, and Body Composition of Adult Men," Medicine and Science in Sports, X (Fall, 1978), 174.

Although the changes for knee extension and knee flexion were not significant, when absolute values were considered the continuous group had an 11% increase in mean differences from pretests to posttests on knee extension and a 7% increase pretest to posttest on knee flexion. This compared with the control group's 11% and 1% decrease for each assessment, respectively, which indicated a possible trend toward skating as being responsible for strength changes in the prime movers of the legs. These findings corroborated those of Dunne who found a 17% improvement in leg strength as measured by an isokinetic double leg press.[20]

The resulting decrease in strength values for plantar flexion when pre/post main effects were examined were not in accord with knee extension and knee flexion results in this study. They did agree partially with a study by Wilmore who found decrements in strength for control groups in three of eight strength values for a ten-week period of time.[21] One possible explanation for the decrease in plantar flexion strength was the absence of the toe-off movement in skating. The toe-off movement is

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[20]M. F. Dunne, "Physiological Profile of a Rollerskating Training Program," Medicine and Science in Sports and Exercise, XIII (May, 1981), 103.

[21]Wilmore, "Physiological Alterations Consequent to Circuit Weight Training," p. 82.

present in running and walking; and the gastrocnemius is the prime muscle used in the toe-off action. This decrement is still unexplained; however, since walking was not inhibited or limited by this study, it should, in fact, have resulted in no significant change in this measurement.

Flexibility

Hupprich and Sigerseth indicated that each major joint has a high degree of specific condition of its own.[22] This was borne out in the present study as the two joints measured demonstrated contrasting results for pretest and posttest assessments. No significant changes were demonstrated for knee flexibility, giving limited support to the premise by Massey and Chaudet that exercise does not result in an overall reduction in range of movement of the joints throughout the body.[23]

The resulting increases demonstrated for ankle flexibility, as determined by pre/post main effects, supported the findings of Kingsley who found that flexibility in certain regions of the body was increased by

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[22] Florence L. Hupprich and Peter O. Sigerseth, "The Specificity of Flexibility in Girls," Research Quarterly, XXI (1950), 28.

[23] Benjamin H. Massey and Norman L. Chaudet, "Effects of Systematic, Heavy Resistive Exercise on Range of Joint Movement in Young Male Adults," Research Quarterly, XXVII (March, 1956), 50.

twenty weeks of tumbling.[24] Because of the main effect results of the findings, it may not be unequivocally stated that skating increased ankle flexibility. It can be presented, however, that skating did not result in a decrease of joint flexibility at either the knee or the ankle.

Attitude

The purpose of the attitude evaluation for the present study was to determine if after a six-week program of roller skating the subject's attitude toward physical activity had changed. No attempt was made to determine if any physchological changes occurred such as life satisfaction, personal well-being, or reduced anxiety.

The results indicated that no changes occurred in five of the six areas surveyed for men and that for women only two areas demonstrated significant changes.

The analysis of variance indicated that a pre/post main effect decrease was demonstrated for men pertaining to their attitude toward physical activity as an aesthetic experience. This area was defined by Kenyon as activities conceived of as possessing beauty or certain artistic

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[24] Donald B. Kingsley, "Flexibility Changes Resulting from Participation in Tumbling," unpublished Master's thesis, University of Oregon, June, 1952, p. 60.

qualities.[25] A decrease in this area would indicate that the men, overall, demonstrated a lessening of an appreciation for activity as beautiful or pleasing to the eye. This may, in part, be accounted for by the repetitive nature of skating and the concern with developing fitness. The lack of interaction indicated that the appreciation decreased with all groups and can not be attributed completely to skating as the direct cause.

For women the analysis of variance revealed that significant between-group differences existed for physical activity for health and fitness and physical activity as an aesthetic experience. When Duncan's multiple range was performed, it was found that the control group differed significantly from the traditional group in health and fitness and that the control group differed significantly from both the continuous and traditional skating groups in regard to aesthetic experience. A further investigation of pretest and posttest mean values indicated that these differences existed for both pretest and posttest mean and, thus, no change occurred as a result of the experimental program.

The final analysis indicated that only one change occurred in attitude--men's aesthetics. This change was an

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[25] Gerald S. Kenyon, "A Conceptual Model for Characterizing Physical Activity," Research Quarterly, XXXIX (March, 1968), 100.

overall pre/post main effect change and, thus, can not be attributed entirely to the testing program.

Leisure-time Activity Assessment

The purpose of leisure-time activity studies has been to classify people, by levels of physical activity, into sedentary, moderately active, and active groupings.[26] The general purpose for this has been, as explained by Alderson, to determine whether exercise apart from work, and particularly in leisure, has any protective value against coronary heart disease.[27] For this study, however, a leisure-time assessment was conducted to determine if any differences existed between the three groups pertaining to their total physical activities during the six-week testing period. The analysis of variance revealed that no difference existed between the groups and that, in fact, all three groups were receiving an equal amount of physical activity during the six-week period.

This equating of physical activities was believed by this investigator to have created a balance between all of

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[26]E. R. Buskirk, "Comparison of Two Assessments of Physical Activity and a Survey Method for Calorie Intake," The American Journal of Clinical Nutrition, XXIV (September, 1971), 1119.

[27]S. Yasin, "Assessment of Habitual Physical Activity Apart from Occupation," British Journal of Preventive Social Medicine, XXI (1967), 163.

the groups and may be mainly responsible for the subsequent results. All groups were instructed to continue their normal life styles. It was anticipated that since the control group was not engaged in a physical education activity class their activity would be less than the traditional and continuous skating groups. The results indicated this was not true and was, thus, believed to be the reason for the results to be of a pre/post main effect nature without significant group interactions.

Chapter 5

SUMMARY, CONCLUSIONS, RECOMMENDATIONS, AND IMPLICATIONS FOR TEACHING

SUMMARY

Fifty-six Middle Tennessee State University students served as subjects for a study to determine the effects of two methods of teaching roller skating on selected anthropometric and physiological parameters. The study investigated the effects of continuous roller skating three times per week for 30 minutes at a time without interruptions and traditional skating once per week for 1 hour and 30 minutes with periodic breaks on cardio-respiratory fitness, body composition, leg strength and flexibility, and attitude toward physical education when compared with a control group. A leisure-time activity assessment was also used to determine if out-of-class leisure activities created differences between the test groups.

An analysis of variance was used to determine if significant changes occurred within the groups from pre-testing to posttesting after a six-week experimental program. It was concluded from the results that roller skating did not contribute to significant changes in physiological or anthropometric parameters. It was further concluded that no changes toward physical activity occurred based on pretest and posttest assessments, and the degree of physical activity was equal for all three test groups.

CONCLUSIONS

Within the limitations of this study and the sample used, the following conclusions appear warranted. Because the results were of a pre/post main effect nature which included the control group and can not be attributed to specific training regimens, the following conclusions were made for the stated hypotheses.

H_1: The hypothesis that traditional roller skating will not result in significant changes in cardiorespiratory fitness was accepted.

H_2: The hypothesis that continuous roller skating will not result in significant changes in cardiorespiratory fitness was accepted.

H_3: The hypothesis that traditional roller skating will not result in significant changes in body composition was accepted.

H_4: The hypothesis that continuous roller skating will not result in significant changes in body composition was accepted.

H_5: The hypothesis that traditional roller skating will not result in significant changes in selected leg strength measures was accepted.

H_6: The hypothesis that continuous roller skating will not result in significant changes in selected leg strength measures was accepted.

H_7: The hypothesis that traditional roller skating will not result in significant changes in joint flexibility was accepted.

H_8: The hypothesis that continuous roller skating will not result in significant changes in joint flexibility was accepted.

H_9: The hypothesis that traditional roller skating will not result in significant changes in attitude was accepted.

H_{10}: The hypothesis that continuous roller skating will not result in significant changes in attitude was accepted.

H_{11}: The hypothesis that out-of-class recreational activities will not differ significantly among the three groups was accepted.

RECOMMENDATIONS

The following recommendations were made as a result of this study:

1. Further investigations should be conducted on

continuous roller skating using subjects who are all of the same sex and skating ability.

2. Different procedures should be implemented to increase the workload for skaters. Alternatives to be considered should be skating surface (wood instead of concrete), wheel composition to increase friction, increased duration of skating time, and an increased number of sessions per week.

IMPLICATIONS FOR TEACHING

Two major implications for teaching were obtained based on the results of this study. First, roller skating, as proposed in this study, was found not to produce significantly improved cardiorespiratory fitness. It is, then, implied that in order for physical educators to use roller skating as part of a fitness program it must be supplemented with additional aerobic activities.

Second, the equating of student activity levels based on outside class activities implies that physical educators should assess and consider the student's total activity rate before developing an individual exercise prescription.

APPENDIXES

APPENDIX A

SUBJECT'S CONSENT FORM

DEPARTMENT OF HEALTH, PHYSICAL EDUCATION,
RECREATION AND SAFETY
MIDDLE TENNESSEE STATE UNIVERSITY
EXPERIMENTAL STUDY CONSENT FORM

PROJECT TITLE: "Effects of Two Selected Roller Skating Programs Upon Anthropometric, Physiological, and Attitudinal Parameters in College-aged Students"

STUDY COLLABORATORS: Dr. Powell McClellan, Professor
HPER, MTSU
Ernest A. White, D.A. Candidate

CLASS INSTRUCTOR: Ernest A. White

This is to certify that I, ______________________________, hereby agree to participate in an experimental study under the direction of the above. I am ________ years of age.

The study will include:

1. Assessments of anthropometric dimensions
2. Leg strength evaluations
3. Cardiorespiratory evaluation

A detailed explanation of this study has been given to me and I understand the procedures to be followed. I have been informed of all inconveniences and risks reasonably to be expected from the procedures, and possible beneficial effects thereof. All of my inquiries have been answered, and I choose freely and voluntarily to participate.

______________________________ ______________
Volunteer's signature Date

I have defined and fully explained the extensiveness of this study to the above volunteer.

______________________________ ______________
Investigator's signature Date

APPENDIX B

WOMEN'S ATTITUDE ASSESSMENT QUESTIONNAIRE

WOMEN

1. I would prefer quiet activities like swimming or golf, rather than such activities as water skiing or sailboat racing.

2. I would gladly put up with the necessary hard training for the chance to try out for the U.S. Women's Olympic Team.

3. The most important value of physical activity is the beauty found in skilled movement.

4. Physical education programs should stress vigorous exercise since it contributes most to physical fitness.

5. The years of strenuous daily training necessary to prepare for today's international competition is asking a lot of today's young women.

6. The need for much higher levels of physical fitness has been established beyond all doubt.

7. Among the best physical activities are those which represent a personal challenge, such as skiing, mountain climbing, or heavy-weather sailing.

8. Among the most desirable forms of physical activity are those which present the beauty of human movement such as modern dance and water ballet.

9. I would get by far the most satisfaction from games requiring long and careful preparation and involving stiff competition against a strong opposition.

10. Of all physical activities, those whose purpose is primarily to develop physical fitness would not be my first choice.

11. The best way to become more socially desirable is to participate in group physical activities.

12. Almost the only satisfactory way to relieve severe emotional strain is through some form of physical activity.

13. Frequent participation in dangerous sports and physical activities is all right for other people but ordinarily they are not for me.

14. Physical education programs should place much more emphasis upon the beauty found in human motion.

15. If given a choice, I sometimes would choose strenuous rather than light physical activity.

16. There are better ways of relieving the pressures of today's living than having to engage in or watch physical activity.

17. I like to engage in socially oriented physical activities.

18. A part of our daily lives must be committed to vigorous exercise.

19. I am not particularly interested in those physical activities whose sole purpose is to depict human motion as something beautiful.

20. Colleges should sponsor many more physical activities of a social nature.

21. For a healthy mind in a healthy body the only place to begin is through participation in sports and physical activities every day.

22. The least desirable physical activities are those providing a sense of danger and risk of injury such as skiing on steep slopes, mountain climbing, or parachute jumping.

23. Being physically fit is not the most important goal in my life.

24. A sport is sometimes spoiled if allowed to become too highly organized and keenly competitive.

25. I enjoy sports mostly because they give me a chance to meet new people.

26. Practically the only way to relieve frustrations and pent-up emotions is through some form of physical activity.

27. The time spent doing daily calisthenics could probably be used more profitably in other ways.

28. Given a choice, I would prefer motor boat racing or running rapids in a canoe rather than one of the quieter forms of boating.

29. Of all the kinds of physical activities, I don't particularly care for those requiring a lot of socializing.

30. One of the things I like most in sports is the great variety of ways human movement can be shown to be beautiful.

31. Most intellectual activities are often just as refreshing as physical activities.

32. Strength and physical stamina are the most important prerequisites to a full life.

33. Physical activities that are purely for social purposes, like college dances, are sometimes a waste of time.

34. The self-denial and sacrifice needed for success in today's international competition may soon become too much to ask of a thirteen- or fourteen-year-old girl.

35. I am given unlimited pleasure when I see the form and beauty of human motion.

36. I believe calisthenics are among the less desirable forms of physical activity.

37. Watching athletes becoming completely absorbed in their sport nearly always provides me with a welcome escape from the many demands of present-day life.

38. If I had to choose between "still-water" canoeing and "rapids" canoeing, "still-water" canoeing would usually be my choice.

39. There are better ways of getting to know people than through games and sports.

40. People should spend twenty to thirty minutes a day doing vigorous calisthenics.

41. There is sometimes an overemphasis upon those physical activities that attempt to portray human movement as an art form.

42. Physical activities having an element of daring or requiring one to take chances are desirable.

43. Since competition is a fundamental characteristic of American society, highly competitive athletics and games should be encouraged for all.

44. A happy life does not require regular participation in physical activity.

45. The best form of physical activity is when the body is used as an instrument of expression.

46. Sports are fun to watch and to engage in, only if they are not taken too seriously nor demand too much time and energy.

47. Calisthenics taken regularly are among the best forms of exercise.

48. I could spend many hours watching the graceful and well-coordinated movements of the figure skater or modern dancer.

49. The best thing about games and sports is that they give people more confidence in social situations.

50. Among the best forms of physical activity are those providing thrills such as sailing in heavy weather or canoeing on river rapids.

51. Regular physical activity is the major prerequisite to a satisfying life.

52. In this country there is sometimes too much emphasis on striving to be successful in sports.

53. I would enjoy engaging in those games and sports that require a defiance of danger.

54. Most people could live happy lives without depending upon frequent watching or participating in physical games and exercise.

APPENDIX C

MEN'S ATTITUDE ASSESSMENT QUESTIONNAIRE

1. I would gladly put in the necessary years of daily hard training for the chance to try out for the U.S. Olympic Team.

2. I would prefer quiet activities like swimming or tossing a ball around rather than such activities as automobile or speedboat racing.

3. Among desirable forms of physical activity are those that show the beauty and form of human movement, such as modern dance and water ballet.

4. I prefer those sports which require very hard training and involve intense competition such as interscholastic and intercollegiate athletics.

5. A happy life does not require regular participation in physical activity.

6. The risk of injury would be well worth it when you consider the thrills that come from engaging in such activities as mountain climbing and bobsledding.

7. It is important that everyone belong to at least one group that plays games together.

8. Of all physical activities, those whose purpose is primarily to develop physical fitness would not be my first choice.

9. Among the best physical activities are those which represent a personal challenge, such as skiing, mountain climbing, or heavy-weather sailing.

10. I would get by far the most satisfaction from games requiring long and careful preparation and involving stiff competition against a strong opposition.

11. The degree of beauty and grace of movement found in sports is sometimes less than claimed.

12. Almost the only satisfactory way to relieve severe emotional strain is through some form of physical activity.

13. I would usually choose strenuous physical activity over light physical activity, if given the choice.

14. Physical education programs should place a little more emphasis upon the beauty found in human motion.

15. There are better ways of relieving the pressure of today's living than having to engage in or watch physical activity.

16. Frequent participation in dangerous sports and physical activities is all right for other people but ordinarily they are not for me.

17. I like to engage in socially oriented physical activities.

18. A large part of our daily lives must be committed to vigorous exercise.

19. I am not in the least interested in those physical activities whose sole purpose is to depict human motion as something beautiful.

20. Colleges should sponsor many more physical activities of a social nature.

21. Being strong and highly fit is not the most important thing in my life.

22. The least desirable physical activities are those providing a sense of danger and risk of injury such as skiing on steep slopes, mountain climbing, or parachute jumping.

23. For a healthy mind in a healthy body the only place to begin is through participation in sports and physical activities every day.

24. A sport is sometimes spoiled if allowed to become too highly organized and keenly competitive.

25. The time spent doing daily calisthenics could probably be used more profitably in other ways.

26. I enjoy sports mostly because they give me a chance to meet new people.

27. Practically the only way to relieve frustrations and pent-up emotions is through some form of physical activity.

28. Given a choice, I would prefer motor boat racing or running rapids in a canoe rather than one of the quieter forms of boating.

29. Strength and physical stamina are the most important prerequisites to a full life.

30. Of all the kinds of physical activities, I dislike the most those requiring a lot of socializing.

31. The most enjoyable forms of physical activity are games and sports engaged in on the spur of the moment, rather than those requiring long periods of training.

32. One of the things I like most in sports is the great variety of ways human movement can be shown to be beautiful.

33. Most intellectual activities are often just as refreshing as physical activities.

34. Physical activities that are purely for social purposes, like college dances, are sometimes a waste of time.

35. I am given great pleasure when I see the form and beauty of human motion.

36. I believe calisthenics are among the less desirable forms of physical activity.

37. The self-denial and sacrifice needed for success in today's international competition may soon become too much to ask of a thirteen- or fourteen-year-old.

38. People should spend twenty to thirty minutes a day doing vigorous calisthenics.

39. Too much attention is paid to those physical activities that try to protray human movement as an art form.

40. Sports are fun to watch and to engage in, only if they are not taken too seriously, nor demand too much time and energy.

41. Of all physical activities, my first choice would be those whose purpose is primarily to develop and maintain physical fitness.

42. If I had to choose between "still-water" canoeing and "rapids" canoeing, "still-water" canoeing would be the better alternative.

43. Watching athletes becoming completely absorbed in their sport nearly always provides me with a welcome escape from the many demands of present-day life.

44. Participating in games and sports can sometimes spoil good friendships.

45. The idea that every human movement is beautiful is absurd.

46. Physical activities having a strong element of daring or requiring one to take chances are highly desirable.

47. I could easily spend an hour watching the graceful and well-coordinated movements of a figure skater or modern dancer.

48. There are better ways of getting to know people than through games and sports.

49. The fun is sometimes taken out of sports and games when they become too highly organized, overly competitive, and too demanding of the participant.

50. Among the best forms of physical activity are those which use the body as an instrument of expression.

51. Since competition is fundamental to American society, sports and athletics need to be much more demanding and competitive than at present.

52. The best thing about games and sports is that they give people more confidence in social situations.

53. One of the best forms of physical activity is that which provides a thrilling sense of danger such as sailing in heavy weather or canoeing on river rapids.

54. Regular physical activity is the major prerequisite to satisfying life.

55. Vigorous daily exercises are absolutely necessary to maintain one's general health.

56. One of the most desirable forms of physical activity is social dancing.

57. In this country there is sometimes too much emphasis on striving to be successful in sports.

58. I would enjoy engaging in those games and sports requiring, to a large extent, the defiance of danger.

59. Most people could live happy lives without depending upon frequent watching or participating in physical games and exercise.

APPENDIX D

LEISURE-TIME PHYSICAL ACTIVITIES ASSESSMENT FORM

LEISURE-TIME PHYSICAL ACTIVITIES

Listed below are a series of leisure-time activities. Please read and check YES in Column 1 for those activities which you currently engage in during the experimental period, the number of times (on average) you perform these per week, and the duration (on average) of actual playing time. Do not include time for dressing, showers, etc., only actual time of activity performance.

Name________________________________

Date________________________________

	YES	AVERAGE NO. TIMES PER WEEK	TIMES PER OCCASION HRS.	MINS.
Walking for pleasure				
Walking to and from work				
Walking during break				
Using stairs when elevator is available				
Cross-country hiking				
Back packing				
Mountain climbing				
Bicycling to work and/or for pleasure				
Dancing--Ballroom an/or square				
Home exercise				
Health club				
Jogging and walking				
Running				
Weight lifting				

	YES	AVERAGE NO. TIMES PER WEEK	TIMES PER OCCASION HRS.	MINS.
Water skiing				
Sailing				
Canoeing or rowing for pleasure				
Canoeing or rowing in competition				
Canoeing on a camping trip				
Swimming (at least 50 ft.) at a pool				
Swimming at the beach				
Scuba diving				
Snorkeling				
Snow skiing, cross-country				
Snow skiing, downhill				
Ice (or roller) skating				
Sledging or tobogganing				
Bowling				
Volley ball				
Table tennis				
Tennis singles				
Tennis doubles				
Softball				
Badminton				
Paddle ball				
Racket ball				

	YES	AVERAGE NO. TIMES PER WEEK	TIMES PER OCCASION HRS.	MINS.
Fishing from river bank				
Fishing in streamer with wading boots				
Hunting pheasants or grouse				
Hunting rabbits, prairie chickens, squirrels, raccoon				
Hunting large game; deer, elk, bear				
Other				

	YES	AVERAGE NO. TIMES PER WEEK	TIMES PER OCCASION HRS.	MINS.
Basketball; non-game				
Basketball; officiating				
Touch football				
Handball				
Squash				
Soccer				
Golf; riding a power cart				
Golf; walking and pulling clubs on cart				
Golf; walking and carrying clubs				
Mowing lawn with riding mower				
Mowing lawn pushing hand mower				
Weeding and cultivating garden				
Spading, digging, filling in garden				
Raking lawn				
Snow shoveling by hand				
Carpentry in workshop				
Painting inside of house includes paper hanging				
Carpentry outside				
Painting outside of house				

APPENDIX E

RAW DATA

RAW DATA INFORMATION

RAW DATA EXPLANATION

The data are listed sequentially as they appear in raw form.

Body Composition: Height, weight, neck circumference, abdominal circumference, bi-illiac diameter, scapula skinfold, triceps skinfold, thigh skinfold, lean weight kilograms, lean weight pounds, fat weight kilograms, fat weight pounds, percent fat.

Oxygen Consumption: Age in months, height, weight, liters per minute, milliliters/kilogram/minute, pulmonary ventilation, treadmill time, terminal heart rate.

Strength: Knee extension, dorsal flexion, knee flexion, plantar flexion.

Men's and Women's Attitude: Social experience, health and fitness, pursuit of vertigo, aesthetic experience, catharsis, ascet experience.

Flexibility: Pretest ankle, posttest ankle, pretest knee, posttest knee.

Leisure-time Activity: Total activity index

Traditional Group--Body Composition

WA HUFF		67.00	146.00	39.00	80.00	30.00	9.50	9.50	7.00
53.97	118.72	12.26	26.97	18.51					
WA HUFF		67.25	151.50	38.50	82.50	30.60	11.50	12.50	11.00
54.36	119.59	14.36	31.59	20.90					
KE WRAY		69.00	209.50	43.60	95.85	32.35	11.50	17.00	9.00
72.17	158.78	22.86	50.29	24.05					
KE WRAY		69.50	207.00	42.30	95.00	30.60	13.50	19.00	10.50
70.33	154.72	23.57	51.85	25.10					
JI SCOTT		71.00	161.00	39.75	78.50	29.70	8.00	11.00	13.00
59.03	129.86	14.00	30.80	19.17					
JI SCOTT		71.50	164.00	38.00	80.00	29.70	7.00	11.50	10.50
58.76	129.27	15.63	34.39	21.01					
MA GIBSON		64.00	162.00	35.40	82.75	29.90	19.50	22.50	22.50
53.53	117.77	19.95	43.89	27.15					
MA GIBSON		63.25	161.50	34.35	80.50	30.00	18.50	23.50	20.50
53.04	116.69	20.21	44.47	27.59					
CH HOGAN		63.00	101.00	30.75	61.75	26.50	8.00	6.50	15.50
38.92	85.63	6.89	15.15	15.04					
CH HOGAN		63.00	108.00	32.10	62.00	27.10	12.50	10.50	14.00
40.75	89.65	8.24	18.13	16.82					
KA SIMPSON		61.50	106.50	28.50	61.00	27.35	10.50	6.00	12.50
39.32	86.50	8.99	19.78	18.61					
KA SIMPSON		61.75	109.00	29.70	62.00	27.20	14.00	8.50	14.00
39.91	87.80	9.53	20.97	19.28					
KA HICKS		68.25	191.50	35.25	89.50	35.50	15.00	11.50	18.50
65.55	139.82	23.31	51.28	26.84					
KA HICKS		68.50	193.00	34.60	90.35	30.15	17.50	19.50	20.00
62.05	136.52	25.49	56.08	29.12					

Traditional Group--Body Composition
(Continued)

PA WATSON	65.00	134.00	34.00	69.75	27.60	7.50	15.00	14.00	48.30	106.26	12.48	27.46	20.54
PA WATSON	65.00	135.00	33.70	71.50	28.30	14.50	21.00	17.00	46.65	102.64	14.58	32.08	23.82
JE UNDERWOOD	65.50	125.25	31.00	71.50	29.35	15.50	10.50	15.50	43.77	96.30	13.04	28.68	22.95
JE UNDERWOOD	66.25	127.50	31.50	66.75	28.20	18.00	14.00	18.00	44.64	98.21	13.19	29.02	22.81
ME IDE	66.50	137.00	31.50	72.25	29.05	13.00	10.00	13.50	47.80	105.15	14.35	31.56	23.09
ME IDE	67.25	139.00	31.20	70.50	28.20	18.50	14.00	15.00	47.39	104.25	15.66	34.46	24.84
KA MEDLEY	68.00	144.00	34.55	72.75	29.00	8.00	13.00	14.00	51.49	113.27	13.83	30.43	21.18
KA MEDLEY	67.50	143.75	34.50	71.50	24.90	28.00	14.00	43.50	49.72	109.38	15.49	34.07	23.75
KE VANHOO	69.00	163.75	39.75	81.75	30.45	4.50	9.50	8.00	59.93	131.85	14.34	31.56	19.31
KE VANHOO	69.00	164.00	39.75	80.25	26.60	8.00	12.50	14.00	59.45	130.80	14.94	32.86	20.08
JO BECKHAM	71.50	195.00	42.00	95.25	28.05	28.00	31.50	21.00	63.30	139.25	25.15	55.34	28.44
JO BECKHAM	71.25	197.00	39.60	93.20	31.45	14.50	25.00	10.50	65.02	143.05	24.34	53.54	27.24
KE MOUNCE	70.50	130.25	34.50	69.50	28.35	11.00	9.00	12.50	48.13	105.88	10.95	24.09	18.54
KE MOUNCE	70.50	132.00	34.25	68.75	28.05	12.00	11.00	14.50	48.23	106.10	11.65	25.63	19.45

Traditional Group--Body Composition
(Continued)

BA BROWN		66.00	131.00	32.00	71.50	27.70	16.00	17.00	22.50
45.00	99.01	14.42	31.72	24.26					
BA BROWN		66.25	134.50	34.00	71.00	29.30	18.00	17.50	25.00
47.00	103.39	14.01	30.83	22.97					
SU FOX		61.50	106.75	30.75	67.00	21.90	11.00	11.00	29.50
38.96	85.72	9.46	20.81	19.53					
SU FOX		61.50	107.50	30.75	64.25	29.00	11.50	14.50	27.00
38.98	85.76	9.78	21.51	20.05					
KA FANNIN		60.75	115.25	31.25	68.75	24.10	24.00	11.50	22.00
40.40	88.88	11.88	26.13	22.72					
KA FANNIN		60.50	117.00	31.25	67.25	27.75	12.50	13.00	12.00
41.87	92.11	11.20	24.64	21.11					
VI WESLEY		70.25	153.50	39.50	77.00	25.10	13.00	19.00	12.00
55.00	121.01	14.62	32.17	21.00					
VI WESLEY		70.25	159.75	38.25	78.25	27.10	13.00	17.50	16.50
56.40	124.09	16.06	35.33	22.16					
ST WILSON		69.50	186.50	43.75	96.25	29.25	13.50	20.50	18.00
64.51	141.92	20.09	44.19	23.75					
ST WILSON		70.50	190.50	41.50	96.25	32.20	13.50	15.00	23.00
65.34	143.75	21.07	46.35	24.38					

Continuous Group--Body Composition

KI MAYS		66.75	142.00	32.35	70.00	31.00	12.00	7.00	1.00
50.60	111.33	13.81	30.38	21.44					
KI MAYS		66.50	142.75	33.00	74.25	26.15	31.50	14.00	41.50
47.90	105.39	16.85	37.07	26.02					
GA BUCHANAN		63.75	136.50	37.50	71.00	28.00	3.00	6.50	4.50
52.54	115.60	9.37	20.62	15.14					
GA BUCHANAN		63.25	137.00	38.75	71.25	24.00	8.00	10.50	8.00
52.30	115.06	9.84	21.65	15.84					
DO ALLEN		67.25	152.00	31.00	70.50	31.25	4.00	5.50	1.50
53.78	118.31	15.17	33.37	22.00					
DO ALLEN		67.25	152.00	31.65	72.15	29.65	15.50	19.50	17.00
50.73	111.60	18.22	40.08	26.43					
DA PATE		70.00	142.00	35.00	72.25	29.75	3.50	7.00	5.00
52.53	115.56	11.89	26.15	18.45					
DA PATE		69.50	145.00	36.00	75.25	27.25	7.00	8.50	7.50
52.96	116.52	12.81	28.18	19.47					
CA MILLER		68.00	134.00	33.00	72.00	27.70	17.50	16.50	28.50
46.35	101.97	14.43	31.75	23.74					
CA MILLER		68.25	133.75	33.00	67.00	27.55	18.00	14.50	30.50
47.25	103.96	13.42	29.52	22.11					
DE GALBRAITH		65.00	138.25	34.00	79.75	23.65	30.50	20.00	34.00
45.45	100.00	17.26	37.96	27.52					
DE GALBRAITH		65.00	142.00	34.25	72.50	25.10	36.50	25.50	39.00
46.38	102.03	18.03	39.67	28.00					
SH JOHNSON		61.25	118.00	34.25	75.00	23.75	14.00	19.00	31.00
41.67	91.68	11.85	26.08	22.15					
SH JOHNSON		61.00	118.00	33.50	69.25	24.45	21.00	18.50	47.00
41.56	91.42	11.97	26.33	22.36					
SU JOLLY		68.00	124.75	33.50	67.50	23.65	23.50	18.50	33.50
43.64	96.01	12.95	28.49	22.88					
SU JOLLY		68.00	126.50	33.50	68.00	24.25	25.00	14.50	38.00
44.60	98.13	12.78	28.11	22.27					

Continuous Group--Body Composition
(Continued)

AL HANES	66.50	145.25	33.50	75.00	26.80	23.50	23.00	31.50	48.08	105.78	17.80	39.17	27.02
AL HANES	66.50	146.75	33.00	73.00	26.40	23.50	14.50	37.00	49.88	109.74	16.68	36.70	25.06
VI BEACH	64.50	122.50	13.10	67.60	27.05	18.00	11.50	19.50	43.18	94.99	12.39	27.25	22.29
VI BEACH	64.25	124.25	30.50	67.25	26.25	23.00	16.00	35.50	42.29	93.05	14.07	30.94	24.96
DE ROBINSON	62.50	140.50	32.10	73.75	29.30	21.00	15.50	27.00	47.49	104.49	16.24	35.72	25.48
DE ROBINSON	62.00	140.50	31.25	74.00	27.55	17.00	15.50	16.50	47.27	103.99	16.46	36.22	25.84
TH FALLAW	63.00	117.00	32.50	65.50	26.45	15.50	14.00	10.50	42.40	93.28	10.67	23.48	20.11
TH FALLAW	63.00	114.00	32.00	66.25	26.95	13.00	16.00	12.00	41.00	90.21	10.71	23.56	20.71
JE NEUHOFF	63.30	156.00	35.35	81.25	29.50	21.50	24.50	19.00	51.42	113.11	19.35	42.56	27.34
JE NEUHOFF	63.50	157.00	34.50	82.25	29.75	17.00	24.50	16.50	51.48	113.26	19.73	43.41	27.71
KI CATES	61.25	168.00	38.50	88.50	30.40	18.00	22.50	20.00	56.39	124.05	19.82	43.60	26.00
KI CATES	61.00	169.00	38.55	91.50	31.00	15.00	27.00	17.00	55.84	122.84	20.82	45.81	27.16
MO BURROWS	61.25	110.00	31.60	64.50	24.55	18.50	14.00	5.00	39.67	87.27	10.23	22.50	20.50
MO BURROWS	61.50	112.00	30.50	64.35	25.60	18.00	14.00	7.50	39.73	87.40	11.08	24.37	21.80

Continuous Group--Body Composition
(Continued)

PA MCDONALD		61.50	141.00	34.50	80.00	28.50	21.50	20.50	24.00
47.21	103.86	16.75	36.85	26.19					
PA MCDONALD		61.50	141.00	32.40	79.15	27.15	14.50	19.00	18.50
46.99	103.37	16.97	37.34	26.53					
JA PATEL		71.00	132.00	36.70	73.50	27.10	6.00	7.00	8.00
50.05	110.12	9.82	21.61	16.41					
JA PATEL		71.00	134.00	35.10	76.00	28.20	7.00	8.00	8.00
49.18	108.19	11.61	25.53	19.09					
PA LAM		67.00	121.00	38.60	72.00	27.00	4.00	11.00	6.00
47.52	104.55	7.36	16.20	13.42					
PA LAM		67.00	126.25	37.75	72.25	25.15	8.00	14.00	8.00
47.80	105.15	9.47	20.84	16.54					
TE CHEATHAM		70.75	211.75	46.25	100.50	29.60	8.00	20.50	19.50
73.41	161.50	22.64	49.81	23.57					
TE CHEATHAM		70.75	193.50	41.00	92.00	28.10	10.00	15.00	18.50
66.87	147.10	20.91	45.99	23.82					
MA BARNES		63.50	139.75	33.00	68.25	24.90	30.00	18.00	42.00
47.33	104.13	16.06	35.33	25.33					
MA BARNES		63.25	137.00	32.50	66.50	26.40	31.50	19.00	44.00
46.19	101.61	15.96	35.11	25.68					
MI BOSCH		72.00	162.25	37.75	84.50	28.80	20.00	18.00	29.00
55.34	121.74	18.26	40.17	24.81					
MI BOSCH		71.50	168.50	37.00	85.00	27.75	26.50	14.00	32.00
56.83	125.02	19.60	43.13	25.65					

Control Group--Body Composition

KA DANIEL	65.50	114.00	32.65	66.25	28.95	10.50	9.00	12.50	42.68	93.89	9.03	19.87	17.47
KA DANIEL	65.00	114.00	32.50	67.50	27.40	23.50	12.50	32.50	40.77	89.70	10.94	24.06	21.15
ME HARRIS	66.50	147.00	34.50	69.95	28.15	18.00	12.00	19.00	52.08	114.57	14.60	32.12	21.90
ME HARRIS	66.50	143.00	32.75	70.50	28.45	17.50	17.50	15.00	48.99	107.78	15.87	34.92	24.47
CH BURLINGAME	68.00	186.00	40.50	88.00	29.85	8.00	15.00	12.50	65.05	143.10	19.32	42.51	22.90
CH BURLINGAME	68.00	183.00	39.90	87.50	30.30	9.00	16.50	13.00	63.55	139.82	19.45	42.80	23.44
JA DUNCAN	70.00	161.00	39.85	84.70	29.75	7.50	8.50	11.50	58.65	129.02	14.38	31.64	19.70
JA DUNCAN	70.00	162.00	38.10	85.15	29.10	7.50	10.00	12.00	57.68	126.89	15.81	34.77	21.51
TA BAYLISS	59.25	102.00	30.05	61.55	25.90	14.50	9.00	19.50	37.93	83.44	8.34	18.35	18.03
TA BAYLISS	59.00	101.50	29.70	62.75	25.35	16.00	12.50	14.50	36.73	80.81	9.31	20.48	20.22
LO SKELTON	63.25	108.50	31.60	50.70	26.50	17.00	7.50	14.50	42.31	93.09	6.90	15.19	14.02
LO SKELTON	63.25	107.00	30.85	66.75	26.80	12.50	11.50	10.50	38.93	85.64	9.61	21.14	19.80
JI MARSHALL	73.00	199.00	41.00	96.25	35.00	2.00	1.50	10.00	70.74	155.62	19.53	42.96	21.63
JI MARSHALL	72.00	194.00	40.50	94.90	32.20	8.50	20.00	10.50	65.67	144.47	22.33	49.13	25.38
RI YOUNG	71.50	116.75	32.38	68.50	29.24	3.50	4.00	11.00	44.42	97.72	8.54	18.78	16.12
RI YOUNG	71.50	119.00	32.40	69.45	27.15	7.00	7.00	12.50	44.21	97.27	9.76	21.48	18.09

Control Group--Body Composition
(Continued)

VI JAMESON	66.00	113.00	32.20	65.80	29.20	17.50	8.50	19.50	41.68	91.70	9.58	21.07	18.68
VI JAMESON	65.50	112.50	31.00	62.50	29.65	21.00	16.00	24.50	39.85	87.67	11.18	24.60	21.91
TO DIAGLE	70.50	158.00	37.25	80.75	29.25	3.50	9.50	10.00	57.03	125.46	14.64	32.21	20.43
TO DIAGLE	69.25	155.00	37.95	80.05	29.10	11.00	17.00	11.00	54.79	120.54	15.52	34.14	22.07
ST DELLVECCHIA	64.25	121.50	30.00	69.00	24.60	20.00	20.00	25.50	40.56	89.23	14.56	32.02	26.41
ST DELLVECCHIA	63.25	122.75	32.50	66.75	25.45	25.00	20.00	35.00	42.22	92.89	13.46	29.61	24.17
NI HENNISS	67.75	133.00	31.75	69.50	31.00	18.50	10.50	16.00	46.57	102.45	13.76	30.27	22.81
NI HENNISS	67.75	132.00	32.50	70.50	29.10	12.00	13.00	11.50	46.69	102.72	13.18	29.00	22.02
GR SOLOMON	69.00	144.25	37.00	75.00	26.25	5.50	10.50	11.00	53.21	117.06	12.22	26.89	18.68
GR SOLOMON	69.00	151.00	37.80	78.00	27.45	8.00	11.50	12.00	54.91	120.79	13.59	29.89	19.84
LY MACMILLAN	64.25	102.25	31.00	64.50	25.15	12.00	9.00	23.50	38.32	84.31	8.06	17.73	17.37
LY MACMILLAN	64.50	104.00	30.75	64.75	29.25	15.00	11.00	22.50	38.03	83.67	9.14	20.11	19.38
JA MULLOY	70.00	187.25	43.50	90.00	32.45	11.00	17.50	16.50	66.16	145.56	18.77	41.30	22.10
JA MULLOY	69.75	189.00	42.00	90.25	30.10	8.50	13.50	12.50	66.67	146.67	19.06	41.94	22.24
LI WALTER	60.50	136.00	33.50	77.50	27.10	14.50	18.50	21.50	46.39	102.07	15.30	33.65	24.80
LI WALTER	60.25	136.00	33.00	74.25	26.20	20.00	24.50	35.00	45.16	99.36	16.53	36.36	26.79

Traditional Group--Oxygen Consumption

WAR HUFF	233.00	67.00	146.00	3.69	55.75	85.06	9.58	187.00
WAR HUFF	234.00	67.25	151.50	5.91	85.94	171.67	12.00	180.00
JEF WRAY	247.00	69.00	209.50	4.07	42.83	140.85	10.00	180.00
JEF WRAY	248.00	69.50	207.00	4.32	45.98	169.29	12.00	187.00
JIM SCOTT	281.00	71.00	161.00	3.52	48.15	85.14	10.00	187.00
JIM SCOTT	282.00	71.50	164.00	3.28	44.13	85.95	11.00	180.00
MAR GIBSON	241.00	64.00	162.00	1.85	25.23	58.85	7.00	200.00
MAR GIBSON	242.00	63.25	161.50	2.08	28.45	56.94	8.00	187.00
CHR HOGAN	221.00	63.00	101.00	1.24	26.96	29.19	6.50	200.00
CHR HOGAN	223.00	63.00	108.00	2.23	45.51	55.60	8.50	180.00
KAT SIMPSON	223.00	61.50	106.50	2.38	49.17	55.37	7.50	195.00
KAT SIMPSON	225.00	61.75	109.00	1.22	24.68	31.61	11.00	187.00
KAR HICKS	265.00	68.25	191.50	2.55	29.33	56.36	5.00	187.00
KAR HICKS	266.00	68.50	193.00	1.85	21.13	57.62	7.00	187.00
PAU WATSON	268.00	65.00	134.00	1.76	28.93	56.90	7.00	187.00
PAU WATSON	269.00	65.00	135.00	1.55	25.39	57.79	11.00	187.00
JEN UNDERWOOD	259.00	65.50	125.25	1.06	18.61	29.87	6.00	180.00
JEN UNDERWOOD	261.00	66.25	127.50	2.24	38.72	55.99	8.00	187.00
MER IDE	274.00	66.50	137.00	2.56	41.22	54.97	5.75	185.00
MER IDE	276.00	67.25	139.00	1.32	20.91	29.89	9.00	180.00
KAR MEDLEY	238.00	68.00	144.00	2.40	36.80	56.83	7.25	187.00
KAR MEDLEY	240.00	67.50	143.75	2.83	43.36	57.12	11.50	180.00
KEI VANHOOSER	235.00	69.00	163.75	2.61	35.20	57.59	8.00	187.00
KEI VANHOOSER	236.00	69.00	164.00	3.77	50.74	114.38	14.00	187.00
JOE BECKHAM	228.00	71.50	195.00	2.80	31.61	58.12	11.00	187.00
JOE BECKHAM	229.00	71.25	197.00	3.64	40.77	83.38	9.75	187.00
KEV MOUNCE	233.00	70.50	130.25	2.04	34.48	57.22	8.00	180.00
KEV MOUNCE	234.00	70.50	132.00	2.04	34.04	58.07	8.75	180.00
BAR BROWN	262.00	66.00	131.00	3.32	55.89	83.02	7.83	185.00
BAR BROWN	264.00	66.25	134.50	2.07	33.93	85.20	10.16	187.00

Traditional Group--Oxygen Consumption
(Continued)

SUS FOX	264.00	61.50	106.75	1.11	22.93	30.67	8.25	180.00
SUS FOX	265.00	61.50	107.50	1.59	32.53	58.32	10.75	187.00
KAY FANNIN	235.00	60.75	115.25	1.19	22.76	28.95	7.50	190.00
KAY FANNIN	236.00	60.50	117.00	2.24	42.22	55.33	10.00	187.00
VIC WESLEY	241.00	70.25	153.50	3.99	57.34	113.09	10.50	190.00
VIC WESLEY	242.00	70.25	159.75	3.31	45.70	85.36	12.50	185.00
STE WILSON	223.00	69.50	186.50	3.88	45.86	84.33	8.00	187.00
STE WILSON	224.00	70.50	190.50	4.21	48.70	83.84	8.00	185.00

Continuous Group--Oxygen Consumption

VIC BEACH	232.00	64.50	122.50	2.18	39.17	58.36	6.50	180.00
VIC BEACH	233.00	64.25	124.25	1.81	32.06	57.91	8.00	195.00
DEB ROBINSON	226.00	62.50	140.50	2.10	32.90	85.58	8.00	190.00
DEB ROBINSON	227.00	62.00	140.50	1.29	20.29	30.57	9.00	187.00
THE FALLAW	239.00	63.00	117.00	1.82	34.38	57.37	8.00	187.00
THE FALLAW	240.00	63.00	114.00	1.89	34.36	58.56	10.00	187.00
JEA NEUHOFF	220.00	63.30	156.00	2.46	34.75	56.26	6.00	180.00
JEA NEUHOFF	221.00	63.50	157.00	2.41	33.79	56.88	8.00	187.00
KIM CATES	233.00	61.25	168.00	1.31	17.17	30.79	5.50	187.00
KIM CATES	234.00	61.00	169.00	2.23	29.11	58.26	7.50	187.00
MON BURROWS	237.00	61.25	110.00	2.53	50.67	55.69	8.00	200.00
MON BURROWS	239.00	61.50	112.00	2.38	44.91	56.47	10.50	187.00
PAT MCDONALD	219.00	61.50	141.00	2.33	36.40	56.37	7.33	180.00
PAT MCDONALD	220.00	61.50	141.00	2.00	31.22	57.38	10.00	187.00
JAY PATEL	267.00	71.00	132.00	2.48	41.49	85.38	8.00	180.00
JAY PATEL	268.00	71.00	134.00	3.48	57.30	113.09	12.00	180.00
CAR MILLER	239.00	68.00	134.00	1.87	30.76	56.32	5.75	187.00
CAR MILLER	240.00	68.25	133.75	1.59	26.26	57.94	8.00	187.00
DEB GALBRAITH	223.00	65.00	138.25	1.14	18.11	30.70	5.50	187.00
DEB GALBRIATH	224.00	65.00	142.00	2.26	35.04	56.01	8.00	187.00
SHA JOHNSON	226.00	61.25	118.00	1.70	31.72	56.79	6.50	185.00
SHA JOHNSON	227.00	61.00	118.00	1.50	28.07	57.57	10.00	187.00
SUS JOLLY	230.00	68.00	124.75	1.79	31.71	56.24	6.00	185.00
SUS JOLLY	231.00	68.00	126.50	1.62	28.23	56.65	6.00	187.00
ALL HANES	225.00	66.50	145.25	1.81	27.42	56.46	4.50	187.00
ALL HANES	226.00	66.50	146.75	1.96	29.39	57.19	7.00	187.00
TED CHEATHAM	312.00	70.75	211.75	3.40	35.35	85.74	7.50	187.00
TED CHEATHAM	313.00	70.75	193.50	3.52	40.09	85.81	8.00	187.00
PAT LAM	287.00	67.00	121.00	3.09	56.30	84.65	11.33	187.00
PAT LAM	288.00	67.00	126.50	3.40	59.19	87.08	16.25	187.00
DAV PATE	226.00	70.00	142.00	2.52	39.19	84.71	10.25	180.00
DAV PATE	227.00	69.50	145.00	2.80	42.51	84.72	12.50	176.00

Continuous Group--Oxygen Consumption
(Continued)

MAR BARNES	228.00	63.50	139.75	2.29	36.05	55.46	5.00	187.00
MAR BARNES	229.00	63.25	137.00	1.88	30.31	57.77	7.25	187.00
MIC BOSCH	216.00	72.00	162.25	2.07	28.15	58.69	8.00	187.00
MIC BOSCH	217.00	71.50	168.25	3.35	43.94	114.45	9.00	187.00
KIM MAYS	235.00	66.75	142.00	3.61	56.00	83.11	8.00	185.00
KIM MAYS	236.00	66.50	142.75	3.35	51.75	56.99	8.00	185.00
GAR BURCHANAN	241.00	63.75	136.50	1.71	27.55	57.82	8.00	180.00
GAR BUCHANAN	242.00	63.25	137.00	1.89	30.35	58.94	15.00	187.00
DON ALLEN	218.00	67.25	152.00	2.36	34.25	55.82	5.25	187.00
DON ALLEN	220.00	67.25	152.00	2.54	36.82	56.67	5.50	187.00

Control Group--Oxygen Consumption

KAT DANIEL	249.00	65.00	114.00	2.21	42.80	55.75	6.00	187.00
KAT DANIEL	251.00	65.50	114.00	2.59	50.02	55.86	6.25	180.00
STE DELLAVECCHI	267.00	64.25	121.50	1.73	31.36	58.58	9.25	180.00
STE DELLAVECCHI	268.00	63.25	122.75	1.75	31.40	58.87	8.00	180.00
NIC HENNISS	234.00	67.75	133.00	1.49	24.77	30.32	6.25	185.00
NIC HENNISS	236.00	67.75	132.00	2.43	40.64	56.85	7.25	187.00
CHR BURLINGAME	230.00	68.00	186.00	2.75	32.55	58.55	8.00	187.00
CHR BURLINGAME	231.00	68.00	183.00	2.97	35.79	58.26	11.00	180.00
JAM DUNCAN	247.00	70.00	161.00	3.28	44.96	86.63	10.25	185.00
JAM DUNCAN	248.00	70.00	162.00	4.57	62.21	141.97	14.00	185.00
TAM BAYLISS	244.00	59.25	102.00	1.11	24.02	29.17	6.50	185.00
TAM BAYLISS	245.00	59.00	101.50	2.22	48.29	55.58	9.00	166.00
LOR SKELTON	233.00	63.25	108.50	1.08	21.90	29.85	6.50	180.00
LOR SKELTON	234.00	63.25	107.00	1.95	40.25	55.81	8.00	187.00
JAM MARSHALL	264.00	73.00	199.00	4.20	46.56	84.05	8.00	185.00
JAM MARSHALL	265.00	72.00	194.00	3.62	41.10	85.71	7.75	185.00
RIC YOUNG	274.00	71.50	116.75	2.08	39.32	58.98	10.50	185.00
RIC YOUNG	275.00	71.50	119.00	3.12	57.84	86.25	10.75	187.00
VIC JAMESON	232.00	66.00	113.00	2.23	43.44	54.58	7.00	187.00
VIC JAMESON	233.00	65.50	112.50	2.46	48.24	55.95	8.00	180.00
TON DAIGLE	247.00	70.50	158.00	2.84	39.59	56.74	8.00	180.00
TON DAIGLE	248.00	69.25	155.00	2.67	37.97	57.66	9.00	185.00
JAM MULLOY	233.00	70.00	187.25	2.45	28.84	58.05	7.00	185.00
JAM MULLOY	234.00	69.75	189.00	3.80	44.35	86.21	9.75	187.00
LIS WALTER	253.00	60.50	136.00	2.80	45.41	83.86	6.66	187.00
LIS WALTER	255.00	60.50	136.00	2.50	40.48	84.94	8.00	185.00
MEL HARRIS	234.00	66.50	147.00	1.24	18.63	30.90	7.00	187.00
MEL HARRIS	235.00	66.50	143.00	2.11	32.45	57.36	8.00	185.00
LYN MACMILLAN	235.00	64.25	102.25	1.14	24.61	29.73	6.00	185.00
LYN MACMILLAN	236.00	64.50	104.00	.95	20.18	30.42	8.25	187.00

Traditional Group--Strength

WA HUFF	155.50	41.00	72.50	73.00	172.50	75.00	63.50	35.50
KE WRAY	167.00	61.50	111.50	81.50	164.50	74.00	92.00	83.50
JI SCOTT	200.00	53.00	96.50	65.00	184.50	42.00	83.00	57.50
MA GIBSON	123.50	60.00	105.00	39.00	96.00	62.00	64.50	40.50
CH HOGAN	73.00	48.00	56.00	34.00	105.00	51.50	57.00	41.00
KA SIMPSON	95.00	43.00	89.50	34.50	102.00	43.50	83.00	43.50
KA HICKS	136.00	80.50	108.00	52.50	148.00	85.00	103.50	57.00
PA WATSON	69.00	43.00	85.50	36.00	66.00	44.50	46.50	37.00
JE UNDERWOOD	102.00	45.50	66.00	23.00	104.00	36.50	85.00	38.00
ME IDE	85.00	33.50	125.50	19.00	108.00	33.50	93.50	42.00
KA MEDLEY	125.00	66.00	107.50	58.50	136.50	51.50	104.50	64.50
KE VANHOOSER	164.50	62.50	185.00	77.00	161.00	72.00	108.00	79.50
JO BECKHAM	164.00	79.00	161.50	77.00	166.50	64.00	96.00	79.50
KE MOUNCE	156.20	62.80	147.00	71.30	152.00	54.50	105.50	64.00
BA BROWN	86.35	72.40	93.80	32.25	82.55	29.90	87.75	35.35
SU FOX	38.50	23.50	65.00	16.50	54.70	17.30	45.50	22.95
KA FANNIN	91.50	34.50	78.50	27.50	90.50	44.50	32.00	32.00
VI WESLEY	189.00	68.50	138.00	72.00	185.50	89.00	152.50	78.00
ST WILSON	165.50	74.50	173.50	84.00	182.00	89.00	188.50	67.50

Continuous Group--Strength

VI BEACH	70.25	19.35	47.00	37.95	75.00	21.00	48.00	29.50
DE ROBINSON	117.00	68.80	87.75	52.00	110.90	53.85	85.75	50.30
TH FALLAW	96.50	44.90	95.00	41.10	105.00	32.20	84.70	44.40
JE NEUHOFF	54.50	29.50	44.25	27.10	91.50	30.40	64.05	41.30
KI CATES	114.00	51.75	27.75	47.50	124.00	57.00	35.50	46.00
MO BURROWS	80.50	36.20	68.00	36.40	106.50	47.00	75.00	40.00
PA MCDONALD	90.00	40.10	47.35	35.50	99.00	44.50	33.50	39.75
JA PATEL	140.00	69.00	100.50	56.00	135.15	47.75	127.70	34.85
PA LAM	145.00	54.50	151.00	69.00	181.50	58.50	135.50	71.00
KI MAYS	96.00	46.50	84.50	48.50	116.00	52.00	90.50	36.50
GA BUCHANAN	200.00	44.50	127.50	68.50	193.50	64.50	69.50	49.50
DO ALLEN	107.50	47.00	81.50	38.50	90.50	44.00	88.00	45.00
DA PATE	149.50	48.50	116.50	73.00	151.00	50.00	101.50	63.50
CA MILLER	93.00	47.00	91.00	27.50	103.50	55.00	71.50	36.00
DE GALBRAITH	133.00	33.00	130.50	31.00	132.00	36.00	78.00	33.50
SH JOHNSON	98.00	43.00	73.00	35.00	106.00	54.00	88.00	35.00
SU JOLLY	79.00	23.00	90.00	23.00	83.50	43.50	80.00	32.50
AL HANES	105.50	40.20	132.00	29.50	109.50	47.50	105.50	46.00
TE CHEATHAM	200.00	54.00	152.50	82.50	200.00	92.50	141.50	69.60
MA BARNES	111.50	50.00	106.00	43.00	109.50	34.00	89.50	44.00
MI BOSCH	130.50	60.50	114.50	37.00	143.00	83.50	115.50	45.00

Control Group--Strength

KA DANIEL	104.70	42.00	93.00	40.55	116.50	45.00	88.50	39.50
ME HARRIS	131.00	57.35	108.80	42.95	121.75	34.75	84.15	46.20
CH BURLINGAME	171.00	87.40	73.00	71.25	189.50	66.00	92.50	96.50
KY DUNCAN	144.00	70.00	97.50	54.20	128.50	41.00	123.00	61.00
TA BAYLISS	82.00	57.00	72.50	38.00	77.50	76.50	70.50	36.00
LO SKELTON	78.00	47.00	88.00	30.45	88.00	43.50	72.50	30.00
JA MARSHALL	136.00	48.00	108.50	62.50	117.10	110.50	42.95	62.80
RI YOUNG	153.90	65.50	117.00	60.50	128.50	62.50	87.00	59.00
VI JAMESON	60.50	30.00	73.50	25.50	81.40	25.40	100.00	40.40
TO DAIBLE	165.50	72.50	111.00	63.25	150.50	52.00	134.00	62.00
ST DELLAVECCHI	102.60	25.50	80.55	37.45	107.50	20.00	94.00	36.00
NI HENNISS	99.50	49.50	64.00	29.50	111.00	33.00	102.50	33.50
GR SOLOMON	144.00	48.95	122.00	78.25	153.00	36.00	162.50	76.50
LY MACMILLAN	95.00	33.00	117.00	22.00	97.80	29.45	116.00	20.40
JA MULLOY	200.00	89.85	183.50	104.50	197.00	47.50	116.00	104.00
LI WALTER	100.50	41.00	58.00	42.50	89.50	43.90	74.25	42.75

Traditional Group--Women's Attitude

HOBSON	MARSHA	34	36	36	39	31	33
HOBSON	MARSHA	28	36	27	31	28	31
BROWN	BARBARA	32	38	41	35	27	30
BROWN	BARBARA	31	42	45	31	28	39
IDE	MERISSA	29	35	42	45	26	23
IDE	MERISSA	27	38	40	41	25	24
HOGAN	CHRISTINE	33	41	26	34	28	21
HOGAN	CHRISTINE	36	46	30	37	35	25
SIMPSON	KATHLEEN	39	37	29	32	29	26
SIMPSON	KATHLEEN	37	31	29	33	30	20
MEDLEY	KAREN	37	44	33	37	43	26
MEDLEY	KAREN	33	32	31	31	40	24
FANNIN	KAY	30	39	37	33	21	16
FANNIN	KAY	30	35	40	36	23	17
WATSON	PAULETTA	34	42	27	39	28	28
WATSON	PAULETTA	35	45	25	35	31	22
HICKS	KAREN	30	40	36	41	36	28
HICKS	KAREN	31	41	37	39	29	29
UNDERWOOD	JENNIFER	41	44	47	39	41	25
UNDERWOOD	JENNIFER	41	41	51	31	31	23
FOX	SUSAN	30	30	23	31	29	11
FOX	SUSAN	30	32	21	36	29	14

Continuous Group--Women's Attitude

GALBRAITH	DEBBIE	35	39	43	39	34	34
GALBRAITH	DEBBIE	33	31	47	28	26	32
FALLAW	THERESA	25	46	31	43	26	20
FALLAW	THERESA	30	46	37	50	26	23
BURROWS	MONICA	36	56	38	36	50	32
BURROWS	MONICA	40	46	41	40	42	25
ALLEN	DONNA	34	43	36	36	29	14
ALLEN	DONNA	36	45	37	42	33	18
CATES	KIM	31	41	23	35	29	23
CATES	KIM	24	39	20	29	23	21
NEUHOFF	JEANETTE	32	46	24	48	33	24
NEUHOFF	JEANETTE	35	55	15	59	41	25
MCDONALD	PATRICIA	28	43	49	27	27	22
MCDONALD	PATRICIA	29	42	52	33	32	20
MAYS	KIM	33	35	37	27	37	33
MAYS	KIM	34	39	38	33	38	34
ROBINSON	DEBORAH	33	35	28	37	30	23
ROBINSON	DEBORAH	34	34	24	33	32	26
JOHNSON	SHERRY	40	37	55	37	30	30
JOHNSON	SHERRY	38	32	55	29	28	31
BARNES	MARY	35	46	45	31	39	30
BARNES	MARY	33	50	45	29	37	28
BEACH	VICKI	35	39	22	28	33	26
BEACH	VICKI	32	39	14	26	27	16
MILLER	CAROLYN	35	29	20	35	31	25
MILLER	CAROLYN	34	29	15	35	27	18
HANES	ALLISON	25	29	28	24	21	29
HANES	ALLISON	23	30	33	23	22	28
JOLLY	SUSIE	27	53	28	32	25	19
JOLLY	SUSIE	32	40	28	37	36	25

Control Group--Women's Attitude

DANIEL	KATHY	33	39	29	36	34	24
DANIEL	KATHY	33	44	33	39	33	26
HARRIS	MELISSA	30	42	44	41	34	25
HARRIS	MELISSA	32	45	35	42	35	25
BAYLISS	TAMMY	36	58	34	44	42	20
BYALISS	TAMMY	34	50	33	38	39	28
SKELTON	LORI	33	44	39	44	27	22
SKELTON	LORI	30	41	34	35	33	31
JAMESON	VICKI	37	47	29	38	33	29
JAMESON	VICKI	44	56	32	33	29	23
DELLVECCHIA	STEP	29	42	23	43	31	24
DELLVECCHIA	STEP	29	44	24	43	32	23
HENISS	NICOLE	36	35	35	40	29	28
HENISS	NICOLE	32	38	29	47	26	25
MACMILLAN	LYNN	32	49	41	38	38	30
MACMILLAN	LYNN	33	46	40	41	32	24
WALTER	LISA	33	48	29	49	36	22
WALTER	LISA	26	40	23	52	36	21

Traditional Group--Men's Attitude

SCOTT	JIM	51	19	29	49	38	14
SCOTT	JIM	49	34	36	45	31	16
MOUNCE	KEVIN	44	42	49	49	37	49
MOUNCE	KEVIN	43	45	51	44	38	45
WILSON	STEVE	35	29	26	36	27	35
WILSON	STEVE	35	36	27	33	29	37
WESLEY	VIC	40	39	36	43	34	34
WESLEY	VIC	44	35	28	44	32	30
HUFF	WARREN	33	50	32	27	39	45
HUFF	WARREN	47	40	40	30	43	49
BECKHAM	JOEL	31	36	33	35	32	37
BECKHAM	JOEL	42	36	43	33	32	35
VANHOOSER	KEITH	41	53	34	36	48	31
VANHOOSER	KEITH	44	63	36	40	49	50
WRAY	KEITH	39	64	39	32	44	49
WRAY	KEITH	33	48	35	26	41	46

Continuous Group--Men's Attitude

LAM	PATRICK	44	33	38	34	30	39
LAM	PATRICK	44	29	40	35	31	31
BUCHANAN	GARY	36	52	33	42	39	36
BUCHANAN	GARY	38	44	40	42	30	40
BOSCH	MICHAEL	48	26	20	39	25	42
BOSCH	MICHAEL	42	32	16	37	25	39
PATEL	JAY	33	41	35	37	30	35
PATEL	JAY	41	39	36	36	38	34
CHEATHAM	TED	54	63	66	66	52	52
CHEATHAM	TED	55	66	66	60	45	50
PATE	DAVID	35	37	39	32	34	32
PATE	DAVID	32	37	47	28	35	33

Control Group--Men's Attitude

BURLINGAME	CHRIS	41	34	41	44	29	33
BURLINGAME	CHRIS	37	32	37	47	29	27
DUNCAN	JAMES	42	39	31	39	41	46
DUNCAN	JAMES	37	42	31	40	40	45
MARSHALL	JIM	38	37	36	37	34	24
MARSHALL	JIM	36	30	29	35	27	21
YOUNG	RICH	34	42	37	34	33	28
YOUNG	RICH	35	41	43	33	35	25
SOLOMON	GREG	49	36	49	38	36	43
SOLOMON	GREG	44	40	49	36	37	39
MALLOY	JIM	38	30	18	50	33	43
MALLOY	JIM	39	33	13	48	28	43
DAIGLE	TONY	42	43	39	47	36	43
DAIGLE	TONY	43	38	36	41	36	36

Traditional Group--Flexibility

WILSON	69	58	143	130
WESLEY	56	62	132	140
HICKS	57	93	132	140
WATSON	56	58	130	123
MOUNCE	63	54	150	153
WRAY	62	59	131	140
SIMPSON	40	53	134	142
HOGAN	77	83	149	153
HUFF	62	74	124	189
BECKMAN	64	66	130	130
GIBSON	72	87	143	139
FOX	72	72	133	161
SCOTT	54	75	119	125
MEDLEY	76	81	196	135
VANHOOSER	62	60	152	133
UNDERWOOD	68	84	128	123
BROWN	70	75	142	136
IDE	61	73	133	119
FANNIN	70	72	135	134

Continuous Group--Flexibility

PATE	72	80	147	150
ROBINSON	86	96	125	137
FALLAW	67	80	134	154
NEUHOFF	97	89	215	161
CATES	52	63	126	131
BURROWS	71	71	148	120
MCDONALD	74	82	122	151
LAM	89	79	142	137
BUCHANAN	40	52	115	121
MAYS	58	72	120	123
ALLEN	86	76	133	122
PATEL	46	66	141	140
BARNES	62	72	143	145
BOSCH	81	68	140	135
CHEATHAM	77	85	140	122
BEACH	64	72	141	147
MILLER	76	79	142	146
JOHNSON	97	68	117	143
GALBRAITH	58	59	150	134
HANES	79	81	131	141
JOLLY	72	65	128	134

Control Group--Flexibility

DANIEL	56	71	127	134
HARRIS	61	68	141	157
BURLINGAME	47	68	115	130
WALTER	67	70	135	145
DUNCAN	70	69	146	140
SKELTON	67	75	146	133
JAMESON	56	60	127	142
BAYLISS	78	70	136	145
YOUNG	70	83	151	159
MARSHALL	72	79	134	138
DAIGLE	71	61	137	120
DELVECCHIA	90	74	130	133
MALLOY	65	66	131	147
MACMILLAN	73	72	162	160
SOLOMON	68	71	144	125
HENNISS	70	69	128	118

Traditional Group--Leisure-time Activity

YOUNG	61.05
BURLINGAME	115.12
HARRIS	49.89
MARSHALL	37.50
MULLOY	127.75
DIAGLE	85.00
JAMESON	79.70
SKELTON	23.30
BAYLISS	52.70
DUNCAN	88.00
SOLOMON	66.49
HENNISS	18.10
WALTER	6.92
DANIEL	5.00
MACMILLAN	46.12
DELVECCHIA	23.94

Continuous Group--Leisure-time Activity

MCDONALD	38.90
CATES	25.20
NEUHOFF	67.39
FALLAW	36.82
ROBINSON	30.18
ALLEN	94.36
BUCHANAN	32.12
BURROWS	23.96
PATEL	39.02
BOSCH	29.96
BARNES	26.80
CHEATHAM	46.85
HANES	19.00
JOLLY	41.06
JOHNSON	13.70
GALBRAITH	25.70
MAYS	32.90
LAM	50.21
PATE	47.60
MILLER	24.90
BEACH	24.34

Control Group--Leisure-time Activity

MOUNCE	120.70
BECKHAM	69.89
WATSON	115.95
HICKS	58.49
GIBSON	205.56
SCOTT	26.09
WRAY	133.08
HUFF	199.98
IDE	77.25
UNDERWOOD	79.39
SIMPSON	57.75
HOGAN	39.51
FANNIN	33.00
WILSON	19.70
WESLEY	25.64
FOX	10.50
BROWN	80.50
VANHOOSER	57.70
MEDLEY	26.80

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