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Comparisons of the habitual acitvity level of selected women to performance on the Bruce multistage treadmill test and the Cooper 12 minute run test

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AN ABSTRACT OF THE THESIS OF Teresa Marie Owen for the Master of Science and Teaching in Physical Education presented February 16, 1979.

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The purpose of this study was to determine whether the Cooper 12 Minute Run test and Bruce Multistage Treadmill test measure the same type of cardiovascular endurance performance when testing adult women. A second purpose was to determine whether divergent levels of habitual activity by women are reflected in the scores on each test. Four groups of habitual activity were defined and labeled as follows: non-exercisers, minimal exercisers, adequate exercisers, and more than

adequate exercisers. Ten healthy women were selected as subjects in each group. Subjects ranged in age from 22 to 35 years and were within the normal weight range according to standard tables. Each subject was tested in accordance with the appropriate protocol on the Bruce test and on the 12 Minute Run test. When individual scores for the two tests were correlated the data seemed to indicate that they were comparable measures of cardiovascular endurance performance. ($r = 0.9097$) An analysis of variance among group scores was performed for each test and highly significant F ratios were obtained. ($F = 24.07$ Bruce; $F = 20.77$ 12 Minute Run) The most likely reason for the differences was seen as the divergent levels of habitual activity in each group. Contrasting tests were performed among groups and various combinations of groups. All test comparisons reached significance except for the one contrasting the 12 Minute Run scores of the two groups with the lowest activity levels. It was concluded that for the population of women at various levels of habitual activity who are represented by the selected sample in this study: the Bruce Multistage Treadmill test and the Cooper 12 Minute Run test measure largely the same type of cardiovascular endurance performance and that each test appears to adequately discriminate among women of divergent levels of habitual activity except at the lowest levels.

COMPARISONS OF THE HABITUAL ACTIVITY LEVEL OF SELECTED WOMEN TO PERFORMANCE ON THE BRUCE MULTISTAGE TREADMILL TEST AND THE COOPER 12 MINUTE RUN TEST

by

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CHAPTER I

INTRODUCTION

THE NATURE AND PURPOSE OF THE STUDY

In recent years there has been a dramatic increase in the participation in strenuous sports and physical activities by women as well as men. Research efforts to assess the physiological responses and adaptations of the female to strenuous physical effort have increased as well (1,2,3,4,5,6,7,8,9,10). The effects of training on various fitness parameters including strength, flexibility, body composition and cardiovascular endurance have been investigated. Measurement of these fitness parameters by the physical educator is necessary to discover the functionally unfit and to classify the functionally fit in positions of various levels of efficiency (11, p. 301).

The popularization of long distance running, swimming, and other endurance-type sports in the last decade has brought to the forefront the need for developing and measuring cardiovascular endurance. Cardiovascular endurance can be defined as "the capacity of the individual to maintain strenuous activity of a number of muscle groups of the whole body for a prolonged period. (A period sufficient to demand a resistance to fatigue)" (12, p. 374).

Measurement of cardiovascular endurance, however, has been a difficult task in that it is difficult to separate it from other fitness parameters; power, strength, speed, and flexibility (13, p. 106).

Oxygen uptake or $\dot{V}O_2$ is generally considered to be the best single criterion of cardiovascular endurance (4,12,14,15), but the direct laboratory measurements needed to acquire this data are too complicated and expensive for use by most physical educators. Many studies, therefore, have investigated the relationship between other more easily administered tests and the direct measurement of $\dot{V}O_2$ in the laboratory (1,3,8,9,16,17,18,19,20,21). Two of these tests are the Bruce Multistage Treadmill Test and the 12 Minute Run, both of which are currently used at the YMCA of Columbia-Willamette.

Since fitness and cardiovascular endurance are objectives of importance at the YMCA of Columbia-Willamette, in particular, and to physical educators in general, a good measuring instrument is needed to make decisions when guiding women in appropriate fitness activities at the YMCA. Such an instrument is also necessary to evaluate later their progress and determine the success of the programs designed for these women. It is necessary then, to determine whether the Bruce test and the 12 Minute Run are appropriate tests to satisfy these needs.

This study intends to look at relationships between the Bruce test and the 12 Minute Run to determine whether they measure the same elements of endurance performance. In addition, since it has been shown that physical training does affect maximal oxygen uptake ($\dot{V}O_2$ max) and thus cardiovascular endurance (10,21,22), the question of whether the 12 Minute Run and Bruce test scores reflect the amount of work done in training by women will be investigated.

CHAPTER II

REVIEW OF THE LITERATURE

What follows is a review of literature conducted from materials available at the Portland State University Library and collections at the YMCA of Columbia-Willamette. This limited review was conducted primarily in journals and texts in the fields of sports medicine, medicine, physical education, physiology and education between the years 1961 and 1977. Areas pursued included: (1) measurement of cardiovascular endurance, $\dot{V}O_2$ max, and oxygen intake, and endurance performance; (2) physiology of cardiovascular endurance performance; (3) the 12 Minute Run and Bruce test; and (4) women and all the above topics.

Oxygen uptake capacity or $\dot{V}O_2$ is generally considered to be the best single physiological criterion of cardiovascular endurance. In a study by Stewart, Williams, and Gutin (14), 33 college women were tested for actual $\dot{V}O_2max$ on the treadmill and on a 2 Km. run. The study compared the relationship between cardiorespiratory endurance and various anthropometric measures and discovered that a significant 70% of the variance in test performance was accountable to $\dot{V}O_2max$.

In another study with more active college women subjects, Higgs (4) found a significant correlation ($r = .64$) between $\dot{V}O_2max$ and physical work done on a treadmill performance test.

The use of the treadmill in testing for endurance is supported by many researchers (8,15,16,23,24) for several reasons. This method

demands the dynamic exercise of large muscle groups, and it requires no skill or special training to use. Bruce (16, p. 546) purports that to be effective, the test should be designed to provide progressive increments in workloads, allowing for time at submaximal levels for physiologic adaptations and it also should have individually determined endpoints.

Bruce (16) tested over 4,000 men and women using the protocol described in Table II, measuring directly $\dot{V}O_2$ at each stage and VO_2max. He determined that $\dot{V}O_2$ for each level and $\dot{V}O_2max$ may be estimated with adequate reliability for clinical purposes from the duration of time on the treadmill when the appropriate regression equation is used: estimated $\dot{V}O_2max$=6.70-2.82 (weighting factor for sex)+0.056 (duration in seconds) (r=0.920) (measured $\dot{V}O_2max$ with duration of exercise on treadmill). Peak values for observed $\dot{V}O_2$ are highly correlated with total duration of this multistage exercise test.

The most common measure of cardiovascular endurance performance is the distance run. Some type of distance run is included in most motor fitness or physical fitness batteries. Because of the increased interest in aerobic conditioning, the recommended distances are becoming longer than before; the 1 1/2 mile run and the 12 minute run for distance are being suggested (25). In shorter runs, the measurement of anaerobic performance becomes an important factor. Longer runs, such as those mentioned above, are better measures of endurance (19).

The distance an individual can run in 12 minutes was proposed and popularized by Cooper (26) as a test of cardiovascular endurance. His basic research was conducted with Air Force personnel, but in

subsequent studies, he and his wife (2) have utilized the same test for women. Reliability co-efficients between .90 and .94 have consistently been obtained for the 12 minute run for men, women, boys, and girls (9,17,18). Conflicting correlations between the run and max $\dot{V}O_2$ have been reported. Cooper (18) and others (17,27) found correlations as high as .90, while other researchers (9,20) obtained correlations as low as .73 and .65.

In another study, Kearney (21) used the bicycle ergometer to validate the 12 minute run. His results showed r=.63 when compared to $\dot{V}O_2max$.

Willingness of an individual to entend him/herself in performing certain tests is inseparable from the actual measure of fitness. Keeney (28, p. 30) says "Motivation joins hand in hand with the utilization of strength, endurance, and coordination in both testing situations and everyday living." In factoring out motivation, however, Ryan (29) did report a study in which the use of four different extrinsic motivational conditions (electric shock, knowledge of results, exhortation, and verbal requests to do well) produced no differences among four matched subgroups doing a grip strength test. In a study of young men tested maximally on the bicycle ergometer, Wilmore (30) employed the combination of desire to improve and peer pressure as motivation. Riding time on the bikes did increase; however there was no significant increase in maximum physiological response.

Training has been shown to have an effect on measurements of $\dot{V}O_2max$ and other variables of endurance (4,10,22,31). Cunningham (32) tested 17 women on a training program and demonstrated strong increase

in $\dot{V}O_2max$ after the initial 9 weeks of the program (depending on the subject's initial level of fitness), and an increase in other fitness parameters after a year on the program. Wright (10) tested middle aged women in a before-after test on a fitness program and also found increases in $\dot{V}O_2max$ as well as other anthropometric measures of fitness.

Pollock (33) has demonstrated that variables, including intensity, duration, frequency, and mode of training all contribute to training effect. What seems to be of most importance is the total amount of work completed.

The work done by a person may be translated into physical units by using either of two approaches: One, measure the amount of mechanical work done in a standardized situation (i.e. using a bicycle ergometer or motorized treadmill). Two, measure the energy expended in any situation, generally from oxygen uptake. Since body weight affects physiological loads, to correct for this factor, energy expenditure during an activity is divided by energy at complete rest. The multiples of the metabolism at rest or METS is the result. The ratio of the metabolic rates at rest is used as an index of the intensity of exercise (12,23).

Minimal intensities required to effect a training response appears to be around 50 to 60% of $\dot{V}O_2max$ (33). The American College of Sport Medicine (ACSM) Guidelines (23) suggest an individual train at 60% of his functional capacity in METS or at 70% of the available heart rate range (maximum heart rate-resting heart rate).

Duration is another important variable in training response. Pollock (33, p. 162) reports that the longer an individual exercises,

the greater the training effect, holding intensity and frequency constant. Minimal bouts of exercise for a training response have been researched little, but bouts for as long as 5 to 10 minutes have shown change. Larson (12, p. 289) reports that "aerobic power," a factor relating closely to such metabolic capacities as $\dot{V}O_2max$, is developed after 3 to 4 minutes after the start of intensive exercise and may continue for a period of 15 to 30 minutes. The ACSM Guidelines (23) suggest a minimum of 10 minutes per bout of exercise and classify 20-30 minutes as "moderate."

Though most of the studies cited by Pollock (33, p. 163-64) were unable to quantify the importance of frequency, he suggests that if all else were held constant, increased frequency would increase the total number of exercise bouts (thus increasing total energy cost). The ACSM Guidelines suggest that a healthy individual exercise at least three times per week.

The importance of the mode of exercise is closely related to intensity. Some activities inherently have higher intensities. Others, such as walking and running, vary as to their intensity by the speed in which they are executed. The ACSM Guidelines has listed (13, p. 31) the approximate range in energy cost for many leisure and sport activities.

In summary, it has been shown that oxygen uptake of $\dot{V}O_2max$ is the best single physiological measure of cardiovascular endurance. Bruce, using his own protocol, observed that measures of $\dot{V}O_2$ highly correlate with total duration of the multistage exercise test. Cooper and others have also shown the 12 Minute Run to be a good

measure of cardiovascular endurance and $\dot{V}O_2max$. Maximum physiologic response has been shown to be affected little by motivational factors, but does change with training. Training variables of frequency, duration, intensity, and mode interrelate in determining total work completed, which can alter performance levels in an individual.

CHAPTER III

STATEMENT OF THE RESEARCH HYPOTHESES

It has been demonstrated that $\dot{V}O_2$ max is the best single physiological measure of cardiovascular endurance (4,5,12,14,15). The 12 Minute Run and the Bruce Multistage Treadmill Test are both designed to measure cardiovascular endurance in persons of either sex. Using subjects of both sexes, the Bruce test has established a high correlation between $\dot{V}O_2$ max and duration of exercise on the test ($r = 0.92$) (16). Correlations between the 12 Minute Run and $\dot{V}O_2$ max have ranged from $r = .90$ (18) to $r = .63$ (21) for men, and $r = .90$ (18) to $r = .64$ (4) for women. They seem to be similarly distributed for either sex. Since the Bruce test and the 12 Minute Run have been designed to measure cardiovascular endurance a preliminary question will determine the relation between scores on both. Therefore, the first research hypothesis is that:

> The correlation between the Bruce test and the 12 Minute Run is significant and high enough to allow the tests to be used interchangeably when measuring cardiovascular endurance.

Physical training of the endurance type results in an increase in max $\dot{V}O_2$ (and therefore endurance capacity) in previously sedentary individuals (4,10,22,31,33). The magnitude of an increase in $\dot{V}O_2$ max with training depends on both the individual's initial level of fitness and on the intensity, frequency, duration, and mode of the exercise program (31,33). Differences in training regimes with respect to these variables should be reflected in endurance scores in a properly

designed test. The next question then is whether the Bruce test and the 12 Minute Run do meet these requirements. Thus the second research hypothesis is:

> The Bruce test scores and 12 Minute Run scores will reflect the amount of habitual work done in training by women subjects.

The present study attempts to test the above two hypotheses.

CHAPTER IV

METHODS AND PROCEDURES

Population of the Study

The population of this study included accessable women volunteers between the ages of 22 and 35 years, who have been determined to be free of major health problems by a physician, not overweight according to standard weight tables, and who have been on a consistent exercise program for a minimum of two months.

Method of Sample Selection

Ideally, a random sample would have been desirable in this study, but was not possible due to cost and availability of subjects. Volunteers were solicited by poster and word of mouth from around Multnomah County; specifically they were obtained from Portland State University students and personnel, and from YMCA Fitness Center members and personnel. Volunteers were used to insure that no human rights were violated in subjecting the participants to maximum stress and to insure that the participants were motivated to perform their best on the tests.

Four categories are stratified in the sample: non-exercisers, minimal exercisers, adequate exercisers, and more than adequate exercisers. The criteria for placing volunteers into categories are seen in Table I. Volunteers were solicited for each category. Once the limit of 10 subjects in a group had been attained, any additional volunteers meeting the criteria for that group were not used.

If a subject did not meet all the criteria for placement in a specific group, she was placed in the next lower group.

TABLE I

CRITERIA FOR EXERCISE GROUP PLACEMENT

CRITERION	NON-EXERCISER	MINIMAL EXERCISER	ADEQUATE EXERCISER	MORE THAN ADEQUATE EXERCISER
Type of Activity	0	Rhythmic, Aerobic, Activity	Rhythmic, Aerobic, Activity	Rhythmic, Aerobic, Activity
Intensity	0	Met Level Below 6	Met Level 6-8	Met Level Over 8
Duration	0	Less Than 5 Minutes	5-30 Minutes	More Than 30 Minutes
Frequency	0	1 x/week	2-3x/week	4-7x/week

Method of Data Collection

Participants completed a medical history form (Appendix 1) and underwent a physical examination to exclude any one who may have problems that might occur as a result of testing maximal work capacity or that would contraindicate the "normalcy" of the individual, thus affecting the study results.

An activity survey (Appendix 2) was administered to each participant to determine:

1. weekly activity
2. the activity's intensity, duration, and frequency

From the information obtained in the activity survey, participants were stratified into the following categories: non-exercisers, minimal exercisers, adequate exercisers, and more than adequate exercisers. To be eligible for stratification into these groups, all the described criteria for that group have been met (see Table I).

A performance score was obtained for each participant on the 12 Minute Run Test designed by Cooper (2). The object of the test was to run as far as possible within a 12 minute period. This test was administered on an outdoor 440 yard oval track divided into eight equal parts. The total distance run was recorded in total one eighth laps run and later computed into yards. The participants were instructed to run as far as they could in the 12 minute period allowed. If running could not be continued, the individual was to walk or keep moving at a slower rate until she recovered enough to pick up the pace and ultimately complete the test. Each girl was encouraged to do her very best, as the test is one measuring maximal effort. A five minute warming up period of light stretching calisthenics and walking were permitted before the test, and individuals were encouraged to cool down after the test with more light calisthenics and walking. Stimulating or depressing drugs were not allowed to be taken the day of the test, nor were eating, or drinking caffeinated beverages two hours prior. Also, participants were not allowed to engage in any strenuous physical activity the day of the run. There were no controls over whether the participants ran singly or in groups; nor was there control over weather and track conditions.

All participants were tested for cardiovascular endurance using the Bruce Multistage Exercise Test. The test utilized a calibrated treadmill to regulate energy expenditure. The test began with the participant walking slowly for three minutes at 1.7 mph. at a 10% grade, with an energy requirement equivalent to 4 "mets." Speed and grade increased every three minutes without resting periods (as

indicated by the test description in Table II) to an individually determined endpoint determined by fatigue and or other limiting symptoms or signs. No support of body weight on the handrails was permitted. A bi-polar lead (from V5 position to the inferior tip of the right scapula) was used to monitor ECG for heart rate at the end of each three minute interval and at the test endpoint. An individual's score reflected the total time in seconds that she was able to complete on the treadmill test.

Participants were instructed not to exercise the day of the test or to eat or drink two hours prior to the test. Too, no depressants or stimulants were to be taken that day. Each participant was encouraged to continue walking/running on the treadmill as long as she possibly could, but to discontinue if she could not go any longer, or if she experienced any nausea, dizziness, or other unusual symptoms.

The running test was administered within one week of the treadmill test, with convenience dictating the order of the tests performed.

TABLE II

BRUCE TREADMILL*
TEST FORMAT
AND
SCORE SHEET

	GRADE	SPEED MPH	MINUTES	CUMULATIVE SECONDS	PREP VO_2	RECORD HEART RATE
Level 1	10%	1.7 mph	1	60	7.2	
			2	120	11.2	
			3	180	13.96	
Level 2	12%	2.5 mph	4	240	17.3	
			5	300	20.7	
			6	360	24.0	
Level 3	14%	3.4 mph	7	420	27.4	
			8	480	30.8	
			9	540	34.1	
Level 4	16%	4.2 mph	10	600	37.5	
			11	660	40.8	
			12	720	44.2	
Level 5	18%	5 mph	13	780	47.7	
			14	840	50.9	
			15	900	54.3	
Level 6	20%	5.5 mph	16	960	57.6	
			17	1020	61.0	
			18	1080	64.36	

Completed: Level _____ Seconds _____

Total Seconds _____

*From Bruce's Study (16)

METHOD OF STATISTICAL ANALYSIS

1. Compare Bruce test scores to 12 minute run scores using the Pearson Product Correlation to obtain the correlation coefficient.

2. Compute analyses of variance to determine if there is a significant difference between Bruce test scores in groups 1, 2, 3, and 4, and 12 minute run scores in groups 1, 2, 3, and 4.

3. Contrast group mean scores between all possible combinations of groups to determine whether mean variances between the different

groups are significant or would normally occur in a single population of scores.

group 1 vs. groups 2, 3, 4
groups 1, 2 vs. groups 3, 4

group 1 vs. group 2
group 1 vs. group 3
group 1 vs. group 4
group 2 vs. group 3
group 2 vs. group 4
group 3 vs. group 4

CHAPTER V

RESULTS AND DISCUSSION

The means and standard deviations of group scores on the 12 Minute Run and the Bruce test are presented in Table III. As indicated in Table III, the subjects in this study were similar physically. While the more than adequate exercise group did have a slightly lower mean weight, it was within one standard deviation for all the other groups. This lower mean weight might have been due to training effects as involvement in intense activities may have had an effect of keeping these subjects' weight down, or they may have been more aware of the need for weight control. It is also possible that the inherent smaller size in an individual predisposed her to more intense involvement in activity. Nevertheless, the differences found between any of the groups in age, height or weight did not follow any apparent pattern.

TABLE III

PHYSICAL CHARACTERISTICS OF SUBJECTS

	Mean Age (years) (S.D.)	Mean Height (inches) (S.D.)	Mean Weight (pounds) (S.D.)
Non-Exerciser	27 (4.06)	64.70 (2.30)	125.5 (12.92)
Minimal Exerciser	28.40 (3.44)	66.30 (1.64)	127.5 (10.65)
Adequate Exerciser	25.40 (2.37)	65.60 (2.41)	129.8 (11.78)
More Than Adequate Exerciser	26.60 (2.27)	64.20 (2.25)	119.8 (12.78)

With regard to the question of the relation between scores on the 12 Minute Run and the Bruce test, a Pearson Correlation Coefficient was calculated and found to be 0.90. An r of .316 is required for the .05 level of significance with 40 subjects. This correlation then, is highly significant. By calculating r^2, one obtains a coefficient of determination of 82.76. Thus 82.76% of the factors contributing to variability in scores on one test are in common with factors contributing to variability in scores on the other test; therefore only 17.24% ($1-r^2$) of such factors are unaccounted for. In view of the high correlation, it seems reasonable to conclude that either test can be used in place of the other as warranted by individual circumstances. In other words, they seem to be tests which measure highly similar types of cardiovascular endurance performance for the tested population.

Subjects in this selected population may be more motivated to do well on the prescribed tests than women in the general population. Also, motivation on the two tests may have differed within individuals; for instance, one may have had more incentive to continue running on a motorized treadmill at a set pace than at a self-determined pace as in the 12 Minute Run. Another factor which may have influenced the outcome was the lack of systematic order in administering the tests.

Table IV presents means and standard deviations of performance scores on the two tests arranged by activity group. On overall inspection, it appears that there is a relationship between the amount of work done in training and performance scores on both the 12 Minute Run and the Bruce test. Lowest mean scores were obtained by the non-exercisers, higher scores by the minimal exercisers, higher yet by the

adequate exercisers, and highest scores were achieved by the more than adequate exercisers.

TABLE IV

MEANS AND STANDARD DEVIATIONS OF TEST SCORES BY GROUP

GROUP	BRUCE TEST mean score (seconds) (standard deviation)	12 MINUTE RUN mean score (yards) (standard deviation)
Non-Exerciser	541.10 (66.28)	2151.20 (232.47)
Minimal Exerciser	593.60 (43.60)	2228.86 (247.86)
Adequate Exerciser	662.20 (44.57)	2478.30 (213.29)
More Than Adequate Exerciser	752.20 (74.54)	2952.10 (300.09)

To further determine whether bruce test scores and 12 Minute Run scores reflect the amount of habitual work done in training by women subjects, an analysis of variance was run between the four activity groups on both of these tests. The results are seen in Tables V and VI. F ratios of 24.07 and 20.77 were found on scores from the Bruce test and 12 Minute Run respectively. This can be compared to 2.86 which is required for significance at the .05 level (34,35). This means that there is considerably more overall variability between the groups than there is within the groups, differences which are presumably due to habitual vigorous activity and resulting cardiovascular fitness. It does not rule out the possibility of inherent genetic factors contributing to these differences however. In view of the

impracticability of obtaining a sample size large enough to likely balance out such possible genetic differences (see discussion in Chapter IV, Methods and Procedures), the question remains open as to the role such genetic factors played in the findings.

TABLE V

ANALYSIS OF VARIANCE FOR BRUCE TEST

SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARES	F RATIO
Between Groups	3	249861.48	83287.16	24.07
Within Groups	36	124536.50	3459.90	
Total	39	374417.98		

*An F ratio of 2.86 is required for significance at the .05 level.

TABLE VI

ANALYSIS OF VARIANCE FOR 12 MINUTE RUN

SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARES	F RATIO
Between Groups	3	3910891.40	1303630.47	20.77
Within Groups	36	2259288.20	62758.01	
Total	39	617097.60		

*An F ratio of 2.86 is required for significance at the .05 level.

In addition, the question which is not addressed by calculating the overall F ratio is whether (and if so which) group scores differed significantly when compared in pairs. To answer this question,

contrasting t ratios were calculated and are presented in Table VII. All test comparisons reached significance except for the one contrasting the non-exercisers and the minimal exercisers on the 12 Minute Run ($t = .072$). This same contrast on the Bruce test barely reached significance ($t = 2.09$). The most likely explanation for the above results is that the criteria for placing subjects into groups did not sufficiently discriminate among those who were truly sedentary and those who were minimally active. This could have been due to errors in memory when the subjects reported their activity habits, or to a tendency to overgeneralize about habitual activity based on most recent weeks. An alternative explanation is that the criteria were adequate, but that the typical level of activity in the minimal exercise group was below the "threshold" level of activity to improve one's endurance capacity, as described by Pollock (33) and others (12,23,32).

TABLE VII

CONTRASTING T RATIOS ON BRUCE AND 12 MINUTE RUN SCORES

CONTRAST GROUP	BRUCE TEST		12 MINUTE RUN	
	S. ERROR	T	S. ERROR	T
1,2 vs. 3,4	18.60	-7.52	79.22	-6.63
1 vs. 2,3,4	69.99	-5.50	261.43	-4.61
1 vs. 2	25.09	-2.09	107.46	-0.72
1 vs. 3	25.26	-4.79	99.77	-3.28
1 vs. 4	31.54	-6.69	120.04	-6.67
2 vs. 3	19.72	-3.48	103.41	-2.41
2 vs. 4	27.31	-5.81	123.08	-5.88
3 vs. 4	27.47	-3.28	116.42	-4.07

*A t ratio of > 2.03 is required for significance at the .05 level.

Based on the high correlation between the two tests, decisions regarding which test should be used can be based on individual circumstances. Second, because either test does discriminate adequately between divergent activity levels, each test can be used repeatedly to monitor progressive training effects with time as a woman engages in a fitness program. Decisions regarding which test to use can be based on individual circumstances.

CHAPTER VI

CONCLUSIONS

For the population of women at various levels of habitual activity who are represented by the selected sample in this study, the following conclusions seem warranted:

1. The correlation between performance scores on the Bruce Multistage Treadmill Test and the Cooper 12 Minute Run Test is high enough to indicate that they measure largely the same type of cardiovascular endurance performance.

2. Each test appears to adequately discriminate among women of divergent levels of habitual activity except at the lowest levels.

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APPENDIX I

Y.M.C.A. Fitness Center-Portland

PHYSICAL FITNESS PROGRAM

HISTORY FORM

Name _____ Date _____

Address _____ Zip Code _____

Home Phone _____ Business Phone _____

HAVE YOU EVER HAD: IF YES, RECORD AGE
(Circle Correct Answer)

NO YES Scarlet Fever
NO YES Rheumatic Fever, Heart Murmurs
NO YES Palpitations
NO YES Rheumatism, Arthritis
NO YES Gout

NO YES Pneumonia
NO YES Asthma, Hay Fever
NO YES Tuberculosis
NO YES Diabetes Mellitus (Sugar Diabetes)
NO YES Liver Disease
NO YES Jaundice
NO YES Anemia
NO YES Gallbladder Trouble

NO YES Stroke
NO YES Fainting Spells
NO YES Convulsions, Epilepsy
NO YES Paralysis
NO YES Dizziness, Unconsciousness
NO YES Anxiety, Depression
NO YES Cancer
NO YES Skin Disease
NO YES Thyroid Trouble
NO YES Kidney Disease
NO YES Indigestion
NO YES Stomach Ulcers
NO YES Other Bowel Disease

NO YES Were you ever turned down by an insurance company for medical reasons. If yes, give details _____

_____

_____

NO YES Have you ever served in the Armed Forces? If so, were you turned down for medical reasons? If yes, give details _____

_____

NO YES Have you ever been hospitalized for any illness? If yes, give details

_____

_____

NO YES Have you ever had any operations? If yes, give details _____

_____

NO YES Do you become easily fatigued?

Do you become short of breath when:

NO YES Climbing stairs?
NO YES Exercising?
NO YES Excited?

If yes, answer the following: Is it:
( ) pain ( ) pressure
( ) burning
( ) squeezing ( ) other
How recently? _____

_____

NO YES Has shortness of breath ever awakened you at night?
NO YES Do you cough frequently?
NO YES Do you cough anything up?
If yes, ( ) Mucus?
( ) Blood?
NO YES Joint pains?
NO YES Joint swelling?
NO YES Bursitis or sciatica?

NO YES Are your ankles swollen at bedtime?
NO YES If yes, does the swelling disappear by morning?
NO YES Do you have varicose veins?
NO YES Have you ever had any discomfort in your:
( ) arm
( ) chest
( ) jaw

NO YES Does (did) it stay in one place?
How long does (did) it last? _____
NO YES Does the pain occur at any special time?
NO YES After meals?
NO YES When you exercise?
NO YES When you walk in cold, windy weather?
NO YES When you are nervous or upset?
NO YES Other? _____
NO YES Does anything relieve the pain?
NO YES Rest?
NO YES Soda Bicarbonate?
NO YES Other? _____
NO YES Do you have pains or cramps in your legs when you walk?
NO YES If yes, is the pain relieved when you stop walking?

FAMILY HISTORY

FAMILY RECORD	AGE IF LIVING	CONDITION OF HEALTH (Give Details)	AGE AT DEATH	CAUSE OF DEATH
Father				
Mother				
Brothers				
Sisters				

Is there a family history of:

NO YES Heart trouble?
NO YES High blood pressure?
NO YES Diabetes?
NO YES Lung trouble--emphysema
NO YES Hardening of the arteries?

BODY WEIGHT

What is your usual weight _____lbs.
What was your weight at age 25 _____lbs.

SMOKING STATUS

NO YES Do you smoke at the present time?
NO YES Have you ever smoked? If yes, did you smoke:

( ) Cigarettes?
( ) Cigars?
( ) Pipe?
( ) Other _____

How old were you when you started smoking regularly _____years.

Give an estimate of how much you smoke now:

used to smoke	cigarettes per day
_____	_____

ACTIVITY RATING

Do you participate in any of the following?

Swimming _____	Platform Tennis _____
Running _____	Volleyball _____
Bicycling _____	Basketball _____
Calisthenics _____	Tennis _____
Exercise Room _____	Badminton _____
Walking _____	Bowling _____
Paddleball _____	Golf _____
Handball _____	Weight Training _____

Other _____

Please state how many times per week you exercise _____

How long (minutes)each time _____

How many years have you exercised _____

Y.M.C.A. Fitness Center - Portland

Name _____

Address _____

PHYSICAL EXAMINATION

1. Height
2. Weight
3. Blood Pressure
4. Neck Veins, Carotid Arteries
5. Chest
6. Heart
7. Abdomen
8. Extremities

APPENDIX II

ACTIVITY SURVEY

ACTIVITY	INTENSITY Speed in Mph or min. miles	MET. LEVEL of activity at said intensity	DURATION minutes percent of exercise	FREQUENCY times week	TOTAL Mets

TOTALS

APPENDIX III

PARTICIPANT INSTRUCTIONS FOR ENDURANCE TESTS

Before taking the treadmill test and the 12 minute run please follow these instructions:

1. Complete the medical history and physical exam.
2. Complete the activity survey.
3. The day of the test, do not exercise before your test.
4. Do not eat or drink caffeinated beverages up to 2 hours before your test.
5. Do not take any depressing or stimulating drugs the day of the test.
6. Do not participate in testing if you have been recently or are presently ill.

APPENDIX IV

12 MINUTE RUN TEST

NORMS FOR WOMEN

Distance (miles) walked and run in 12 minutes

Fitness Category	Age (years) Under 30	30-39
1. Very poor	L. 95	L. 85
2. Poor	.95-1.14	.85-1.04
3. Fair	1.15-1.34	1.05-1.54
4. Good	1.35-1.64	1.25-1.54
5. Excellent	1.65 +	1.55 +

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APPENDIX V

DATA FROM BRUCE TREADMILL TEST AND COOPER 12 MINUTE RUN

TEST NUMBER	AGE (YEARS)	HEIGHT (INCHES)	WEIGHT (POUNDS)	SECONDS COMPLETED ON BRUCE TEST	YARDS RUN IN 12 MIN.
NON-EXERCISERS					
1	25	67	133	584	2200
2	26	62	127	580	2420
3	32	70	145	600	2310
4	30	63	130	550	2150
5	23	63	106	558	2200
6	33	64	105	420	1760
7	24	64	120	600	2200
8	31	63	124	522	2420
9	23	67	140	570	2092
10	23	64	125	427	1760
MINIMAL EXERCISERS					
11	30	70	132	516	1870
12	26	65	120	636	2475
13	28	66	110	610	2112
14	24	67	140	603	2147
15	27	66	120	613	2464
16	31	65	135	582	2200
17	24	68	128	558	2035
18	35	65	145	630	2640
19	28	66	120	540	1980
20	31	65	125	648	2365
ADEQUATE EXERCISERS					
21	28	65	125	684	2475
22	27	65	130	670	2475
23	29	66	125	690	2640
24	24	63	125	581	2200
25	22	63	115	670	2640
26	24	69	135	638	2346
27	24	70.5	130	639	2460
28	25	66	127	630	2253
29	25	66	160	750	2851
30	27	63	126	670	2263

TEST NUMBER	AGE (YEARS)	HEIGHT (INCHES)	WEIGHT (POUNDS)	SECONDS COMPLETED ON BRUCE TEST.	YARDS RUN IN 12 MIN.
MORE THAN ADEQUATE EXERCISERS					
31	27	64	117	732	2805
32	26	63.5	115	660	2915
33	30	67	135	670	2750
34	24	68.5	132	780	3115
35	26	63	105	725	2882
36	24	62	115	906	3355
37	30	65	114	720	2437
38	28	63.5	117	757	3080
39	27	61	105	840	3432
40	24	66.5	143	732	2750