COMPARISON OF ACTIVE AND INACTIVE WOMEN IN THE PERFORMANCE OF THE VERTICAL JUMP AND SELECTED CHARACTERISTICS OF ISOKINETIC FORCE-TIME CURVES

by

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B. S., Texas A&M University, 1970

A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Health, Physical Education and Recreation

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1974

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Dedicated to

My wife and parents who had the confidence and patience necessary to sustain me through a year of struggling.

ACKNOWLEDGEMENTS

I would like to acknowledge Bill O'Donnell for his assistance in the testing of subjects in this study. Thanks also to Dr. John Merriman and Dr. Richard Hause for their short-notice assistance. Finally, I would like to offer my sincerest appreciation to Dr. Larry Noble, without whom this paper might not have been finished.

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CHAPTER I

INTRODUCTION AND STATEMENT OF THE PROBLEM

Power of the lower extremity is of considerable importance to success in many court and field activities. Consequently, coaches and trainers are interested in establishing training techniques designed to improve power performances. The first problem was to determine a means by which power could be measured. The vertical jump test has often been used as a measurement of leg power (3, 4, 7, 12, 13, 26). Using a vertical jump test, researchers can measure performance differences in trained and untrained individuals but not the particular characteristics of power. For example, power or maximum strength at different speeds of contraction are parameters that cannot be accurately measured. There is a need for a test that can measure characteristics of power and better detect differences between trained and untrained individuals. More specific and accurate measurement techniques allow an increased capacity to detect training effects and ultimately may improve training techniques.

Recently a bioengineer, James Perrine, developed a totally new concept of resistive training called isokinetics. Some isokinetic exercisers make it possible to measure force-time curves during the performance of a movement at various speeds.[1] The force-time curves allow for the measurement of the following: (1) rate of tension development; (2) maximum strength; and (3) total area under the force-time curve.

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[1] Super Mini Gym Corporation, Independence, Missouri.

If these measures are found to be reliable and to discriminate between trained and untrained subjects, they would provide information that could increase the capability of detecting training effects and allow for the development of training programs more specific to the development of power.

STATEMENT OF THE PROBLEM

The purpose of this study is two-fold: (1) to compare differences in performance between active and inactive women on vertical jumping ability and three measurements taken from isokinetic force-time curves in the knee extension-hip extension movement at two contraction speeds; and (2) to determine the interrelationships between vertical jumping ability and the three characteristics of the force-time curves measured at two contraction speeds. The three characteristics are rate of tension development, maximum strength, and total area under the curve.

LIMITATIONS

It is essential to the validity of this study that maximal effort be exerted on each test. College women are not accustomed to strenuous physical exertion and there is the possibility that some may not have realized their fullest potential. Other studies have experienced the problem of reliability when using women subjects performing strength measures (15, 17, 22).

DEFINITIONS OF TERMS

Isometric contraction

A muscle contraction in which there is no movement.

Isotonic contraction

A muscular contraction where resistance remains constant throughout the range of a movement.

Isokinetic contraction

A muscular contraction where the speed of contraction remains constant and resistance varies directly with the amount of force applied at any point in the range of the movement.

Power

The capacity to produce maximum muscular contraction in the shortest possible time (3). $\text{Power} = \frac{\text{Force x Distance}}{\text{Time}}$

CHAPTER II

REVIEW OF LITERATURE

The review of literature chapter is generally divided into four major categories. The first section presents studies relative to testing procedures followed such as preliminary exercise, jump test used, and the particular jump used in test correlations. The second section considers past studies involving tests of leg strength and power and their relationship. Section three includes studies dealing with training techniques and their effect on vertical jumping ability. Finally, the last section presents studies specifically related to isokinetic exercise.

STUDIES RELATED TO TEST PROCEDURES

Richards (24) found significant improvement in jumping performances by eighty sixteen-year-old girls following a one to two minute warm-up exercise (stool stepping). She divided the subjects into four groups and tested them at one, two, four, and six minute work tasks prior to jumping tests. The one and two minute tasks improved performance approximately twenty percent. There was no effect by the four minute level and twenty-seven percent impairment by the six-minute warm-up.

Pacheco (23) found results similar to Richards. She reported that her subjects improved in vertical jumping nearly eight percent using stationary running as the warm-up exercise. She also experienced increases of 2.88 percent and 4.99 percent with warm-ups of deep knee bends and isometric stretching, respectively.

Gray and others (12) conducted a study using college males to determine a more efficient method of testing vertical jumping ability. He used four tests, the jump reach, standing broad jump, squat jump, and modified vertical power jump to investigate their relationship to the standard power jump test he devised earlier (13). The standard power jump test had a coefficient of objectivity of 0.981 and a retest correlation of 0.985. Gray reported the modified vertical power jump to have a validity coefficient of 0.989 and to be significantly more valid than any of the other tests. The squat jump measured 0.840, the standing broad jump 0.682, and the jump reach method 0.780. The modified vertical power jump was also found to be less time consuming, eliminated body and arm swing, took less time to learn, and was easier to measure.

Whitley and Smith (26) found higher correlations using the average of the trials in their tests. Using sixty college males, they determined an $r = .66$ using average scores versus $r = .57$ using "best" scores when correlating strength with speed. McCraw (20) also found higher correlations using average scores rather than best but reported the difference was not of significance. He further stated that it would seem that the best of three would be an acceptable method. Berger and Sweney (4) concurred with McCraw and stated there is no logical reason for using one in lieu of the other.

RELATIONSHIP OF LEG STRENGTH AND LEG POWER

McClements (19) tested eighty-six college males to compare power of the lower body, as measured by the vertical jump and body weight, with the strength of leg and thigh flexor and extensor muscles. He also compared the effect on power of strength development of agonistic muscle groups. All four training groups increased significantly in flexion strength, extension strength, and power. All programs were found to be equally effective. He added that, although strength is related to power, gains in strength are not necessarily related to gains in power.

Costill (9) found that the squat lift was related to anaerobic power in a study using seventy-six college men, sixty-five of which were varsity football players. He also noted that the relation between squat lift and body weight was significant. Since body weight was used in calculating anaerobic power, he hypothesized that body weight might have accounted for the correlation of squat lift and anaerobic power.

Smith (25) ran a similar study to that of Costill's and found a low, nonsignificant correlation between ratio of tested strength and body weight to vertical jumping ability. His study was comprised of seventy college males tested in a position designed to employ the power thrust of the major muscle groups involved in vertical jumping. Smith reported that strength exerted against a dynamometer involves a different neuromotor pattern than strength exerted in the vertical jump movement pattern.

Gray (13) concluded from a study using male adults as subjects that leg speed as measured by a bicycle ergometer and leg power as measured by the vertical jump are significantly related at the .001 level of confidence. His procedure on the bicycle ergometer had a retest reliability of 0.969.

EFFECT OF TRAINING METHODS ON VERTICAL JUMP PERFORMANCE

In a study using isometric training, Ball (1) divided sixty-three college males into two groups. He trained one group with isometrics and the other was untrained. Results found significant improvements in strength measures of the trained group but no significant increases in vertical jumping ability.

Lindeburg (18) tested seventy-six eighth grade boys for broad jumping ability and then trained them using isometrics for a six-week period. Results showed no significant improvement in broad jumping ability.

In a study including both static and dynamic training, Berger (5) trained four different groups of college males. Group I (N=29) trained with ten repetitions maximum per work-out, group II (N=20) worked at fifty to sixty percent of maximum for ten repetitions, group III (N=21) trained statically, and group IV trained by performing vertical jumps. Dynamically trained groups improved significantly more in vertical jumping than did the statically trained group or the group trained by vertical jumping alone. Berger added that the static training did not involve specificity of exercise as did the dynamic training. According to Moffroid (21) specificity of exercise is important. She explains that the amount of work done is not as important as the rate at which it is done.

Chui (7) trained two groups of college freshmen and sophomores with weights to improve vertical jumping ability. Both groups were reported to have improved significantly in vertical jumping ability.

Daugherty (11) used two high school basketball teams in a similar study. One team trained with weights including overhead presses, curls, heel-raises, and half knee bends. The other group used an apparatus which made it possible to actually jump while holding weights on the shoulders. Results showed significant increases in vertical jumping ability for both groups and the group jumping while holding weights on their shoulders improved significantly more than the other group.

ISOKINETIC EXERCISE TRAINING STUDIES

Hislop and others (14) used fifty-one physically normal subjects to test the effectiveness of the isokinetic exerciser. After an eight-week training period, the isokinetic exerciser was found to be more effective in strength improvement than was the weight training technique employed. The isokinetic exerciser also was found to work well as a dynamometer for measuring muscle performance, including torque parameters, total work, and power rates.

Knight and George (16) used isotonics and isokinetics to train thirty-nine college men. Group I used an isotonic technique (weights), group II trained with an isokinetic exerciser, and group III remained untrained. After a six-week training session, results indicated no significant differences between isotonic and isokinetic techniques. There was, however, significant improvement in muscular power with both methods. Margaria's Power Staircase Test was used to determine power increases.

SUMMARY OF REVIEW OF LITERATURE

The following summarization is offered in review of the literature cited:

1. Leg strength and leg power are related but strength gains are not necessarily accompanied by similar gains in power.

2. Static strength measures are not specific to the dynamic measure necessary for power assessment.

3. Isotonic training produces increases in leg strength, leg power, and vertical jumping performances.

4. Isokinetic exercise has been found to be effective in improving muscle rehabilitation, strength development, power development, and vertical jump performances.

CHAPTER III

PROCEDURE

This chapter includes information concerning selection of subjects, testing procedure followed, data reduction techniques, and statistical methods used for determining correlations.

This study was conducted in the spring semester, 1972-1973, at Kansas State University. All equipment and facilities utilized were the property of the Physical Education Department. The investigator and one volunteer carried out the testing procedure which took two weeks.

SELECTION OF SUBJECTS

Fifty female college students at Kansas State University aged eighteen to twenty-four years were tested. As subjects volunteered, they were questioned as to their daily activities and classified either active or nonactive. Those subjects actively involved on an athletic team at Kansas State or currently participating in a daily physical fitness program were classified as active. Those subjects neither actively competing nor engaging in a regular fitness program were classed as inactive. Testing time schedules were arranged to suit the convenience of the subject.

TESTING PROCEDURE

Three tests were administered to each subject: (1) the modified vertical power jump, (2) the isokinetic power thrust, slow speed, and (3) the isokinetic power thrust, fast speed. The three tests were administered in one testing session with the order of administration of the tests rotated to control for warm-up and fatigue effects. Four testing sequences were used: (1) vertical jump, power thrust slow, power thrust fast, (2) vertical jump, power thrust fast, power thrust slow, (3) power thrust slow, power thrust fast, vertical jump, and (4) power thrust fast, power thrust slow, vertical jump. Five-minute rest intervals were allowed between the vertical jump test and the power thrust tests. Before beginning testing, each subject followed the warm-up exercise program listed below:

1. Bend and touch toes slowly. Keep feet together and knees straight. Repeat five times.
2. Squat to ninety-degree angle at the knee. Keep hands on hips. Repeat five times.
3. Run in place. Raise knees high. Repeat until left foot touches twenty times.
4. Jump vertically twice. Do not exert a maximal effort.

To test vertical jumping ability, each subject touched the middle fingers of their preferred hand in a container of white chalk. The subject then stood with the preferred side to the testing wall, reached on tip toes, and touched as high as possible. Next, the feet were spread to approximately shoulder width, the nonpreferred hand was tucked in the shorts behind the back, and the arm of the preferred hand was held in vertical extension with that side next to the wall. Finally, the knees were flexed until the upper legs were nearly or completely horizontal to the ground (knee joint angle approximately ninety degrees). The subject held this position momentarily and then jumped and touched as high as possible. No arm swing or bouncing was allowed. The distance between the highest point touched on tip toes and the highest point touched after jumping was measured and recorded. Three trials were given with thirty-second rest periods between each trial.

Identical procedures were used for the two tests on the power thrust machine except for the rate of speed. The slow speed was set at 6.3 feet per second and the fast speed was set at 8.6 feet per second. The subject positioned himself in the machine similar to the ready position for the vertical jump test. The knees were flexed to the same angle and the back was held straight (see Figure 1). The movement was a maximum effort vertically against the machine. One trial was allowed at each speed with a three minute rest interval between efforts.

DATA REDUCTION METHODS

The power thrust machine used in this study was manufactured by the Super-Mini Gym Corporation, Independence, Missouri, and was equipped with a device that recorded on graph paper force-distance curves. From this recording, maximum strength, rate of tension development, and total area under the force-time curve was measured and recorded. Figure 2 provides an example of a force-distance curve as used in this study. The peak of the curve (A) was used as the measure of maximum strength. The rate of tension development (B) was taken by measuring the half-

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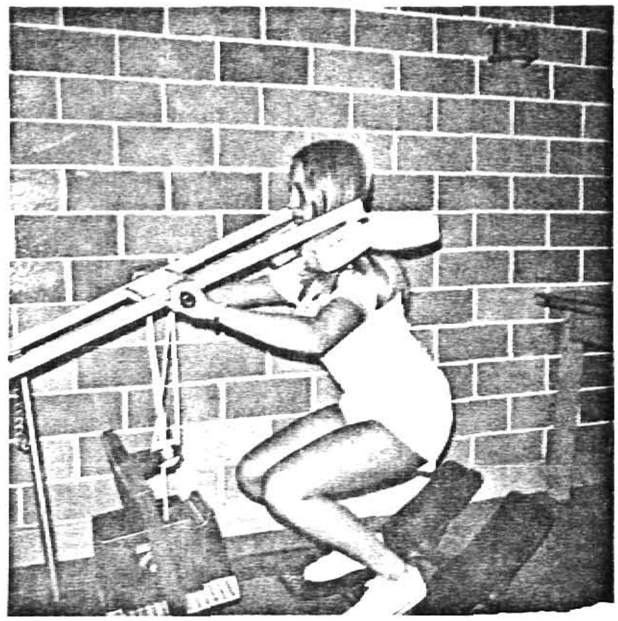

Figure 1. Isokinetic Power Thrust Machine

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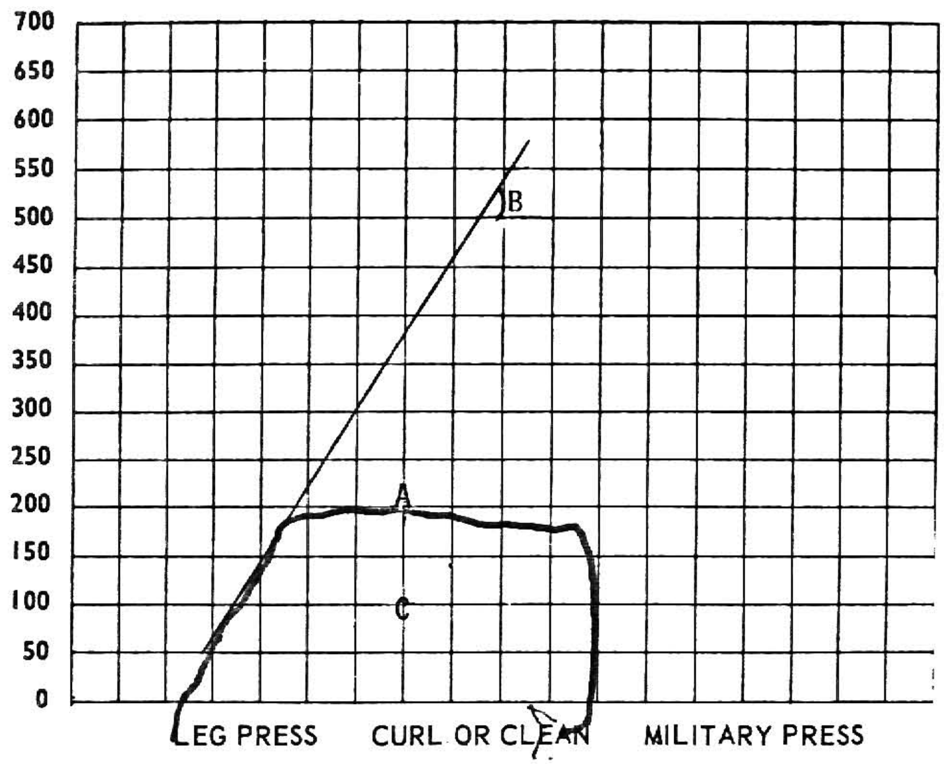

Figure 2. Force-Time Curve.

time slope of the curve. This was done by determining the beginning of tension development, the peak of the curve, and finding the mid-point of that distance. The angle from the mid-point on the curve to the peak was used as the rate of tension development. Finally, total area under the curve (C) was measured with the use of a planimeter. All results of total area are reported in 1/100 of square inches. Weights were used to calibrate the power thrust machine to actual pounds of force. It was determined by calibration with weights that the read-out of maximum strength in pounds was equal to .67 of the true force. The results of this study for maximum strength have been corrected accordingly. However, to determine true strength of the individual it would be necessary to compute a correction factor for the lever advantage presented by the machine. This correction factor was found to be .657. For the purposes of this study, it was not necessary to use this factor. If desired, the strength figures in Table II can be multiplied by .657 to yield true strength of the subject. To convert planimeter units to ft. lb./sec., multiply by 62.2 (fast speed) or 49.8 (slow speed). This figure was arrived at by use of the following formula:

$$P = \frac{S \times D}{t}$$

where:

P = power; S = actual strength in pounds; D = distance moved; t = duration of contraction

On the recording, one inch vertically was equal to eighty-eight pounds of force and one inch horizontally on the graph equalled 1.12 sec. (fast speed) or 1.4 sec. (slow speed). Also, one inch corresponded to .792 ft. in distance irrespective of the testing period. Therefore, to convert hundredths of square inches into ft. lb./sec.:

1. Fast speed (8.6 feet per second)

$$P = \frac{88 \text{ lbs.} \times .792 \text{ ft.}}{1.12 \text{ sec.}} = 62.2 \times \text{planimeter reading} = \text{ft. lbs. per sec.}$$

2. Slow speed (6.3 feet per second)

$$P = \frac{88 \text{ lbs.} \times .792 \text{ ft.}}{1.4 \text{ sec.}} = 49.78 \times \text{planimeter reading} = \text{ft. lbs. per sec.}$$

STATISTICAL METHODS

The .05 level of confidence was used in all statistical tests for significance. A t-test for individual samples was run to test for significant differences in performance measures between trained and untrained subjects. The Pearson Product Moment Correlation Coefficient was used to investigate intercorrelation of performances in vertical jumping and each of the characteristics measured by the isokinetic exerciser. The coefficients were converted to z-scores to determine if they were significant. Finally, eleven subjects were tested on two different days to determine the reliability of each of the measures recorded. These subjects were chosen according to individual availability for testing. Seven were active and four were inactive.

CHAPTER IV

RESULTS AND DISCUSSION

This chapter presents the results of the data analysis and a discussion of those results. The material is presented under three major sections: (1) results of reliability correlations, (2) summary of the comparison of trained and untrained women, and (3) intercorrelations between the variables measured.

RELIABILITY RESULTS

Table I lists the reliability results for each measure. The reliability of total area at the slow speed measure was found to be .930 and the most reliable measure. At .447, rate of tension development (slow speed) was found to be the least reliable measure. Reliability of the vertical jump measure used in this study was found to be .861.

TABLE I

RELIABILITY TEST

Best Jump	.861
Total Area (Fast)	.856
Total Area (Slow)	.930
Rate Tension Development (Fast)	.847
Rate Tension Development (Slow)	.447
Maximum Strength (Fast)	.679
Maximum Strength (Slow)	.743

COMPARISON OF TRAINED AND UNTRAINED WOMEN

Table II gives a summary of the comparison of trained and untrained subjects. Total area (fast speed), total area (slow speed), and maximum strength (slow) were found to be significantly different between trained and untrained women. The mean scores for the trained group were higher in every case and several of the other variables, best jump, rate tension development (slow) and maximum strength (fast), approached significance.

INTERCORRELATION OF VARIABLES

Table III presents the results of an intercorrelation between the variables using the Pearson Product Moment Correlation Coefficient. Group membership was not considered in this comparison. The best jump had only low and insignificant correlations with the various measures from the force-time curves. Total area (fast speed) was found to correlate significantly with total area (slow speed), rate of tension development (slow), and maximum strength (fast and slow). Total area (slow) was significantly correlated to total area (fast), rate of tension development (slow), and maximum strength (fast and slow). The rate of tension development (fast) was found to correlate significantly with rate of tension development (slow). The rate of tension development (slow) correlated significantly with total area (fast and slow). Maximum strength (fast) was found to correlate significantly with total area (fast and slow), rate of tension development (slow), and maximum strength (slow) while maximum strength (slow) correlated well with total area (fast and slow), rate of tension development (slow), and maximum strength (fast).

TABLE II

BETWEEN GROUP COMPARISON

	t-ratio	df	M_1	M_2	SD_1	SD_2
Best Jump	1.271	48	25.868	24.010	3.331	5.801
Total Area (Fast Speed)	1.861*	48	214.211	170.032	120.770	43.202
Total Area (Slow Speed)	2.086*	48	235.632	172.129	160.132	45.587
Rate Tension Dev. (Fast)	0.886	48	27.263	24.065	13.478	11.699
Rate Tension Dev. (Slow)	1.565	48	28.947	23.839	13.990	9.133
Max. Strength (Fast)	1.555	48	225.632	152.226	217.186	116.992
Max. Strength (Slow)	2.373*	48	217.526	139.839	152.515	79.032

* Significant at .05 level of confidence

TABLE III

INTERCORRELATIONS OF ALL VARIABLES

	Best Jump	Area Fast	Area Slow	Rate Tension Dev. (Fast)	Rate Tension Dev. (Slow)	Max. Strength (Fast)	Max. Strength (Slow)
Best Jump	-	.1377	.0755	.0395	.0620	.0738	.1345
Total Area (Fast)		-	.9220*	-.0225	.2319*	.3194*	.6276*
Total Area (Slow)			-	-.0537	.3110*	.3518*	.6690*
Rate Tension Dev. (Fast)				-	.5250*	-.0203	-.0587
Rate Tension Dev. (Slow)					-	.2752*	.3492*
Max. Strength (Fast)						-	.8577*
Max. Strength (Slow)							-

* Significant at .05 level of confidence

DISCUSSION

The results of this study indicate that while the trained group was superior in performance measures of total area (fast and slow speeds) and maximum strength (slow speed), the differences between the groups on best jump, rate of tension development (fast and slow speeds), and maximum strength (fast speed) were not significant. The basic assumption for this study was that there was a difference between the groups with respect to leg power. The relatively poor reliability measurements could possibly account for the inability of some of the variables to distinguish significant differences between group performances.

The total area (slow speed) was the most reliable test and was capable of determining differences between trained and untrained individuals. The high correlation between total area (fast speed) and total area (slow speed) would indicate that either speed could be used in testing. The two total area measures were also found to be significantly related to maximum strength at both speeds. Therefore, it appears that the total area (either speed) measure could be considered a reliable and valid indication of power. The total area (fast and slow speed) and the maximum strength measures could be more direct measures of leg power than the vertical jump. The vertical jump is a measure of the effect of an individual's power to propel his body weight vertically. The power measure obtained on the isokinetic exerciser is a more direct leg power measurement that is not contaminated with elements of skill.

CHAPTER V

SUMMARY AND CONCLUSIONS

The purpose of this study was two-fold: (1) to compare differences in performance between trained and untrained women on vertical jumping ability and three measurements taken from isokinetic force-time curves in the knee extension-hip extension movement at two contraction speeds; and (2) to determine the interrelationships between vertical jumping ability and the three characteristics of the force-time curves measured.

This study was conducted in the spring semester, 1973, at Kansas State University. The subjects were fifty college women used on a voluntary basis. The women were classified either trained or untrained depending on whether or not the subject was currently following a daily fitness program. This fitness program could be either collegiate athletics or a personal fitness program and still be classified as trained.

Each subject was allowed three trials at vertical jumping and one maximum effort at each contraction speed (1.12 feet per second and 1.4 feet per second) on the power thrust machine. The order of administration of tests was rotated to minimize possibilities of bias due to fatigue or warm-up effects.

The .05 level of confidence was used in all statistical tests of significance. A t-test for independent samples was run to test for significant differences in performance measures between trained and untrained subjects. The Pearson Product Moment Correlation Coefficient was used to investigate intercorrelation of performances in vertical jumping and each of the characteristics measured by the isokinetic exerciser. The coefficients were converted to Z-scores to determine if they were significant. Finally, eleven subjects were tested on two different days to determine the reliability of each of the measures recorded.

CONCLUSIONS

The following conclusions are justified from the data gathered and should be considered within the limits of this study:

1. The following measures recorded by the isokinetic exerciser are capable of differentiating between trained and untrained women: (a) total area under the curve (fast speed); (b) total area under the curve (slow speed); (c) maximum strength (slow speed).

2. Total area under the curve (fast speed) and total area under the curve (slow speed) are related.

3. Maximum strength (fast) measures and maximum strength (slow) measures are related.

4. Total area under the curve measures at fast or slow speeds and maximum strength at either fast or slow speeds are related.

5. There is no relationship between vertical jumping ability and the three characteristics of the force-time curve at either contraction speed.

NEED FOR FURTHER RELATED RESEARCH

The following are suggestions for further related research:

1. A study similar in nature using male subjects.

2. A study similar in nature giving consideration to body weight of the subject.

3. A longitudinal study investigating changes in force-time curves and improvements in vertical jumping following a training program using the isokinetic power thrust machine.

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APPENDIX A

RAW SCORES FOR INACTIVE GROUP

Subject	Jump (cm) 1st	2nd	3rd	Best	Total Area (1/100 sq in) Fast	Slow	Rate of Tension Dev.(°) Fast	Slow	Max. Strength (lbs.) Fast	Slow
1	23.0	25.2	24.5	25.2	0177	0133	50	18	198	132
2	27.0	27.0	32.2	32.2	0133	0101	13	16	96	92
3	23.9	29.5	28.3	29.5	0097	0115	24	24	76	79
4	30.5	28.6	35.0	35.0	0160	0151	26	24	149	137
5	18.0	22.8	23.9	23.9	0214	0160	16	24	139	139
6	30.0	31.1	32.2	32.2	0159	0177	22	16	116	119
7	24.2	25.3	23.6	25.3	0198	0175	29	34	172	172
8	11.5	16.1	15.0	16.1	0122	0123	32	24	109	109
9	16.8	23.7	24.5	24.5	0244	0209	25	29	162	149
10	33.1	36.8	36.9	36.9	0202	0219	14	33	149	188
11	32.5	32.2	34.0	34.0	0246	0245	11	19	132	165
12	16.5	17.3	15.5	17.3	0163	0152	17	13	83	76
13	19.2	28.3	27.4	28.3	0236	0195	20	28	149	149
14	16.0	17.5	16.7	17.5	0219	0218	22	28	162	145

APPENDIX A (Con't.)

Subject	Jump (cm) 1st	2nd	3rd	Best	Total Area (1/100 sq in) Fast	Slow	Rate of Tension Dev. (°) Fast	Slow	Max. Strength (lbs.) Fast	Slow
15	15.4	18.0	16.4	18.0	0100	0148	14	20	79	99
16	18.7	18.6	20.3	20.3	0117	0108	8	8	79	73
17	21.2	23.8	22.4	23.8	0137	0156	50	29	162	172
18	23.4	26.0	27.8	27.8	0143	0170	23	18	86	132
19	15.2	18.7	17.3	18.7	0183	0190	30	34	152	172
20	22.8	24.8	24.2	24.8	0170	0199	15	28	125	158
21	16.2	18.4	15.3	18.4	0195	0175	18	25	112	112
22	26.8	28.6	28.0	28.6	0243	0235	27	19	165	149
23	25.0	24.3	24.0	25.0	0200	0233	43	24	195	172
24	17.1	17.3	17.8	17.8	0177	0162	35	25	152	145
25	18.2	19.3	19.6	19.6	0158	0201	20	17	116	149
26	15.8	18.2	20.1	20.1	0116	0152	9	23	73	99
27	18.2	19.3	21.0	21.0	0163	0130	46	36	178	165
28	21.3	21.5	17.6	21.5	0119	0127	18	20	112	115
29	16.4	16.9	18.2	18.2	0135	0160	15	10	99	116
30	20.0	20.6	19.7	20.6	0193	0130	25	14	172	116
31	15.6	21.6	22.6	22.6	0145	0174	5	12	116	132

APPENDIX B

RAW SCORES FOR ACTIVE GROUP

Subject	Jump (cm) 1st	2nd	3rd	Best	Total Area (1/100 sq in) Fast	Slow	Rate of Tension Dev. (°) Fast	Slow	Max. Strength (lbs.) Fast	Slow
1	30.3	31.1	31.3	31.3	0188	0175	26	15	162	162
2	24.7	25.4	27.0	27.0	0288	0250	36	15	205	162
3	21.7	22.0	23.4	23.4	0133	0132	13	15	92	99
4	24.0	22.5	23.5	24.0	0267	0286	21	24	162	175
5	21.8	21.0	22.9	22.9	0103	0179	12	13	73	125
6	22.3	21.6	24.0	24.0	0143	0133	17	26	92	119
7	24.2	24.7	27.1	27.1	0172	0193	39	44	185	205
8	16.5	19.9	17.3	19.9	0223	0270	22	19	165	185
9	25.0	25.7	27.1	27.1	0262	0273	15	17	182	191
10	22.2	22.0	24.1	24.1	0205	0169	10	16	112	106
11	19.3	21.2	25.5	25.5	0177	0174	20	21	145	165
12	26.8	27.2	27.4	27.4	0126	0140	15	23	99	149
13	25.2	24.6	25.3	24.3	0200	0278	24	30	149	185

APPENDIX B (Con't.)

Subject	Jump (cm) 1st	2nd	3rd	Best	Total Area (1/100 sq in) Fast	Slow	Rate of Tension Dev. (°) Fast	Slow	Max. Strength (lbs.) Fast	Slow
14	25.6	26.7	24.2	26.7	0250	0230	34	30	172	185
15	17.3	18.7	19.0	19.0	0148	0136	46	45	185	182
16	30.0	28.8	28.3	30.0	0168	0193	47	33	175	175
17	26.8	29.8	31.5	31.5	0218	0281	45	37	198	208
18	25.5	24.7	26.9	26.9	0177	0232	39	62	172	224
19	24.2	26.7	28.2	28.2	0217	0177	46	48	211	215

VITA

Roy Allen Gann, Jr. was born in Ft. Worth, Texas, on July 9, 1948, the son of Mary Alice and Roy Gann, Sr. After graduating from Jenkins High School, Savannah, Georgia, in 1966, he attended Texas A&M University for four years. He received his Bachelor of Science degree from Texas A&M in 1970. In August, 1970, he was employed as an elementary physical education instructor in the Ft. Worth Public School System. He married Judy Carol Smith on February 6, 1971. After two years in elementary physical education, he accepted a position as a graduate teacher's assistant at Kansas State University, Manhattan, Kansas, in August, 1972.

COMPARISON OF ACTIVE AND INACTIVE WOMEN IN THE PERFORMANCE OF THE VERTICAL JUMP AND SELECTED CHARACTERISTICS OF ISOKINETIC FORCE-TIME CURVES

by

ROY ALLEN GANN, JR.

B. S., Texas A&M University, 1970

AN ABSTRACT OF A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Health, Physical Education and Recreation

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1974

The purpose of this study was to: (1) compare differences in performance between active and inactive women on vertical jumping ability and three measurements taken from isokinetic force-time curves in the knee-extension, hip-extension movement at two contraction speeds; and (2) to determine the interrelationships between vertical jumping ability and the three characteristics of the force-time curves measured. These characteristics are rate of tension development, maximum strength, and total area under the curve. The subjects were fifty college female volunteers classified as trained or untrained according to physical fitness training programs currently being followed. Subjects were tested for vertical jumping ability and performance on the isokinetic exercise power thrust machine at two contraction speeds.

A t-test for significant differences between groups and between performances of the two tests was used. Also, the Pearson Product Moment Correlation Coefficient was used to determine correlations between measures taken in the two tests. The data analysis revealed that: (1) the following measures recorded by the isokinetic exerciser are capable of differentiating between trained and untrained women: a) total area under the curve (fast speed), b) total area under the curve (slow speed), c) maximum strength (slow speed); (2) total area under the curve (fast speed) and total area under the curve (slow speed) are related; (3) maximum strength (fast) measures and maximum strength (slow) measures are related; (4) total area under the curve measures at fast or slow speeds and maximum strength at either fast or slow speeds are related; and (5) there is no relationship between vertical jumping ability and the three characteristics of the force-time curve at either contraction speed.