THE EFFECTS OF ROPE JUMPING UPON THE VERTICAL JUMPING ABILITY OF BOYS AND GIRLS

A Thesis

Presented to

the Faculty of the Department of Physical Education

Kansas State Teachers College of Emporia

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

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by

Stephen Joseph Herrmann

August 1969

Approved for the Major Department

Approved for the Graduate Council

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CHAPTER I

THE PROBLEM AND DEFINITIONS OF TERMS USED

Throughout most of life, one is required to employ certain bodily movements in fulfilling daily activities. All of these basic body movements are employed during ones early years. Some of them are needed during an entire life span. One of these basic body movements which is used everyday is the basic skill of jumping.

Jumping is one of the most vigorous of the natural basic skills and can be applied in many more complex activities. Rope jumping, for example, offers satisfactory play and recreation for many children. As an added advantage, rope jumping equipment is inexpensive and readily obtained.[1]

Jumping, in several of its forms, is one of the track and field events in which individuals may participate. The importance of establishing a basic foundation of strength and skill in this basic bodily movement must not be overlooked. By developing the ability to jump early in life and continually working on it will aid the individuals in adapting it to more complex activities later in life such as basketball, football, track and field, tennis, and badminton only to mention a few.

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[1]Edwina Jones, Edna Morgan, and Gladys Stevens, Methods and Materials in Elementary Physical Education (new edition; New York: World Book Company, 1957), p. 52.

I. STATEMENT OF THE PROBLEM

The purpose of this study was to investigate the effects of rope jumping upon the vertical jumping ability of sixth, seventh, eighth, and ninth grade boys and girls.

The specific problem was designed to answer the following questions:

1) Will a physical education activity program supplemented by rope jumping at various heights significantly increase vertical jumping ability of sixth, seventh, eighth, and ninth grade boys and girls?

2) Will a physical education activity program supplemented by rope jumping for various lengths of time significantly increase the vertical jumping ability of sixth, seventh, eighth, and ninth grade boys and girls?

3) Will a physical education activity program supplemented by rope jumping at various heights and time intervals significantly increase the vertical jumping ability of sixth, seventh, eighth, and ninth grade boys and girls at specific grade levels?

II. DEFINITIONS OF TERMS USED

Vertical reach. This is the height an individual can reach with arms fully extended from a position on the floor with both feet flat on the floor.

Vertical jump reach. This is the height an individual can jump off the floor from a crouched position, feet flat on the floor, and reach with arms fully extended.

Rope jumping. Rope jumping consists of an individual holding onto a piece of rope seven to nine feet in length, with the ends of the rope in his hands. The subject then swings the rope over his head toward his feet and at the same time springs off his feet to let the rope pass beneath his feet, landing on his toes, the subject then prepares to repeat the action again as rapidly as he can.

Vertical jump reach. This is the height an individual can jump off the floor from a crouched position, feet flat on the floor, and reach with arms fully extended.

Rope jumping. Rope jumping consists of an individual holding onto a piece of rope seven to nine feet in length, with the ends of the rope in his hands. The subject then swings the rope over his head toward his feet and at the same time springs off his feet to let the rope pass beneath his feet, landing on his toes, the subject then prepares to repeat the action again as rapidly as he can.

CHAPTER II

REVIEW OF THE LITERATURE

The chapter on the review of literature will be divided into sections on strength of the lower limbs, effects of isometric and isotonic exercises on vertical jumping, improvement of vertical jumping and tests, and literature on rope jumping for improvement of body skills.

I. GENERAL STRENGTH OF THE LOWER LIMBS

Start, Gray, Glencross, and Walsh in their study used sixty-three first year college men to provide nineteen measures of the lower limb. There were seven measures of isometric strength, four of power, seven anthropometric estimates, and one of speed. Start, Gray, Glencross, and Walsh found that power was linked with speed rather than strength, and that total leg strength had decreasing loadings on the factors of ankle, knee, and hip strength.[2]

McClements compared the power of the body, as measured by the product of jumping height and body weight, with the strength of the leg and thigh extensor muscles. He also

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[2]K. B. Start, R. K. Gray, D. J. Glencross, and A. Walsh, "Factorial Investigation of Power, Speed, Isometric Strength, and Anthropometric Measures in the Lower Limb," The Research Quarterly, XXXVII (December, 1966), 553-559.

compared the effect on power of strength development of agonistic and antagonistic muscle groups. McClements used eighty-six college men enrolled in eight physical-conditioning classes. The classes met twice a week for sixteen weeks. For measuring height he used the vertical jump test. He used the Clarke cable tension technique in measuring the force exerted in the isometric contraction of the muscle groups involved in leg flexion, leg extension, thigh flexion and thigh extension. He then randomly assigned two classes to each of the four training programs: the extensor program, the flexor program, the flexor-extensor program, and the normal program to work on improving the strength of each group. McClements found that the four programs were equally effective in causing increases in the power of the leg and thigh muscles used in the vertical jump. McClements discovered that although strength is related to power, gains in strength are not related to gains in power.[3]

Smith in his study of the relationship between explosive leg strength and performance in the vertical jump measured in a position designed to involve the power thrust of the major muscle groups used in the vertical jump. The

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[3]Lawrence E. McClements, "Power Relative to Strength of Leg and Thigh Muscles," The Research Quarterly, XXXVII (March, 1966). 71-78.

subjects then performed a modified Sargent Jump that used no arm snap. Although the reliability of all measures was high, individual differences in the ratio of tested strength to body mass showed only a low and nonsignificant correlation with jumping performance. The results are interpreted to support the hypothesis that strength exerted against a dynamometer involves a different neuromotor pattern than strength exerted by the muscles during a movement.[4]

Clarke in his study of sixteen strength and ten anthropometric tests that were related by correlational methods to eight trunk and leg measures, involving dynamometric strength, muscular endurance, agility, and power. The intercorrelations among some of the anthropometric variables were especially high: .91, standing height with leg strength; .88, foot length with leg length; and .87, body weight with both hip width and thigh girth. The highest strength test intercorrelation was .65 between trunk flexion and extension. Significant multiple correlations obtained were: .74 for leg lift with body weight, ankle dorsal flexion strength, and trunk flexion strength; .71 for back lift with knee extension strength, hip width, trunk flexion strength, and knee flexion

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[4]Leon E. Smith, "Relationship Between Explosive Leg Strength and Performance in the Vertical Jump," The Research Quarterly, XXXII (October, 1961), 405-408.

strength; and .66 for standing broad jump with adipose tissue over the abdomen (negative) and hip extension (positive).[5]

Tuttle, Janney, and Salzano used a back and leg dynamometer based on a strain gauge technique, designed for measuring and recording both maximum strength and strength endurance. The data they collected by use of this back and leg dynamometer showed that (1) individuals with the greater maximum strength have a greater absolute strength endurance index, (2) stronger individuals maintain a smaller proportion of their maximum back and leg strength than those with less initial strength, and (3) the development of strength endurance is not directly proportional to the development of maximum strength.[6]

Berger made a study to determine whether there were differences in the amount of force able to be exerted at leg angles of approximately 105 degrees, 120 degrees, and 140 degrees. Eighteen male college students were tested for maximum leg extension strength at the various angles. The inverted leg press was used to determine the leg strength. The amount of weight lifted by one leg at a time was used as

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[5]H. Harrison Clarke, "Relationships of Strength and Anthropometric Measures to Physical Performance Involving the Trunk and Legs," The Research Quarterly, XXVIII (October, 1957), 223-232.

[6]W. W. Tuttle, C. D. Janney, and J. V. Salzano, "Relation of Maximum Back and Leg Strength to Back and Leg Endurance," The Research Quarterly, XXVI (March, 1955), 96-106.

the muscular force. The angle at the knee was measured with a goniometer while the subject exerted near-maximum force. Subjects were tested at one position every other day. Berger found that leg extension force is increased as the angle of the leg increases from 105 degrees to 140 degrees in the inverted leg press position.[7]

Della obtained the foot-lever measurements of forty-seven high school track athletes in order to determine if some particular type of foot was of value in jumping as measured by the Sargent Jump, the average standing broad jump, and the running high jump. Della in his findings concluded that: 1) The longer the malleolusdistal measurement in proportion to the total foot length, the greater the jumping ability. 2) The longer the malleolus-to-metarsalphlange measurement in proportion to the heel-to-metatarsalphlange measurement the greater the jumping ability. 3) The less the heel-to-ankle measurement (absolute rather than relative) the less the advantage in jumping. 4) There is no significant degree of relationship between total foot length and jumping ability. 5) The ratio of the average heel-to-ankle measurement of the two feet to total foot length correlated r equals -.20 with the standing broad jump and r

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[7]Richard A. Berger, "Leg Extension Force at Three Different Angles," The Research Quarterly, XXXVII (December, 1966), 560-562.

equals -.15 with the running high jump. 6) When the factor of body weight is included in the calculations the coefficients of correlation increased. 7) None of these correlations is sufficiently high to be of much practical use for predictive purposes, and 8) Average scores are a better measure than best scores as was found when certain foot measures were correlated with the Sargent Jump.[8]

The purpose of the Clarke and Degutis study was to determine the relationship between the standing broad jump as a test of leg power and the maturational, anthropometric, and strength characteristics of twelve-year-old boys. The subjects were tested within two months of their birthdays. This had the effect of largely partially without chronological age in the correlations. Seven of the sixteen correlations with the jump, all experimental variables being strength tests; were significant at the .05 level. The highest multiple correlation obtained was .694; the independent variables were elbow flexion strength, body weight, hip extension strength, ankle plantar flexion strength, and leg length. As a consequence, it may be concluded that leg power as evaluated in this study is dependent in part upon the body size and

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[8] Dan G. Della, "Individual Differences in Foot Leverage in Relation to Jumping Performance," The Research Quarterly, XXI (March, 1950), 11-19.

muscular strength; however this trait is also distinctive inasmuch as the coefficient of multiple determination was .482.[9]

Willgoose used his study as a further endeavor to gain insight into the peculiar nature of the growing and developing child during the period of adolescence. It is an attempt to understand motor coordination more clearly. Through a program of scientifically testing and measuring in physical education, it has been possible to analyze neuro-muscular control through tests of skills. Skill tests, when used to measure fundamental movements of walking, running, jumping, climbing, dodging, swimming, handle simple tools, and using pieces of equipment, represent measurement of processes vital to life. The specific elements that contribute to neuro-muscular skill are strength, speed, agility, accuracy, form, rhythm, and balance. There seems to be a certain relationship of muscular strength to motor coordination.

Willgoose used three hundred boys, ages fifteen to eighteen years, a battery of strength tests were administered that measured the essential large muscle groups of the body. He used the standing broad jump as the measure of the power

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[9]H. Harrison Clarke and Ernest W. Degutis, "Relationships Between Standing Broad Jump and Various Maturational, Anthropometric and Strength Tests of Twelve Year-Old Boys," The Research Quarterly, XXXV (October, 1964), 258-264.

element in large muscle coordination. He took seventy-five junior high boys, ages thirteen to fifteen, and had them compete in the thirty year crab race to determine arm strength, abdominal strength, and motor coordination. He took five hundred boys, ages twelve to eighteen, and tested them for speed in the fifty yard dash.

Willgoose found that the Strength Index score is a fair measure of motor coordination especially in activities where gross strength is a factor. He also found that adolescent motor coordination, as measured by tests of motor performance, improves with an increase in physical power brought about by development of muscular strength.[10]

Latchaw conducted a study in which seven tests that were devised for measuring selected motor skills in fourth, fifth, and sixth grade boys and girls was used. An analysis of the data indicated that the tests were reliable for the population measured, and that age, height, and weight factors were not statistically significant in determining performance as measured by these tests. Performance standards were computed for each sex within each grade level. The following activities were used to measure the selected motor skills: 1) Basketball wall pass, 2) Volleyball wall volley,

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[10]Carl E. Willgoose, "Relationship of Muscular Strength to Motor Coordination in the Adolescent Period," Journal of Educational Research, ILIV (October, 1950), 138-142.

3) Vertical jump, 4) Standing broad jump, 5) Shuttle run, 6) Soccer wall volley, 7) Softball repeated throws.

Latchaw concluded from her studies that the difference between fifth and sixth grade means for boys was not significant in the vertical jump, standing broad jump and the shuttle run.[11]

II. EFFECTS OF ISOMETRIC AND ISOTONIC EXERCISES ON VERTICAL JUMPING

Coppoc in his study investigated the effects of a supplementary bout of isometrics upon the vertical jump performance of junior high school boys and girls. Coppoc used 94 seventh, eighth, and ninth grade boys and girls in his study. The subjects were placed into equated groups on the basis of their initial vertical jumps. The subjects in group I, performed an isometric half squat exercise, which was held for an eight second count, during each of the physical education class periods for six weeks. The subjects in group II, or the control group, did not have the supplementary isometric exercise program.

Coppoc found in his study the following things: 1) Group I and Group II both made highly significant improvement at the .01 level of confidence on the vertical jump

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[11]Marjorie E. Latchaw, "Measuring Selected Motor Skills in Fourth, Fifth, and Sixth Grades," The Research Quarterly, XXV (December, 1954), 439-449.

test. 2) The difference between the final mean vertical jump scores of the two groups was not significant. 3) The subject in the seventh grade of group I and group II did not improve their vertical jump performance significantly. 4) The subjects in the eighth grade of group I and group II significantly improved their vertical jumping performance at the .01 level of confidence. 5) The subjects in the ninth grade of group I and group II significantly improved their vertical jump performance at the .01 level of confidence. 6) The males of both groups made significant improvement in vertical jump performance at the .01 level of confidence. 7) The females of both groups made significant improvement in vertical jump performance at the .01 level of confidence.[12]

Crane investigated in his study the effects of two programs of weight training upon the vertical jump performance of college males. Specifically this study investigated the effect of training with the Exer-Genie, and an isometric training program upon the vertical jump performance of 47 college males, and the comparative effects of the two programs of exercise. Forty-seven male students enrolled in a required physical fitness course were randomly divided into

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[12]James N. Coppoc, "A Study of the Effect of One Isometric Exercise on Vertical Jump Performance of Junior High School Boys and Girls" (unpuhlished Master's thesis, Kansas State Teachers College, Emporia, 1967), pp. 25-49.

two groups; Group I was the Exer-Genie group and Group II was the isometric group. Both groups met for fifty minutes a day and performed three comparable exercises four times a week for five weeks.

The findings in Crane's study were as follows: 1) The isometric weight training program over a five week period did result in a significant improvement in vertical jump performance at the .05 level of confidence. 2) The Exer-Genie weight training program over a five week period did not result in a significant improvement in vertical jump performance. 3) No significant difference in vertical jump performance was found when the two weight training programs were compared.[13]

Berger conducted the study to determine the effects of strength improvement on vertical jump ability. He used ninety-eight male college students that participated in four different training programs. Group I (N equals 29) trained with the (10-RM). Group II (N equals 20) with 50-60 per cent of the 10-RM for 10 repetitions of jumping squats, Group III (N equals 21) trained statically, and Group IV (N equals 19) trained by jumping vertically. Training occurred three times

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[13]Neil E. Crane, "A Comparison of Two Programs of Weight Training Upon Vertical Jump Performance of College Males" (unpublished Master's thesis, Kansas State Teachers College, Emporia, 1967), pp. 31-47.

weekly for seven weeks. Vertical jumping height was determined before and after the seven-week training period. The groups that trained dynamically improved significantly more in vertical jump than did the groups that trained statically by jumping vertically.[14]

Stockholm and Nelson conducted the study to determine whether physical performance is in fact altered as a result of the application and removal of an overload. They used the vertical jump as the physical performance criterion. Two levels of overload were employed: 5 per cent and 10 per cent of the subject's body weight. A control condition was included which involved no addition of weight during the overload jumps. Forty-four college men enrolled in required physical education programs served as subjects. To allow the subjects sufficient warm-ups, three maximal jumps with designated overload, sixth through eighth were overload jumps performed with the added weight, or with no weight with the control group. The last five were post-overload. The jumps within the pre-overload and overload phases were performed at six second intervals, while the post-overload jumps were spaced twelve seconds apart. Before a subject jumped he extended his dominant arm up on the jump board to

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[14]Richard A. Berger, "Effects of Dynamic and Static Training on Vertical Jumping Ability," The Research Quarterly, XXXIV (December, 1963), 419-424.

determine his vertical reach, then he jumped to determine his vertical jump reach performance. A weight training vest was used to hold the necessary weight. Weight varied in range from 6.8 pounds to 10 pounds (5 per cent) and 13.4 pounds to 20 pounds (10 per cent). The experiment consisted of two identical testing periods, each for three days. Subjects performed twice under each three overload conditions. The Hartley test was employed to test further the difference between groups. To ascertain the positive or negative effects of the overloads a correlated t-test between pre-overload and post-overload performances was computed for each group.

Stockholm and Nelson concluded that the application and removal of an overload has no immediate positive effect upon physical performance although it may prevent a decrement in performance as was observed when no overload was applied.[15]

Capen's study was concerned with determining which of four methods of weight training might be superior so far as strength development was concerned. Eight groups of university freshmen were utilized in the study and the statistical significance of the difference in the amount of strength that was gained was determined by the use of t-formulas.

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[15]Alan J. Stockholm and Richard C. Nelson, "Immediate After-Effects of Increased Resistance Upon Physical Performance," The Research Quarterly, XXXVI (October, 1965), 337-341.

The results of this research suggests that those methods which employ heavy weights so as to allow a maximum number of five executions are probably the superior methods for the development of muscular strength.[16]

Ball, Rich, and Wallis in their study on the effects of isometric training on vertical jumping ability divided sixty-three college men into two equated groups on the basis of their initial ability to exert-isometric force upward against shoulder pads of a specially constructed device. Measurements were made and the apparatus adjusted to fit each subject so that the knees were flexed to the angle at which a vertical jump is usually initiated. All subjects in the experimental and control groups were precisely measured in the vertical jump at the beginning and the conclusion of the six-week training program. The experimental group trained on the apparatus three times per week for six weeks. The control group was not trained. One ten second bout of maximum effort was made on each training day. The experimental group increased significantly in strength (mean gains of 78 pounds or 17.3 per cent, significant at

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[16]Edward K. Capen, "Study of Four Programs of Heavy Resistance Exercises for Development of Muscular Strength," The Research Quarterly, XXVII (May, 1956), 132-142.

the 1 per cent level of confidence). However, this increase in strength was not accomplished by an increase in jumping ability.[17]

III. IMPROVEMENT OF VERTICAL JUMPING

The purpose of Van Dalen's study was to clarify and validate the various types of jumps in general usage today under optimum conditions and statistically point out their deficiencies. The Sargent Jump, as described by McCloy, is primarily, a test of the ability of the body to develop power relative to the weight and size of the individual. Power is force times velocity. Hence, the jump is a measure of the way in which force can combine with the highest possible contraction velocity of the muscle so as to project the body upward to a maximum height. Van Dalen used four track and field events (six second run, running high jump, shot put, and standing broad jump) to test this item of muscular contraction. He used one-hundred-and-six senior high boys, ages 15-17 years, for his study. He taught them the correct form of the following seven types of jumps: (1) The Sargent Jump--Individual was told to bend knees to 90 degree angle, spring upward and swing his arms upward

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[17] Jerry R. Ball, George Q. Rich, and Earl L. Wallis, "Effects of Isometric Training on Vertical Jumping," The Research Quarterly, XXXV (October, 1964), 231-235.

and forward to gain the greatest possible vertical height. At the height of his jump he was instructed to pull his arms downward to his side. The jump was scored in cm. by how high he jumps minus his original standing height. (2) The Sargent Weight Jump--Same as the Sargent Jump except each subject carried one-half pound dumbbells and a pound and a half dumbbells in their respective jumps. (3) The Jump and Reach--Subject faces the wall, jumps vertically and reaches as high as possible with his favored arm on the wall. Highest mark made by his fingers was the height of his jump. (4) Chalk Jump--Same as Jump and Reach except chalk on the hand was used to mark height of jump. (5) Wall Jump--Same as Jump and Reach except the individual was instructed to keep his free arm at his side. (6) Belt Jump--Similar to the Sargent Jump except hands are placed on hips and the individual jumps vertical. Do not use a vigorous arm swing. The Belt Jump is measured by how high he jumps minus standing height.

From the results it would seem to indicate that the Sargent Jump when standardized, practiced, and correctly administered is undoubtedly a valuable test for predicting the ability to develop power. The arm swing of the Sargent Jump is exceedingly important to the successful execution of the jump. The difference between the best two jumps is so slight that it would probably not be worth using the weights.

This does, however, give considerable evidence as to the importance of the use of the arms. Several deficiencies exist in the Chalk and Wall Jumps as to their administration and execution that may prohibit as accurate measurement of this jump and a warning is issued against their use.[18]

Using a psychological control (placebo) and a balanced experimental design to secure unequivocal results, Merlino found that pre-exercise massage yielded 2.6 per cent improvement in the vertical jumping performance of thirty-six college men. The amount of improvement was twice as large in the fifth and sixth trials as in the preceding jumps of the six trial test series. The average jump (48.8 cm.) and the test retest reliability (r equals .94) agreed closely with previous studies using the Henry jumping apparatus. During the six jumps of the first day (without massage), the practice effect caused 3.6 per cent improvement, but there was no significant practice effect during the second or third day of testing or between three successive days spaced one week apart.[19]

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[18] Deobold Van Dalen, "New Studies in the Sargent Jump," The Research Quarterly, XI (May, 1940), 112-115.

[19] Lawrence V. Merlino, "Influence of Massage on Jumping Performance," The Research Quarterly, XXX (March, 1959) 66-74.

Glencross investigated the nature of the vertical jump and standing broad jump, specifically in terms of their variance components as revealed by correlation and factor analytic techniques. Glencross used four movements: preferred and nonpreferred shoulder flexion and preferred and nonpreferred leg extension to test what the two tests measured. A sample of eighty-five male college students was used. The mean age was 19.3 years. For each testing period the required number of subjects was randomly selected from the available group. Each subject completed the seven tests in the one testing period.

The investigation reveals that although the two jump tests are similar, about half of the variance of each test is specific variance. The jump-reach test and standing broad jump have limited application as valid measures of muscle power as measured by the power lever as the criterion.[20]

Pacheo used ten experienced subjects to make ninety or more vertical jumps preceded by isometric stretching exercises, isotonic work (running in place), or a combination (knee bends). Compared with control conditions (no preliminary exercises), performance was improved for each individual and by each of the three exercises. The average gains showed

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[20]D. F. Glencross, "Nature of the Vertical Jump Test and the Standing Broad Jump," The Research Quarterly, XXXVII (October, 1966), 353-359.

high statistical significance. In a second experiment, fifty young men each made ten jumps. Psychological control was secured by disguising the purpose of the tests. Warm-up exercises again improved performance to a significant extent. The observed gains averaged 2.9 to 7.8 per cent. The Henry jump testing apparatus gave reproductive results when compared with earlier studies and revealed reliable individual differences in jumping ability (r equals .975).[21]

IV. LITERATURE ON ROPE JUMPING FOR IMPROVEMENT OF BODY SKILLS

Mellby recommends rope jumping as one phase of a well-rounded physical education program. Rope jumping may be used to obtain the same benefits that are obtained in other activities such as leg and arm development, which may be regularly obtained from calisthenics, free exercise, or apparatus work; rhythm and coordination that are obtained from marching, dances and games; the organic development that is obtained from some of the more strenuous sports and activities. Jumping is one of the fundamental physical actions of a child and rope jumping provides a natural outlet for this expression of physical vigor, especially for the

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[21] Betty A. Pacheo, "Improvement in Jumping Performance Due to Preliminary Exercise," The Research Quarterly, XXVIII (March, 1957), 55-63.

pupils of junior high school age or younger, who, when they have been sitting still in a classroom for some time, come in to the gymnasium and seem to be ready to "pop," so anxious are they to get rid of some of this pent-up energy. At this age we find also that the desire for skill and technique is overlapping with this former desire for activity for its own sake. In providing for individual differences, rope jumping provides an activity that has a wide range of appeal, both for members of the class who are not so athletically inclined (that is toward "contact sports") and who are motivated by the fact that they have seen some of their heroes of the ring jumping rope in training and realize its "training" value. We do believe that jumping gives a unique method of varying the class work. At the same time it maintains and aids in carrying out the objectives of a physical education program.[22]

Rawlinson says that rope skipping is neglected by many coaches, but it constitutes a fine conditioner (strength and stamina) and aids in the development of agility, gracefulness, and body-balance. In this connection, its especially recommended for the big awkward boy.[23]

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[22] R. E. Mellby, "Rope Jumping," Journal of Health and Physical Education, VII (January, 1936), 93-95.

[23] Ken Rawlinson, "Training and Conditioning for Basketball," Scholastic Coach, XXIII (October, 1953), 30.

Wilbut states that rope jumping must be more than passing out a rope to each child for freestyle jumping in order to realize all the many benefits of this activity in the physical education program. Good body control, improved posture, poise, and balance are ultimate achievements; fitness, creativity, skill challenge, and fun are all possible outomes.[24]

Fahey mentions that years ago a boy was taunted by his chums if he were persuaded by his sister and her friends to do a little rope turning while the girls jumped. Now if he expects to be the athletic hero of high school or college, he knows that rope jumping will probably be used as a conditioning activity for track, boxing, or other sports. It is therefore, natural that rope jumping is no longer considered a girl's game, and from first grade through college, boys as well as girls are participating in this activity.

With this growing popularity of rope jumping, it has ceased to be an out-of-school activity, and is assuming a place in the regular spring play activity program. Rope jumping to the intermediate child, or older boy and girl, it

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[24]Helen Wilbur, "Plus Values for Rope Jumping," Journal of Health, Physical Education and Recreation, XXXVII (February, 1966), 32-33.

is an activity that can be made more challenging through tournament routines, or through rhythm routines to music.[25]

Hathaway suggests that modern rope skipping grew out of a need to supplement team games and sports with an activity designed to give a maximum amount of exercise in a minimum amount of space and to provide a medium for recreation and sport expansion.

Rope skipping is economical in time, space, and money. It is enjoyed by young and old, male and female, individuals and teams. Fundamentally simple, rope skipping can be advanced to a high degree of skill and achievement and is interesting enough to carry-over into post-school life.

Rope skipping employs a single, light leap to each swing of the rope, while rope jumping refers to the bouncing, jolting movement accompanying use of the long rope or inexperienced use of the short rope. Hathaway differentiates between the two activities by saying that rope skipping refers to the name of the activity and skipping rope to the movement in the activity. According to Hathaway, the use of "jump" in rope skipping will modify the movement.[26]

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[25]Helen Fahey, "Everyone Jumps Rope," Journal of Health and Physical Education, XI (September, 1940), 420-422.

[26]Gordon J. Hathaway, "Modern Rope Skipping," Journal of Physical Education and Recreation, XXVI (May, 1955), 23.

Jones conducted a study in which seven untrained, non-athletic women 19-42 years of age participated in a daily five minute rope skipping program during a four-week period. As a result of this training program, there was a significant improvement in physical work capacity as judged by pulse response to a standardized submaximal work load, or by the estimated maximal oxygen uptake based upon the pulse response to submaximal ergometer work according to the A strand nomogram. It is suggested that rope skipping can be adopted as a simple method of improving the physical work capacity of a large segment of our population.[27]

V. SUMMARY OF THE REVIEW

Individual studies in the various related fields showed varying results and conclusions. In the area of general strength of the lower limbs, Start, Gray, Glencross, and Walsh (2); McClements (3); Clarke (5); Clarke and Degutis (9); and Willgoose (10) found that speed and power were related in increasing the working ability of the lower limbs. Smith (4) in his study of explosive leg strength found that strength exerted against a dynamometer gave a different result than strength exerted by muscles during

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[27] D. Merritt Jones, "Effect of Rope Jumping on Physical Work Capacity," The Research Quarterly, XXXIII (May, 1962), 236-238.

movement. Tuttle, Janney, and Salzano (6) tested for maximum strength and strength endurance and found variances in the strength of each individual. Berger (7) found that leg extension force is increased as the angle of the leg increases. Della (8) by taking foot measurements found no significant degree of relationship between total foot length and jumping ability. Latchaw (1) concluded from her studies that the grade means for boys and girls was not significant in the vertical jump, standing broad jump, and the shuttle run.

Coppoc (12); Capen (16); Ball, Rich, and Wallis (17) by the use of isometric exercises found an increase in vertical jump ability of participants. Crane (13) and Berger (14) however, found the increase in vertical jump performance was more significant for the groups that trained dynamically than for the group that trained statically. Stockholm and Nelson (15) found no immediate positive effect of the application and removal of an overload upon physical performance.

The studies by the following experimenters show proper tests and improved methods of administering the various tests. Van Dalen (18) tested various types of jumps and found that the Sargent Jump is the most valid when administered properly. Merlino (19) found that pre-exercise massage increases jumping performance. Glencross (20) in his

study states that the jump-reach test and the standing broad jump have limited application as valid measures of muscle power. Pacheo (21) reveals in her study that preliminary exercise increases jumping performance.

Rope jumping for the improvement of body skills can be seen from the reports of Mellby (22); Rawlinson (23); Wilbur (24); Fahey (25); Hathaway (26); and Jones (27) that it is a conditioner; develops coordination, agility, rhythm, body balance, poise, fitness, stamina, gracefulness; and increases work capacity.

CHAPTER III

METHODS AND PROCEDURES

This study investigated the effects of rope jumping in the physical education activity program on the vertical jumping ability of sixth, seventh, eighth, and ninth grade boys and girls.

The one hundred and twelve male and female subjects were selected from the sixth, seventh, eighth and ninth grades. All subjects were placed into equated groups on the basis of the difference between their vertical reach and their initial vertical jump performance. The subjects in Class I were divided into three groups, all groups jumped for three minutes, Group I jumped a height of six inches, Group II jumped a height of four inches and Group III jumped a height of two inches. The subjects in Class II were divided into three groups, all groups jumped for five minutes, Group IA jumped a heighth of six inches, Group IIB jumped a heighth of four inches, and Group IIIC jumped a heighth of two inches. All sections participated in the rope jumping activity for eleven weeks during the physical education program. All groups also participated in ten minutes of calisthenics and thirty minutes of physical education activities each class period for eleven weeks.

The initial testing of vertical jump reach ability was completed during the first week of the study. The following nine weeks the conditioning program was administered during the physical education class period. The eleventh week the final testing of vertical jump reach ability was again administered.

I. NATURE OF THE PHYSICAL EDUCATION PROGRAM

All sixth grade and junior high school students at the Delphos Attendance Center are required to enroll in a physical education activity class. This physical education activity program was established to meet the requirements of the State of Kansas for graduation from high school. The school board of unified school district 239 requires all sixth, seventh, eighth, and ninth graders in the Delphos Attendance Center to enroll in a physical education activity class.

The class periods were fifty-five minutes in length. The physical education classes consisted of a calisthenic period plus an activity period. The first five minutes and the last ten minutes of each class period were spent in showering and dressing. Ten minutes were devoted to calisthenics such as side straddle hops, sit-ups, push-ups, leg raises, and stretching exercises. The remainder of the class

period was used for instruction in such activities as soccer, volleyball, softball, tumbling, and wrestling.

The sixth, seventh, and eighth grade physical education activity classes of male and female students are held together daily. If the weather permits, physical education activity classes are held outdoors. During inclement weather, both male and female classes meet in the gymnasium. It is shared by the boys; the girls meet on the stage for organized activity. The ninth grade physical education activity classes of male and female students are held together daily. The ninth grade physical education activity classes of male and female students met daily. Due to limited facilities the ninth grade students had physical education activity for one semester and health education for one semester. The ninth grade students had health education and physical education classes on alternating days. One day the boys would have health education while the girls had a physical education activity. The next day the girls would have health education while the boys had a physical education activity class.

II. SUBJECTS

During the 1968-69 school year one hundred and nineteen sixth, seventh, eighth, and ninth grade boys and girls were enrolled at the Delphos Attendance Center in physical education activity classes. Of these one hundred and

nineteen students, there were twelve in the sixth grade, twenty-three in the seventh grade, twenty-seven in the eighth grade, and fifty-seven in the ninth grade. Due to illness on the final day of testing and students who moved out of town during the training program only one hundred and twelve male and female students were used in the final testing of the study. The male subjects were required to wear white T-shirts, gym shorts, athletic supporter, socks, and tennis shoes. The female subjects were required to wear white blouses, shorts, socks, and tennis shoes.

III. FACILITIES AND EQUIPMENT

The facilities used in the study were the Delphos Attendance Center gymnasium. The gymnasium has a playing area sixty feet wide and eighty feet long with portable bleachers on each side. Along the bottom board of the portable bleachers a piece of masking tape was placed at a height of six inches for twenty-five feet, another piece of masking tape was placed on the bleacher at a height of four inches for twenty-five feet, and finally another piece of masking tape was placed on the bleachers at a height of two inches for twenty-five feet. This gives us a total training area of seventy-five feet in length with three different jumping heights. This served as a guide for the subjects participating, so the participants would not jump below their required heights.

The rope jumping equipment consisted of twenty jump ropes constructed from three-eighths inch clothes line cord. The jump ropes ranged in length from seven feet to nine feet to fit the individual body height of the subjects participating in the study.

One stop watch with two sweep hands was used to time the subjects as they completed the principle exercises.

The vertical jump reach test performances were measured on a three-eighths inch plywood eighteen inches wide by seventy-two inches in length. The plywood was nailed to a two inch by four inch board eight feet in length. The vertical jump board was painted black and then scaled off in one inch graduations. Foot scales were indicated by a yellow line extending across the board. The inch scales were indicated by green lines extending across the board. The eight foot two by four extended four feet above the vertical jump reach scoring board. A U-bolt was placed in the extended end of the two by four so the scoring board could be bolted securily to a pipe supporting the basketball backboard. The board was attached on the playing side of the basketball backboard so the participants and observers would have plenty of room for moving about. The top of the vertical jump score board when attached to the basketball backboard was eleven feet. The measurement at the bottom of the scoring board when suspended was five feet from the gymnasium floor. The low point on

the vertical jump scoring board gave a range of five feet to eleven feet at the top or uppermost extreme end of the board.

IV. TRAINING PROCEDURES

According to their initial vertical jump reach performances, the subjects were placed in either Class I, Group I, II, or III; or Class II, Group IA, IIB, or IIIC. In order to have equated groups, the subject having the highest vertical jump reach in his grade level and sex division was placed in Class I, Group I. Then the subject having the second highest jump was placed in Class I, Group II. From this point on, the subjects were placed into the correct groups accordingly. For example, the sixth subject was placed into Class II, Group III, and so forth.

The experiment began in the spring of 1969 on the twenty-fifth week of school and continued until the thirty-fifth week of school. The first week of the ten week period was used for the initial test of vertical jump reach performance. The second through the ninth week was used in the actual training program. During this eight-week period, each subject jumped rope the allotted time for his group each class period in which they suited up for physical education activity class. The tenth week was used for final testing of vertical jump reach performance.

After five minutes for dressing and roll call, each subject in their respective groups jumped rope. This activity lasted approximately ten minutes. The students assembled in their proper groups in their designated areas along the gymnasium wall. On the signal by the experimenter the subjects would start jumping rope. At the end of the allotted time all participants stopped at the signal of the experimenter. Then the next Class took the ropes, gathered in their designated areas and jumped rope the allotted time. After all subjects had completed the exercise, they all joined together for the remainder of the period for instruction and activity.

V. STUDENT ASSISTANTS

The experimenter selected four student assistants from Class I and four student assistants from Class II to assist him during the exercise. It was the duty of the student assistants to aid the experimenter in making sure all subjects were jumping the required heights. The student assistants were selected on their interests in the exercise and dependability. The participants would get in their designated areas in front of the masking tape at the various heights along the gymnasium wall. While Class I jumped rope the four assistants from Class II along with the experimenter

would watch the feet of the participants to see that they were even with or above the masking tape along the gymnasium wall. When Class I finished jumping rope Class II would then jump rope for their allotted time and the four student assistants from Class I would aid the experimenter. If the experimenter or an assistant noticed a subject not jumping high enough they would tell the subject to jump higher.

During the tenth week, the final vertical jump reach test was administered to all subjects. This test showed the increase or decrease in vertical jump performance of each participating subject.

VI. TESTING PROCEDURES

A vertical jump scoring board was used for testing of vertical reach performance. During the first week of the experiment, the vertical reach of each subject was recorded. To determine the vertical reach of each subject they were directed to stand next to the vertical jump scoring board with their preferred side toward the scoring board. The subject stood flat footed and extended his preferred arm upward on the scoring board. The height of the subjects reach was recorded by the experimenter.

The vertical jump scoring board was also used for the testing of the vertical jump reach of each subject. The subject took a position approximately twelve inches from the

vertical jump board with his feet shoulder width apart, toes parallel and even with each other, with the preferred side to the vertical jump board. Each subject before jumping smeared white chalk dust on his fingertips, by doing this the experimenter was able to accurately tell the height of the subjects jump from the white marks left on the vertical jump scoring board. The subject stood in a crouched position. From this position, the subject, with arms moving in an upward swing, jumps and touches the vertical jump board with fingertips at the height of the jump. After each trial the subject assumed the jumping position again. Each subject had three jumping trials in succession. The height of each of the three jumps was visually noted by the experimenter, who was facing the scoring board five feet from it, with the best of the three jumps being recorded for the records.

VII. STATISTICS

There were two statistical computations used in this study to determine the effects of rope jumping upon the vertical jump reach performance of sixth, seventh, eighth, and ninth grade boys and girls. The t-test for significance was computed for gains made on the vertical jump reach for each group and was also computed for significant difference

between the groups for mean gain. Also determined by the t-test was the significance of the mean gain for the groups by grade and sex.

CHAPTER IV

PRESENTATION OF DATA

I. INTRODUCTION

The purpose of this study was to determine the effects of rope jumping upon the vertical jumping performance of sixth, seventh, eighth, and ninth grade boys and girls.

The gains between the initial and final test scores on the vertical jump test was the data used for this study. The statistical procedure computed for this study was the t-test of significance between correlated means for all groups and analysis of variance to determine whether differences existed among the training groups on the final vertical jump performance.

II. ANALYSIS OF VARIANCE

When there are more than two groups in the design of an experimental study and the investigator wishes to study the amount of variance existing with a given set of scores, analysis of variance is a method of analyzing the data.

For the purpose of this study analysis of variance was computed on the initial, final and the differences of the vertical jump test scores for all groups. It can be noted on Table I, which shows the analysis of variance in full for the

initial score the F test of .623 resulted which indicated that all groups were of similar standing in so far as the Vertical Jump Test scores are concerned at the initial stage of the study.

At the conclusion of the training period, the analysis of variance yielded an F test of .481. For a significance at the .05 level of confidence an F of 2.30 was required. This was a non-significant F score. This data is presented on Table II.

Table III, illustrated in full the analysis of variance on the differences on the Vertical Jump Test scores for all groups. An F of 2.30 with 5 degrees of freedom was needed at the .05 level of significance and at the .01 level of significance required an F of 3.21. The study computed a result of .634, indicating that all groups were similar but no significant differences in terms of improvement among the group scores.

TABLE I

ANALYSIS OF VARIANCE
INITIAL VERTICAL JUMP TEST

Source	Sums of Squares		Mean Squares	F	P
Among Groups	166.53	5	33.31	.623	—
Within Groups	5664.33	106	53.44		
Total	5830.86	111			

F necessary at the .05 level of significance with 5 df = 2.30

F necessary at the .01 level of significance with 5 df = 3.21

TABLE II

ANALYSIS OF VARIANCE
FINAL VERTICAL JUMP TEST

Source	Sums of Squares	df	Mean Squares	F	P
Among Groups	137.66	5	27.53	.481	—
Within Groups	6070.62	106	57.27		
Total	6208.28	111			

F necessary at the .05 level of significance with 5 df = 2.30

F necessary at the .01 level of significance with 5 df = 3.21

TABLE III

ANALYSIS OF VARIANCE
DIFFERENCES BETWEEN INITIAL AND FINAL
VERTICAL JUMP TEST OF ALL GROUPS

Source	Sum of Squares	df	Mean Squares	F	P
Among Groups	6.67	5	1.3330	.634	—
Within Groups	223.01	106	2.1039		
Total	229.68	111			

F necessary at the .05 level of significance with 5 df = 2.30

F necessary at the .01 level of significance with 5 df = 3.21

III. ANALYSIS OF VARIANCE FOR DIFFERENCES BETWEEN INITIAL AND FINAL VERTICAL JUMP TEST OF ALL GROUPS

The analysis of variance was computed on the initial, final and differences of the vertical jump test scores for the three groups that jumped the three heights of six inches, four inches, and two inches. It can be noted on Table IV, which shows the analysis of variance for the initial score, the F test of .079 resulted which indicated that all groups were of similar standing in so far as the vertical jump test scores are concerned at the initial stage of the study.

At the conclusion of the training period, the vertical jump test was again administered and the analysis of variance

yield an F test of .106. For a significance at the .05 level of significance an F of 3.09 was needed and at the .01 level of significance an F of 4.82 was required. This was a non-significant F score. This data is presented in Table V.

Table VI, illustrates in full the analysis of variance on the differences of the vertical jump test scores for the three groups. An F of 3.09 with 2 degrees of freedom was needed at the .05 level of significance and at the .01 level of significance an F of 4.82 was required. The study computed a result of .584, indicating that the three groups were similar but no significant differences in terms of improvement among the groups scores.

TABLE IV

ANALYSIS OF VARIANCE
INITIAL VERTICAL JUMP TEST FOR THE THREE SEPARATE HEIGHTS

Source	Sums of Squares	df	Mean Squares	F	P
Among Groups	8.48	2	4.24	.079	_
Within Groups	5822.38	109	53.42		
Total	5830.86	111			

F necessary at the .05 level of significance with 2 df = 3.09

F necessary at the .01 level of significance with 2 df = 4.82

TABLE V

ANALYSIS OF VARIANCE
FINAL VERTICAL JUMP TEST FOR THE THREE
SEPARATE HEIGHTS

Source	Sums of Squares	df	Mean Squares	F	P
Among Groups	12.05	2	6.03	.106	_
Within Groups	6196.22	109	56.85		
Total	6208.28	111			

F necessary at the .05 level of significance with 2 df = 3.09

F necessary at the .01 level of significance with 2 df = 4.82

TABLE VI

ANALYSIS OF VARIANCE
DIFFERENCE BETWEEN INITIAL AND FINAL
VERTICAL JUMP TEST OF ALL GROUPS

Source	Sums of Squares	df	Mean Squares	F	P
Among Groups	.94	2	.47	.22	_
Within Groups	228.74	109	2.10		
Total	229.68	111			

F necessary at the .05 level of significance with 2 df = 3.09

F necessary at the .01 level of significance with 2 df = 4.82

IV. THE SIGNIFICANCE OF THE MEAN DIFFERENCE FOR EACH GROUP IN THE VERTICAL JUMP TEST PERFORMANCE

In testing for the significance of mean difference in the Vertical Jump Test performance, t tests were computed comparing the means of the initial and final vertical jump scores for each of the six groups.

When computed, the group which jumped rope for three minutes for a height of two inches; Class I, Group I, had an initial mean score of 97.44 and a final mean test score of 96.00 which resulted in the mean difference of a negative 1.44. The standard error of the mean difference was a .12 which in turn resulted in a t of .593. With 17 degrees of freedom, to be significant at the .05 level a t of 2.11 was necessary while a 2.90 was required for significance at the .01 level of significance. With a t of .593, it can be noted that Class I, Group I did not make significant improvement upon their vertical jump performance.

The group which jumped rope for three minutes at a height of four inches; Class I, Group II, had an initial mean of 96.85 and a final mean test score of 95.10 which resulted in the mean difference of a negative 1.75. The standard error of the mean difference was a .04 which resulted in a t of .645. With 19 degrees of freedom, to be significant at .05 level a t of 2.09 was necessary while a 2.86 was required for significance at the .01 level of significance. With

a t of .645, it can be noted that Class I, Group II did not make significant improvement upon their vertical jump performance.

Class I, Group III, which jumped rope for three minutes at a height of six inches had an initial mean score of 97.83 and a final mean test score of 96.67 which resulted in the mean difference of a negative 1.16. The standard error of the mean difference was a .22 which in turn resulted in a t of .530. With 17 degrees of freedom, to be significant at the .05 level a t of 2.11 was necessary while a 2.90 was required for significance at the .01 level of significance. With a t of .530, it can be noted that the results of Class I, Group III were non-significant for their vertical jump performance.

When computed, the group which jumped rope for five minutes at a height of two inches; Class II, Group I, had an initial mean of 95.68 and a final mean test score of 94.47 which resulted in the mean difference of a negative 1.21. The standard error of the mean difference was a .08 which resulted in a t of .495. With 18 degrees of freedom to be significant at the .15 level a t of 2.10 was necessary while a 2.88 was required for significance at the .01 level of significance. With a t of .495 it can be seen that Class II, Group I did not make significant improvement upon their vertical jump performance.

Class II, Group II, which jumped rope for five minutes at a height of four inches had an initial mean score of 94.71 and a final mean score of 93.71 which resulted in the mean difference of a negative 1.00. The standard error of the mean difference was a .12 which in turn resulted in a t of .370. With 16 degrees of freedom, to be significant at the .05 level a t 2.12 was necessary while a 2.92 was required for significance at the .01 level of significance. With a t of .370 it can be seen that Class II, Group II did not make significant improvement on their vertical jump performance.

The final group which jumped rope for five minutes at a height of six inches, Class II, Group III, had an initial mean score of 94.80 and a final mean test score of 93.65 which resulted in the mean difference of a negative 1.15. The standard error of the mean difference was a .03 which in turn resulted in a t of .561. With 19 degrees of freedom, to be significant at the .05 level a t of 2.09 was necessary while a 2.86 was required for significance at the .01 level of significance. With a t of .561 it can be noted that Class II, Group III produced non-significant results in improvement of their vertical jump performance.

TABLE VII

THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN INITIAL AND FINAL VERTICAL JUMP TEST SCORES FOR ALL GROUPS

Group	N	Initial Mean	Final Mean	Mean Diff.	SE	t	P
Class I Group 3 min. at 2 inches	17	97.44	96.00	-1.44	.12	.593	--
Class I Group II 3 min. at 4 inches	19	96.85	95.10	-1.75	.04	.645	--
Class I Group III 3 min. at 6 inches	17	97.83	96.67	-1.16	.22	.530	--
Class II Group I 5 min. at 2 inches	18	95.68	94.47	-1.21	.08	.495	--
Class II Group II 5 min. at 4 inches	16	94.71	93.71	-1.00	.12	.370	--
Class II Group III 5 min. at 6 inches	19	94.80	93.65	-1.15	.03	.561	--

As can be seen (Table VII) all groups decreased in their vertical jump performance from the initial jump to the final jump giving each group a negative mean difference. This then resulted in a negative t for the test making the results non-significant for all groups at the .05 and the .01 levels of significance.

V. SIGNIFICANCE OF THE MEAN GAIN FOR BOTH GROUPS BY LENGTH OF TIME JUMPED

To establish the significance of the mean gain for both groups by length of time jumped, the mean difference for each group by length of time jumped was compared for the final vertical jump test.

As can be noted on Table VIII, improvement for both Class I and Class II was non-significant. For significance with 110 degrees of freedom, a t of 1.99 at the .05 level of significance was required, while a t of 2.63 was required at the .01 level of significance.

VI. SIGNIFICANCE OF THE MEAN GAIN FOR BOTH GROUPS BY SEX

To establish the significance of the mean gain for both groups by sex, the mean difference for each group by sex was compared for the final vertical jump tests.

As can be noted on Table IX, all groups regardless of sex had a decrease in their vertical jump performance. The male group had a final mean of 98.68 and the female group had a final mean score of 90.77. A mean difference of 7.91 resulted and produced a t of 6.52 at the .01 level of significance. The results of the final jump were significant at the .01 level of significance. To be significant with 110 degrees of freedom at the .01 level of significance a 2.63 was necessary, a t of 1.99 at the .05 level of significance was required.

TABLE VIII

SIGNIFICANCE OF THE DIFFERENCE BETWEEN THE FINAL MEANS OF THE TWO CLASSES

Group	N	Final Mean	Mean Diff.	t	P
Class I 3 Minutes	55	95.89	2.49	1.68	–
Class II 5 Minutes	55	93.40			

t necessary for significance at the .05 level with 110 df = 1.99

t necessary for significance at the .01 level with 110 df = 2.63

TABLE IX

THE SIGNIFICANCE OF THE FINAL VERTICAL JUMP TEST SCORES OF BOTH SEXES

Group	N	Final Mean	Mean Diff.	t	P
Group I Male	58	98.68	7.91	6.52	.01
Group II Female	52	90.77			

t necessary for significance at the .05 level with 110 df = 1.99

t necessary for significance at the .01 level with 110 df = 2.63

CHAPTER V

SUMMARY, FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

I. SUMMARY

It was the purpose of this study to investigate the significant improvement, if any, which rope jumping will make upon vertical jumping performance of sixth, seventh, eighth, and ninth grade boys and girls.

The study was conducted with one hundred and twelve students in the sixth, seventh, eighth, and ninth grade enrolled in a physical education program at the Delphos Attendance Center. The students were divided into six equated groups for the study. All groups met for fifty-five minutes a day and jumped rope for a period of ten weeks.

Testing procedures included one week of pre-testing and demonstration, eight weeks of training, and one week of post-testing. The pre-test and post-test scores were obtained by recording the best jump of three vertical jump performances.

The statistical procedure computed for this study was the analysis of variance to determine whether differences existed among the training groups on the final Vertical Jump test performance and the t-test of significance correlated means for all groups.

II. FINDINGS

The findings of this study were as follows:

1. The rope jumping program over a ten week period did not result in a significant improvement in vertical jump performance at the .01 level of significance.

2. Jumping rope at the various heights of six inches, four inches, and two inches did not result in significant improvement of vertical jumping ability at the .01 level of significance.

3. The comparison of the male and female final vertical jumps were significant at the .01 level of significance.

4. A comparison of the two groups, when they jumped for a period of five minutes and of three minutes, showed no improvement in vertical jumping performance at the .01 level of significance.

III. CONCLUSIONS

Within the limitations of this study the following conclusions were made:

1. The vertical jump performance of sixth, seventh, eighth, and ninth grade boys and girls cannot be improved through the use of a ten-week rope jumping program.

2. Jumping rope at various heights will not increase sixth, seventh, eighth, and ninth grade boys and girls vertical jumping performance.

3. Jumping rope for five minutes and three minutes will not improve the vertical jumping ability of sixth, seventh, eighth, and ninth grade boys and girls.

IV. RECOMMENDATIONS

The recommendations for further study are as follows:

1. A study which would compare a daily rope jumping program against a stationary running program for all participants.

2. An identical study that would be divided into three stages of training periods for jumping rope. One stage would be for three weeks, another six weeks, and a nine week period of training to determine whether or not the length of training had a diminishing effect upon vertical jump performance.

3. A study investigating other variables such as speed increase in running, agility of movement, and eye-hand coordination.

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APPENDIX

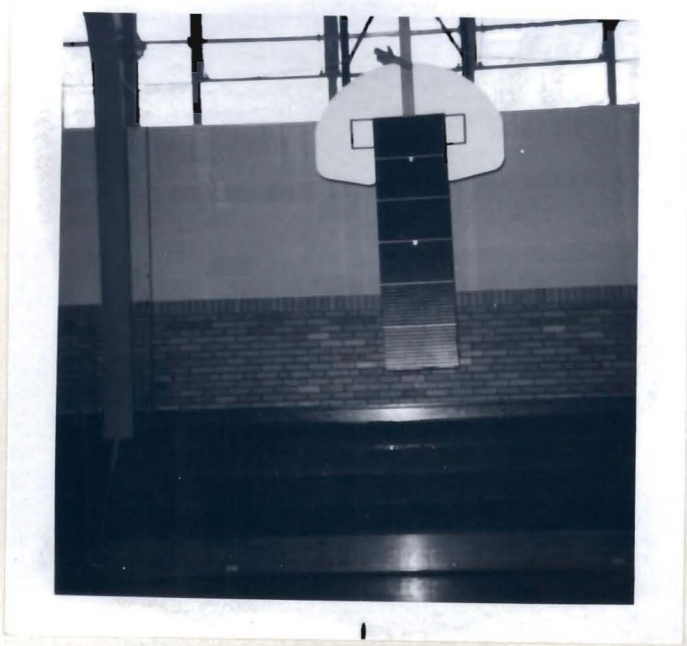

FIGURE 1

VERTICAL JUMP BOARD

FIGURE 2

SUBJECT PERFORMING VERTICAL REACH

FIGURE 3

SUBJECT IN POSITION TO JUMP ROPE AT A HEIGHT OF TWO INCHES

FIGURE 4

SUBJECT IN POSITION TO JUMP ROPE AT A HEIGHT OF FOUR INCHES

FIGURE 5

SUBJECT IN POSITION TO JUMP ROPE AT A HEIGHT OF SIX INCHES