THE EFFECTS OF THE BENT ARM HANG EXERCISE AND CONCENTRATED ROPE CLIMBING ON THE ABILITY TO CLIMB A ROPE

by

Bruce B. Trickel

ABSTRACT

This study was made to determine the effect that the bent arm hang exercise and concentrated rope climbing would have on the ability of a fourth grade student to climb a rope. Boys and girls from six fourth grades in the public schools at Manitowoc, Wisconsin were used as subjects in this study.

The study involved three groups: a control group which maintained their regular physical education schedule and did not do anything in conjunction with the study except perform in the pretest and post-test, the first experimental group took part in weekly practice sessions doing the bent arm hang exercise, and the second experimental group had weekly practice sessions in rope climbing. The latter two of these three groups continued the practice for twelve weeks between the pretest and post-test trials.

The three groups showed no significant statistical difference, at the time of the pretest, in their rope climbing ability. The groups were compared statistically according to the analysis of variance, which is the F-test.

At the end of the study the groups again were compared according to their rope climbing ability, and it was found through statistical treatment with t-ratios that the group that practiced weekly rope climbing was significantly better, at the 15% level of confidence, than the control group and also better then the experimental group that worked on the bent arm hang at a 10% level of confidence.

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CHAPTER I

INTRODUCTION

A lack of muscular strength in the arm and shoulder areas was observed by this writer while teaching physical education to elementary school students for the past nine years. Physical fitness tests administered during this period of time confirmed, statistically, that the elementary school students of Manitowoc were below average according to national standards[1] and to those standards set up by the Iowa Physical Education department.[2]

With these thoughts and facts in mind the physical education department of the Manitowoc Public Schools is attempting to compensate for this deficiency in the elementary school children. More outdoor apparatus of the climbing-hanging variety, chinning bars and climbing ropes, has been and is being purchased for the elementary school gyms, heretofore without them.

It is obvious that equipment alone will not strengthen muscles, but that a physical education program incorporating this equipment in the activities taught to the children

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[1] AAHPER Youth Fitness Test Manual (Washington 6, D. C.: American Association for Health Physical Education and Recreation, 1962).

[2] Iowa Physical Fitness Standards (Iowa: State Physical Education Department, 1964).

is essential to the growth and development of these inadequate muscles.

It was noted that rope climbing was both very popular and frustrating to the elementary school child. The frustration, in many cases, over came the popularity, to the point of giving up.

The defeat shown by the poor rope climber presented two questions: is arm strength, in relationship to weight, the greatest obstacle to overcome or, is it the lack of knowing how to climb the rope that is the barrier to overcome?

During the past year the writer set up a program of concentrated rope climbing and an exercise called the bent-arm-hang, in hopes of finding an answer to the rope climbing questions.

Statement of the Problem

The problem is to determine the effect of both the bent-arm-hang exercise, and concentrated rope climbing, on the ability of a fourth grade student to climb a rope.

Purpose of the Study

Rope climbing is a part of the elementary physical education curriculum in the Manitowoc Public Schools. Many of the students involved in the program have great difficulty in climbing a rope and some have no degree of sucess at all.

It is the intent of this study to provide material for the improvement of the teaching-learning process by determining some of the causes for rope climbing failures.

By observation it was noted that arm strength in relationship to weight seemed to be the greatest obstacle to overcome. It was also observed that through rope climbing practice alone the student seemed to improve in ability.

It is intended that this study measureing the ability to climb a rope will determine either the importance of the development of arm strength through exercise or the importance of more concentrated rope climbing. However, it may be possible that child growth and development alone will improve the ability to climb a rope.

Delimitations

The study is to be confined to fourth grade boys and girls who are a part of the regular physical education program in four elementary schools in Manitowoc, Wisconsin.

Limitations

This study is confined to the fourth grades of four schools in Manitowoc, Wisconsin, the results of the study are indicative of fourth grade students in Manitowoc, but not necessarily of students in other school systems.

The ropes used for testing and practicing rope climbing were not long enough to adequately measure all students, because they could climb to the top of the rope during the

the pretest.

The length of the class period in relationship to class size limited each student to one practice session each week during the study.

Since the free time of the students could not be controlled the people doing the bent-arm-hang may have had an advantage over those doing the rope climbing part of the study. The advantage being the fact that all schools have chinning bars out of doors that would allow for free time practice on the bent-arm-hang, but there were no facilities for the rope climbers to practice on during their free time.

Definitions

Bent-arm-hang (BAH). The student grasps the chinning bar with both hands on the opposite side of the bar, palms of the hands facing toward the face of the performer. The bar is adjusted so that the chin of the student is over, but not on, the chinning bar while the student is standing on a box approximately one foot high. With the hands on the bar in the proper position and the chin over the bar, the arms are in a fully flexed postion. On the signal "go" the student steps off of the box and suspends the body weight in the bent-arm-hang postion. The test administrator stops the students legs from swinging if need be.

Rope Climb. The hand over hand method, leg action determined by the climber as the best suited for them.

Starting from a standing position going as far as the climber feels safe.

Climbing Rope. A rope one and one half inches in diameter made of hemp fibers and suspended from the gymnasium super structure. Approximate length eighteen feet.

Rope Markings. Each rope was marked with a painted black ring at one foot intervals starting at five feet above the floor and continuing to the top, or thirteen feet above the first mark.

Chinning Bar. A steel horizontal bar one and one half inches in diameter wrapped with adhesive tape.

Basic Assumptions

It was assumed that all students being tested had little or no advanced training in either rope climbing or the bent-arm-hang exercise. The bent-arm-hang is not an activity that one would turn to normally during every day recreation and rope climbing activities are not a part of the physical education program prior to the fourth grade.

CHAPTER II

REVIEW OF RELATED LITERATURE

In an attempt to best meet the needs of the problem, the writer reviewed available information pertaining to the subject with two definite areas in mind: one being the area of rope climbing; while the other was the search for methods of development of arm strength through various forms of exercise.

Historical Background

Through the pages of history rope climbing, whenever mentioned, is usually mentioned in conjunction with gymnastics and apparatus activities.

The Greeks were among the earliest civilizations practicing physical activities on various types of apparatus. According to G. U. A. Vieth,[3] who was reportedly one of the most scholarly writers on this subject, ropes were used for both climbing and pulling activities. He also reported the use of weights in the form of dumbbells to increase body strength and as a measure of strength.

During the training period before achieving knighthood men had to develop physical skills in seven different

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[3]Leopold F. Zwarg, A Study of the History Uses and Values of Apparatus in Physical Education (Philadelphia: Joseph Mc Vey, 1930), p. 16.

areas; one of these areas was climbing on ladders, poles and ropes.

In the year 1785 Guts Muths,[4] who is known as the great-grandfather of German gymnastics, introduced German gymnastics. He started by setting up an outdoor gymnasium which included, among other pieces of apparatus, climbing ropes and poles. This man had a group of forty to sixty pupils to put through daily exercises. By observing their daily performances and recording these observations he was able to establish measurements for strength and ability as it related to their performance on the apparatus.

A mention of rope climbing occured in Gerhard Vieth's third book which appeared in Leipzig, Germany in 1818.[5] This book contained a series of exercises to be done on the apparatus.

Aldoph Spiess[6] was known as the founder of German School gymnastics. He studied the methods and ideas of Guts Muths and Frederick Jahn. While teaching school he attempted to adapt all known physical training activities to school conditions. Spiess graded his activities according to the different school ages. His exercises on the

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[4] Ibid., p. 21.

[5] Ibid., p.23.

[6] Ibid., p. 39.

apparatus were divided into two parts; that of hanging and exercises of support. The apparatus used for hanging exercises were the ladders, horizontal bar, parallel bars, scaling walls, giant stride, climbing poles and ropes. The "support" apparatus included the horizontal bar and beam, tree trunks, ladders, ropes, oblique boards, parallel bars, horses, bucks, stilts, skates and sleds.

In the year 1824 the use of gymnastic apparatus was introduced in the United States. At the request of certain prominent American educators, Charles Beck, Charles Follen, and Francis Lieber, playgrounds modeled after those of Frederick Jahn were established.[7] Three of these playgounds were at: Roundhill School, Northampton, Harvard University and at the Boston Gymnasium.

These playgrounds of gymnastic apparatus did not take hold at this time and for the most part gymnastics lay dormant until after 1848. It was at this time that the Turners were formed. The popularity of the Turners gave gymnastics and the use of gymnastic apparatus a solid foot hold in America.

There were national festivals of the American Turnerbund which brought together the better performers from the

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[7] Ibid., p. 39.

various Turners from around the country. Milwaukee was host to the ninth national Turnfeste, held by the societies of the Turnerbund, in August of 1857, again in July of 1877, and again in July 1893.[8] George Wittick was in charge of the Milwaukee Turnerbund from 1902-1907 teaching year-long courses for those five years.

At these festivals the rope climb was included as a "special event."[9] The contestant started the climb while seated on a chair with the legs off of the floor; he was to climb a distance of twenty feet using the free style hand over hand method. The performance was judged on speed alone..

In Philadelphia during the 1920's a series of standardized tests were formed that would measure the physical abilities of high school boys on certain pieces of apparatus. Test measuring climbing ability on ropes was one of the areas included in these standardized tests. The test for boys in their first year of high school was climbing to the top of the rope (no distance was stated) and down again, using arms and legs. The difficulty of the test progressed with each half grade level until the final senior semester; at this

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[8]Fred E. Leonard, History of Physical Education (Philadelphia and New York: L E A and Febiger, 1923), pp. 293, 296, 307.

[9]Leopold F. Zwarg, Apparatus and Tumbling Exercises (Philadelphia: John Mc Vey, 1928), p. 310.

time the boys were required to climb two ropes simultaneously, without the use of the legs, to the top and then decend in the bent arm position. The responsibility of learning the required exercises was solely up to the boys. They were tested every six weeks and were given a rating of: Excellent, Good, Fair, Poor, Deficient.[10]

The last record of rope climbing in the Olympic Games was during the 1932 Olympics in Los Angles. A man by the name of Raymond Bass,[11] from the United States, was the winner with a time of 6.7 seconds for the rope climb, no distance or other facts were included with this record information.

Milo of Crotona, the great Greecian Olympic wrestler, was one of the earliest devotees to weight lifting for strength development. He, as legend has it, as a small boy lifted a young bull each day. As the days went on the weight of the bull increased and so did the strength of Milo. He was using the overload principle, that is: increasing the resistance with each gain in strength.

Weight training in America was aided by Alan Calvert

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[10]Leopold F. Zwarg, A Study of the History Uses and Values of Apparatus in Physical Education (Philadelphia: Joseph Mc Vey, 1930), p. 95.

[11]John Kieran and Arthur Daley, The Story of the Olympic Games (Philadelphia and New York: J. B. Lippincott Company, 1965), p. 499.

who is called "the father of weight training in American."[12] This man formed a manufacturing company to make bar-bells because of the lack of adequate weight training equipment. Calvert, as a part of his bar-bell sales promotion, published and gave to his bar-bell buyers an exercise program. The theory of "overload" was stressed in this program: the person would perform each exercise a given number of times (repetitions). At the start of each week repetitions were added to the workout. This was continued until ten repetitions was achieved, then the load was increased and the repetitions dropped back to five per day.

Intermitent principle as it related to weight lifting was also included in Calverts program by instructing students to train only three times each week. This three-day-a-week schedule for workouts has a direct bearing on the intermitent principle.

A renaissance in weight training occured during the Second World War. As a result of the war many Americans recuperating in hospitals and training camps needed to rebuild damaged muscles. "Progressive resistance exercise" was the term applied to the rejuvenating exercises, but in reality they were disguised forms of weight lifting and

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[12] Weight Training in Sports and Physical Education (Washington 6, D. C.: American Association for Health, Physical Education and Recreation, 1962), p. 3.

weight training.[13]

Thomas De Lorme was one of the men most responsible for the change in thinking as it related to weight training. People had formed the opinnion that weight training made men slow, muscle bound and was bad for the heart, but De Lormes progressive resistance exercise programs proved to the contrary. His exercise programs were used in clinics and hospitals with benificial results to the recovery of the patients.

Weight training for a time became nothing more than theatrical entertainment. The Mr. America contests and the weight lifting demonstrations distracted from the real values of weight training. While the men who entered into these contests certainly developed strength through weight lifting, they did it for show purposes only.

Athletes may be thought of as coming to the rescue of the real values of weight training. The emphasis during the Mr. America period was on big beautiful muscles with very little effort being placed on the actual use of these muscles. The athletes gave real meaning to weight training by developing muscles and muscle groups for the purpose of improving their skill and ability in the athletic contests they were connected with.

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[13]Ibid., p. 7.

In an ever expanding list of athletes using weight training only a few will be listed to partially satisfy the readers curiosity: Fortune Gordien the one time world record holder for the discus throw, Bob Richards who is an all time great in the pole vault event, Mal Whitfield and John Landy both of which were great runners, Parry O'Brien another one time world record holder, but in the shot put event, and in baseball the names of Mickey Mantle, Ted Williams and Al Kaline can be included.

It should be evident by the performances of these, above mentioned, athletes performances that weight training can aid in physical activity of any type and can in fact make a champion out of the person who follows the proper schedules.

Published Material Available

In searching for rope climbing methods, it was found that the majority of books contained the same or very similar procedures on the subject. Halsey and Porter[14] stated:

> In climbing a rope or a pole, the feet should be wrapped around in such a way that they support the weight during successive pulls of the arms. Suggest that the child place one foot on top of the other, with the rope between them. If feet are carried well forward, the rope may be gripped

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[14]Elizabeth Halsey and Lorena Porter, Physical Education for Children (New York: Henry Holt and Company, Inc., 1958), pp. 383-84.

> between the calf muscles of the upper leg and the shin of the lower leg; this permits a firm locking grip of the knees to hold the rope between them while the arms and hip muscles are moving the body upward.

Motor ability tests listed in another source, Wild and White,[15] stated that the average ten year old boy will be able to climb a distance of twelve feet, while an excellent climber would be able to go one foot higher. The distance listed for the excellent ten year old boy would be the height of the ropes to be used in the study.

It was decided that a measurement for rope climbing ability would be simply, a climb for height. While reading "Methods and Materials in Elementary Physical Education"[16] it was noted that these authors recommended that "speed should not be emphasized in the accomplishment of this skill" and that a child should be encouraged to climb only as far as he feels safe.

One of the reasons for using an experimental group that would use the bent-arm-hang as the variable factor was an idea presented by Cozens, Trieb and Neilson.[17] This

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[15]Monica Wild and Doris White, Physical Education for Elementary Schools (Cedar Falls: Iowa State Teachers College, 1952), p. 299.

[16]Edwina Jones, Edna Morgan and Gladys Stevens, Methods and Materials in Elementary Physical Education (New York: World Book Company, 1957), p. 57.

[17]Frederick W. Cozens, Martin Trieb and N. P. Neilson, Physical Education Achievement Scales for Boys in Secondary Schools (New York: A. S. Barnes & Company Inc., 1936), p. 37.

idea states that any work requiring hanging on apparatus by the hands and arms would be good practice for rope climbing.

In gleaning the literature on muscle development the overload principle was constantly brought to the attention of the investigator. Murray and Karpovich[18] stated that: "though there is no unanimous agreement regarding the details of training, there is one agreement in principle: if you want to develop strength use the overload method." Another source, in discussing the overload principle, stated: "the limits of performance must be persistantly extended to improve muscle strength; and the rate of improvement depends upon the degree to which a person is willing to overload."[19]

To pursue this thought a little farther, "the principle of any method of strength development is the same; the muscle to be overloaded in order for the strength of the muscle to be increased."[20]

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[18]Jim Murray and Peter Karpovich, Weight Training in Athletes (Englewood Cliffs, N. J.: Prentice Hall Inc., 1956), p. 38.

[19]Hellebrandt and Houtz, Exercise and Fitness (Monticello, Illinois: Robert Allerton Park, 1960), P. 209.

[20]Gene Hooks, Application of Weight Training To Athletics (Englewood Cliffs, N. J.: Prentice Hall Inc., 1962), p. 16.

The principle of overload, stated simply, is making a muscle or groups of muscles do more work than they normally do. In an article written by C. Etta Walters[21] it was stated that "working in overload means performing against increased resistance." This overloading of muscles can be produced in slow paced or unpaced activity as long as the activity is continued beyond the limits which are easily met by the individual

It is common knowledge that there are basically two forms of exercise: isometric exercise and isotonic exercise. Isometric exercise or isometric contraction, as it is sometimes called, is the tightening or contraction of a muscle without changing its length.

It was found in material written by Hoffman[22] that while performing an isometric contraction "neither the object nor the muscle moves, yet the muscle contracts powerfully to the limit of its ability." A practical example of an isometric exercise would be: while seated at a piano, place the palms of the hands against the under side of the key board and lift upwards as hard as possible for

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[21]C. Etta Walters, "Scientific Foundations of the Overload Principle," Scholastic Coach. April 1958, p. 20.

[22]Bob Hoffman, Functional Isometric Contraction for Football (York, Pennsylvania: Bob Hoffman Foundation, 1962), p.13.

for eight or ten seconds. In this method of exercise, once the position is assumed, it is quite evident that the piano will not be lifted, therefore the angle of the arms do not move and likewise the length of the working muscles does not change.

Isotonic exercise, on the other hand, requires that the length of the muscle be changed during the duration of the exercise. The muscle will, for example, begin in an extended position, a load is then applied to the muscle, then the muscle is contracted and shortened to its fullest extent. Lifting weights is the best example of isotonic exercise. It could be said that any movement of the body could be classified as an isotonic exercise, because the muscles are moving and changing in length as the body moves and of course the weight of the body or part of the body being moved provides the load or resistance.

Intensity and inhibition are two terms connected with weight training and they have a place in this study. Intensity is the amount of work which produces the greatest gain in muscle strength without producting, as the students would say, sore muscles.[23] In hibition, meanwhile, is the students fear of damage to the muscles and as a result the limiting

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[23]Frank D. Sills, Laurence E. Morehouse and Thomas De Lorme, Weight Training in Sports and Physical Education (Washington 6, D. C. : American Association for Health, Physical Education and Recreation, 1962), p. 21.

of the length of time they would remain in the bent-arm-hang position.[24] "Experience gives the organism the courage to overcome inhibition, and by this means the strength of performance is permitted to increase."[25]

Previous Studies

To the best of the investigators knowledge there has been no previous studies concerned with the effects of concentrated rope climbing and the bent-arm-hang exercise on the ability of rope climbing for fourth grade boys and girls.

Related Studies

The writer was unable to discover any studies that directly related to the study about which this paper is being written. However, there are studies that are indirectly related to the problem being discussed within these pages.

In a study done by Mc Craw[26] on the forearm position as it related to elbow flexion while doing the pull-up, there was no significant difference in the results of the tests

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[24] Ibid., p. 16

[25] Laurence E. Morehouse, "Physiological Basis of Strength Development," Exercise and Fitness (Monticello, Illinois: Robert Allerton Park, 1959), p. 198.

[26] Lynn W. Mc Craw, "Effects of Variation of Forearm Position in Elbow Flexion," Research Quarterly, 35: 504-509, 1964.

given. The subjects used in these tests were required to perform pull-ups with the forearms in the supinated and prone positions. There was a slight indication that the supinated position resulted in slightly higher scores, but this did not appear in the statistical treatment of the data.

The topic of another study was, "Effects of Isometric and Isotonic Exercises on Elbow Flexor Muscle Groups."[27] It was found in this study that the isometric exercises produced a greater gain in muscle strength than did isotonic exercises. It was also found that no matter how many days per week the exercise program was based on, there were significant strength gains for both the isometric and isotonic exercise groups. However, the five day a week program produced the best results as far as increase in muscular strength.

In relationship to the trained male athlete, as stated by Rasch,[28] there is no significant difference between the amount of tension recorded in a single maximum isometric elbow contraction and the amount of weight which may be lifted in a single elbow flexion.

It goes without saying, at this point, that exercise

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[27]Mathews, D. K. and Kruse, R., "Effects of Isometric and Isotonic Exercises on Elbow Flexor Muscle Groups," Research Quarterly, 28: 26-37, March, 1951.

[28]Philip J. Rasch, "Relationship Between Maximum Isometric Tension and Maximum Isotonic Elbow Flexion," Research Quarterly, 28: 85, March, 1957.

regardless of the type when pursued according to a definite plan will produce an increase in muscular strength and subsequently will fill the needs of this study.

CHAPTER III

PROCEDURES

The solution to this problem was begun by equating the members of six fourth grade classes attending four different schools. Any exposure, on the students part, to activities connected with this study was handled solely by the writer.

During the week prior, which included three physical education class periods, to the pretest week each class was instructed as to the proper mechanics of rope climbing, and the bent-arm-hang. Individual assistance was given those students who could not assume the proper positions on both pieces of apparatus. Care was taken to make sure that no student actually did any climbing or hanging during this orientation period. At the end of the week it was judged by the writer that all students could assume the proper positions on both the climbing rope and the chinning bar.

The pretesting began with the rope climbing test. The students were instructed to climb as far as they possibly could while still feeling safe. Their eye level would be the point at which the measurement would be determined. They were to start with the eyes adjacent to the first mark on the rope and their bodies in the proper rope climbing position. If the student could not reach the proper start-

ing position, assistance was given by the writer. Each student was given one attempt and the score achieved was recorded on the score card in the rope climb column B. One point was given for each black mark that the student met at their eye level. They proceeded alphabetically in order until all were tested.

During the rope climbing pretesting period all students were present, this allowed for pretestting the students on the bent-arm-hang during the next class period.

The bent-arm-hang pretest was begun by instructing all students that their test score would be the number of seconds their chin remained over the chinning bar after stepping off of the box. They were timed with a stop watch controlled by the author. In the event that the body, of the student being tested, swung after stepping off of the box the test administrator stopped the swing with an arm held across the legs of the student. As in the rope climb pretest each student was given one trial with encouragement to do the best job possible. These scores were recorded on the score card in column B of the bent-arm-hang.

Any student not present for the bent-arm-hang pretest was tested during the following class period.

It was decided before hand, by the author, that any student that could climb to the top fo the rope would be omitted from the study groups, since it would be impossible

to measure any increase in their ability.

Equating of groups was done according to rope climbing ability. All groups were shown to be equal according to statistical treatment with an F-test. The groups were divided into three parts according to schools, with the two schools that had only one fourth grade class being put into one group. The groups were designated, by selection out of a hat, as number I the control group, number II experimental group BAH (bent-arm-hang), and number III experimental group RC (rope climb).

The training sessions were begun the following week and continued for the next twelve school weeks.

The control group did not practice either the rope climb or the bent-arm-hang during this period of time.

The BAH experimental group practiced the bent-arm-hang exercise once each week. While the RC experimental group was also given one practice attempt during each of the twelve practice weeks. As each person in each experimental group took their practice trial they were encouraged to match or exceed their previous or best performance. The instructor told each student prior to the practice trial what their best previous score was and encouraged them to better that score. It was found, that while doing the bent-arm-hang, the students had no concept of how long they were hanging, so the writer counted out each five second interval to the person during

their practice trial. Another problem that occured with the BAH experimental group was the soreness of the muscles. It was necessary to discuss with them, on their level, the theories of intensity and inhibition.

The scores of each practice session for each group were recorded on a practice score card so that the information could be used for motivation purposes.

If a student was absent during a practice session they had an opportunity to make up the trial during the next physical education period.

One reader may wonder about the use of only one practice trial for each student during each practice session. In view of the fact that the testing and practicing for this study was done entirely during regularly scheduled physical education period, it was felt that this was all the time that could be alloted to the study. Also, the class period length was twenty-five minutes and would allow for only one practice trial for each student.

After the twelve week practice period, post tests were given each group exactly according to the plan set up when giving the pretest. The results were recorded on the same score card as the pretest, only in column A under the proper heading, rope climb or bent-arm-hang.

This data was then treated statistically in an attempt to determine the answers to the questions stated in the beginning of this paper.

TABLE I

PRETEST AND POST-TEST MEANS, STANDARD DEVIATIONS AND STANDARD ERRORS OF THE MEANS FOR EACH GROUP

Control Group	Pretest	Post-test
Mean	4.40	6.80
Standard deviation	2.90	4.29
Standard error of the mean	.53	.78
Experimental Group BAH*		
Mean	4.30	6.82
Standard deviation	3.01	4.18
Standard error of the mean	.47	.66
Experimental Group RC**		
Mean	3.87	8.02
Standard deviation	3.66	4.51
Standard error of the mean	.57	.70

*Represents group doing the bent-arm-hang exercise during practice.

**Represents group doing the rope climbing during practice.

TABLE II

ROPE CLIMBING t-RATIOS BETWEEN GROUPS

GROUP	PRETEST		POST-TEST	
	t-score	Level of Confidence	t-score	Level of Confidence
Control and RC*	.68	50%	1.46	15%
Control and BAH**	.14	89%	.01	99%
BAH and RC	.58	57%	1.66	10%

**Represents group doing the bent-arm-hang exercise during practice.

*Represents group doing the rope climbing during practice.

CHAPTER IV

ANALYSIS OF DATA

The data compiled during the pretest and post-test was used in an effort to illustrate statistically the answers to the problem stated earlier. What is the effect of the bent-arm-hang exercise and concentrated rope climbing on the ability of a fourth grade student to climb a rope?

After administering the rope climbing pretest to all classes this data was used to determine the equality of the groups according to rope climbing ability. The author used the analysis of variance or F-test to find out how equal the groups were. An F-score of .2654 with degrees of freedom of two and one hundred and nine indicated, at lower than the one per-cent level of confidence, that there was no significant difference between any of the groups in rope climbing ability at the time of the pretest.

In an attempt to further substantiate the equality of groups, t-ratios were computed for the differences between groups one and three, one and two, and two and three. The three groups had t-ratios of .68, .14, and .58 respectively. These t-ratios indicate, at the 50% level of confidence or higher, that the groups are equal, with any differences being due to chance only.

At the conclusion of the post-test the data compiled

was again subjected to statistical treatment. Using the same pairing of groups used earlier to show equality among the groups, according to t-ratios, the post-test data was similarly statistically treated. A difference in rope climbing ability between groups one and three was indicated at the fourteen per-cent level of confidence with a t-score of 1.46. A slightly greater difference between groups two and three was noted. The t-ratio between these two groups was 1.66 allowing the author to reject the null hypothesis, which states that there is no real difference between the two groups and any difference that there is, is due merely to chance, at the ten per-cent level of confidence.

To the reader these levels of confidence, for rejecting the null hypothesis, may seem a little high. The author must remind the reader that the study was being done with fourth grade boys and girls, and that a one hundred per-cent performance would not always be achieved, even though it was encouraged by the writer. Factors that would have a definite outcome on the test results were the mental attitude and desire of the student at the time of the test. Finally, anyone who has ever worked with a class of fourth grade students knows that it is practically impossible to motivate all of the students to do their best during any given class period.

Further statistical treatment was applied to the

data compiled on the bent-arm-hang exercise for experimental group BAH. A t-ratio was computed to determine the difference between the pretest and post-test, if indeed there was to be a difference. A t-score of 3.98 shows significantly at less than the one per-cent level that there was a difference in the performance of the BAH experimental group. The mean score of this group on the pretest of the bent-arm-hang was 20.2 seconds, while the mean score of 48.4 seconds on the bent-arm-hang post-test shows a marked improvement in this group with regards to the ability to perform the bent-arm-hang.

TABLE III

BENT ARM HANG t-RATIOS BETWEEN PRETEST AND POST-TEST MEANS FOR EXPERIMENTAL GROUP BAH*

GROUP BAH	PRETEST	POST-TEST
Mean	20.2	48.4
Standard Deviation	15.5	21.1
Standard error of the mean	2.45	3.33
Standard error of the difference between the means	7.1	
t-ratio	3.98	

*Represents group doing the bent-arm-hang exercise during practice.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

Several conclusions can be derived from this study and the data, statistically treated, compiled during the study.

First it is apparent that maturation alone does not sufficiently improve the rope climbing ability of a fourth grade student.

A second conclusion indicates that the increase in arm strength alone in relationship to weight is not enough to improve rope climbing ability.

According to this study the best method of improving the ability of rope climbing is to simply have the students do more rope climbing under the proper guidance and supervision.

Further study could be done during a shorter period of time using more practice sessions and giving each person more practice opportunities.

Another possibility of improving on this study would be to use a different exercise to develop arm strength.

Fianlly there is always the idea of extending the study to include larger numbers of participants over a longer period of time.

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APPENDIX

TABLE IV

RAW SCORES OF THE CONTROL GROUP

STUDENT NUMBER	ROPE CLIMB		BENT-ARM-HANG	
	B*	A**	B*	A**
1	8	13	31	74
2	1	2	24	61
4	5	10	6	15
5	4	6	8	20
7	5	9	7	21
8	8	10	17	31
9	2	7	32	66
11	0	2	0	0
12	0	0	0	0
14	3	5	3	12
17	6	10	21	60
18	9	12	10	33
19 19	4	5	5	14
22	10	13	12	41
23	7	10	14	42
1.1	0	0	5	2
2.1	5	4	19	18
3.1	6	8	17	32
4.1	8	13	28	32
5.1	3	1	9	18
6.1	0	0	0	0
9.1	2	6	11	9
17.1	8	11	42	60
19.1	0	0	8	15
20.1	2	3	33	56
22.1	5	7	25	14
23.1	5	6	13	17
24.1	6	10	24	31
27.1	4	13	10	13
28.1	6	8	16	26

*Pretest score column.
**Post-test score column.
Rope climb scores represented in feet.
Bent-arm-hang scores represented in seconds.

TABLE V

RAW SCORES OF THE BENT-ARM-HANG EXPERIMENTAL GROUP

STUDENT NUMBER	ROPE CLIMB		BENT-ARM-HANG	
	B*	A**	B*	A**
1	6	13	33	70
3	0	0	7	21
4	7	7	16	30
5	1	1	4	52
6	5	6	13	72
7	2	5	14	23
9	1	1	4	13
10	10	13	55	48
11	6	7	24	49
12	8	13	15	39
13	0	0	5	15
14	10	13	80	86
15	5	6	21	76
16	1	3	15	47
17	2	4	11	50
18	2	7	22	68
21	0	0	8	26
22	4	4	15	19
24	7	13	48	101
25	5	10	21	60
26	4	13	12	67
27	7	8	23	45
1.2	2	5	22	35
2.2	5	10	20	61
5.2	7	5	14	30
6.2	4	7	36	80
7.2	8	13	14	51
8.2	6	5	12	56
10.2	12	12	56	76
12.2	4	8	22	35
13.2	0	0	9	52
14.2	7	12	34	55
16.2	1	4	12	16
17.2	4	7	16	44
20.2	0	2	14	21
21.2	4	8	10	42
22.2	3	5	8	36

TABLE V (continued)

STUDENT NUMBER	ROPE CLIMB		BENT-ARM-HANG	
	B*	A**	B*	A**
23.2	2	5	10	55
24.2	5	9	16	52
25.2	5	8	17	65

*Pretest score column.

**Post-test score column.

Rope Climb scores represented in feet.

Bent-arm-hang scores represented in seconds.

TABLE VI

RAW SCORES OF THE ROPE CLIMB EXPERIMENTAL GROUP

STUDENT NUMBER	ROPE CLIMB		BENT-ARM-HANG	
	B*	A**	B*	A**
2	2	4	23	35
3	2	3	11	2
4	2	3	9	9
5	12	13	31	65
6	8	13	9	52
11	5	13	10	9
12	6	13	16	21
13	0	1	5	0
14	12	13	22	41
15	0	0	60	10
19	4	10	17	18
20	2	10	4	10
21	0	1	22	26
22	1	5	23	25
23	9	13	30	19
25	0	5	15	9
26	2	6	30	50
28	6	8	40	23
29	3	11	30	35
30	8	13	16	45
1.3	1	13	32	47
3.3	0	1	0	5
4.3	3	7	21	16
5.3	0	1	5	15
6.3	5	13	35	25
7.3	10	13	27	53
10.3	2	13	41	21
13.3	4	11	15	10
16.3	0	0	4	3
17.3	2	13	29	40
18.3	3	7	25	23
20.3	4	7	21	12
21.3	3	7	25	18
22.3	6	9	25	29
24.3	1	6	42	53
25.3	0	2	11	16
26.3	12	13	56	104

TABLE VI (continued)

STUDENT NUMBER	ROPE CLIMB		BENT-ARM-HANG	
	B*	A**	B*	A**
27.3	0	7	5	6
28.3	11	13	29	51
29.3	4	8	20	17
31.8	4	7	35	42

*Pretest score column.

**Post-test score column.

Rope climb scores represented in feet.

Bent-arm-hang scores represented in seconds.