THE RELATIONSHIP OF SEVERAL PHYSICAL FITNESS VARIABLES IN SELECTED ELEMENTARY SCHOOL CHILDREN

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THE RELATIONSHIP OF SEVERAL PHYSICAL FITNESS

VARIABLES IN SELECTED ELEMENTARY

SCHOOL CHILDREN

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CHAPTER I

INTRODUCTION

This study consisted of the measurement of several variables in fourth grade students and dealt with relationships and interrelationships of these variables. The ones measured were height, weight, and intelligence quotient, movement time, leg strength, distance attained in the standing broad jump, time in running the fifty-yard dash and in the shuttle run.

Previous research has been confined mainly to college students due to their accessibility, with the most popular problem tending to be a comparison of the reaction time of athletes and non-athletes, studied for its predictive value in athletics. Norms for the college student have been established in body movement time and in leg strength. Research, then, has been done in this general area, but none of the studies have dealt with as many variables as does this one, and only a few have been concerned with the grade school student. Of the norms available for the elementary school child, ones indicating leg strength and body movement times were limited, leaving this writer unable to locate any research with which to compare his findings, except for Florence D. Moudy's 1965 study of movement times in elementary school children.[1]

Purpose of Study. The purpose of this study was to determine what, if any, relationships or interrelationships existed between the several

[1] Florence D. Moudy, "Reaction Time and Movement Time in Elementary School Children" (unpub. M.A. thesis, Oklahoma State University, 1965).

variables measured in this study: intelligence quotient, height, weight, movement time, leg strength, shuttle run, and standing broad jump. Sub-problems were (1) to establish or substantiate leg strength norms for fourth grade boys and girls using simplified measuring devices; (2) to establish or substantiate body movement time norms for fourth grade boys and girls; (3) to compare levels of achievement of these boys and girls with the national norms on standing broad jump, shuttle run, and fifty-yard dash; (4) to determine if any difference exists between boys and girls of the same age group in intelligence quotient, body movement time, and leg strength.

Definitions. The abbreviation "I.Q." was used to designate intelligence quotients of the fourth grade students measured by the Stanford Achievement Test administered two weeks prior to testing for this study.

The abbreviation "M.T." was used to designate body movement time, discussed in Chapter III, Figure 1.[2] This variable was measured by the Athletic Performance Analyzer.

"L.S." was the abbreviation for leg strength determined by a test explained in Chapter III, "Methodology," and in Figure 2.[3]

"S.B.J." was the abbreviation for the standing broad jump, and "S.R." represented the shuttle run, both to be discussed in Chapter III.

The Athletic Performance Analyzer, which was used to indicate body movement time, was abbreviated as "APA" throughout the remainder of this study.[4]

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[2]Figure 1, p. 15.

[3]Figure 2, p. 17.

[4]Figure 7, Appendix B, p. 43.

Standard abbreviations of "Ht." for height, and "Wt." for weight, were used, with height being measured to the nearest one-half inch and weight to the nearest pound. Each subject's age was recorded in months; for example, a child with a recorded age of 118 months would be approximately nine years, ten months old. Sex of the subjects was indicated in the raw data material as "M" for male and "F" for female,[5] as "1" for male and "2" for female in the computer program.[6]

Background of Subjects. The elementary school physical education program in Ponca City, Oklahoma, starts in the second grade and continues through the sixth grade. The subjects used in this study had a physical education class period daily. A typical weekly program included team games and relays, stunts and tumbling, rhythms, as well as classroom studies of health. All these activities were preceded daily by ten minutes of calisthenics. Therefore, norms resulting from this study would apply only to other fourth graders who would have had similar physical education training.

The one hundred students who served as subjects for the study represented the fourth grades from two randomly chosen elementary schools in Ponca City. Forty-nine of the subjects were male, and fifty-one, female.

One of the elementary schools was located in an area made up of people of upper-middle class tastes and incomes. All the children tested from this school were Caucasian. The second elementary school was located in an older section of the city which has a mixture of socio-economic groups; a large percentage of families in this area have

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[5] Appendix A, pp. 38-41.

[6] Appendix C, pp. 47-49.

minimal educations and low incomes. The subjects studied from these homes were composed of seventy-eight percent Caucasian, seventeen percent Indian, and five percent Negro students.

CHAPTER II

REVIEW OF THE LITERATURE

Reaction Time and Movement Time Studies. After reviewing the history of movement and reaction time, the author found such studies were not an innovation, but dated back to experiments done by Helmholz as early as 1850.[1] Further, it was found that many studies were credited to the field of physiology rather than physical education and that leadership in this area of reaction and movement times had shifted frequently from psychologists to physiologists to physical educators.

An abundance of material exists concerning movement and reaction times, but studies of reaction time in elementary school children are extremely limited. In addition, most of these studies do not have the scope of the project at hand due to the many variables involved here. One such study involves the effects of rhythmic versus nonrhythmic stimulation in which the author, Don J. Wilson, found these results:

1. Reaction is faster when the potential stimuli were presented in a rhythmic rather than nonrhythmic series.

2. The speed of movement initiated by such a reaction is not influenced by the rhythm or the nonrhythm.

3. Individual differences in quickness of reaction and quickness of movement are almost completely independent.[2]

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[1]H. Helmholtz, Popular Lectures on Scientific Subjects (New York, 1891), p. 322.

[2]Don J. Wilson, "Quickness of Reaction and Movement Related to Rhythmicity or Nonrhythmicity of Signal Presentation," Research Quarterly, XX (March, 1959), p. 109.

Correlation Studies. Several studies have been made over the past years dealing with the relationships of body size and different measures of speed. In this study the body movement, shuttle run, and times of the fifty-yard dash will be compared with age, weight, height, and sex.

Sir Francis Galton, early in his scientific career, came to the conclusion that men of genius tend to be above average in height and weight. In 1869 he stated in his Hereditary Genius:

> There is a prevalent belief that men of genius are unhealthy, puny beings--all brain and no muscle--weak-sighted and generally poor constitutions. I think most of my readers would be surprised at the stature and physical frames of the heroes of history, who fill my pages, if they could be assembled together in a hall. I would undertake to pick out of any group of them, even out of that of the Divines, an "eleven" who should compete in any physical feats whatever, against similar selections from groups of twice or thrice their numbers, taken at haphazard from equally well-fed classes . . . . I do not deny that many men of extraordinary mental gifts have had wretched constitutions, but deny them to be an essential or even the usual accompaniment . . . . A collection of living magnets in various branches of intellectual achievement is always a feast to my eyes; being as they are, such massive, vigorous, capable looking animals.[3]

By 1891 Galton discarded this theory and stated:

> The experience gained by the measurement of about 2,000 students at Cambridge conclusively proves that success in literary examinations is in no manner connected with stature, weight, strength, or breathing capacity, and but slightly with keenness of eyesight.[4]

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[3]Francis Galton, Hereditary Genius (reprinted from the first edition, 1869, by Macmillan and Company, Ltd., London, 1925) quoted in Warren C. Middleton and Donovan C. Moffett, "The Relationship of Height and Weight Measurements to Intelligence and to Dominance-Submission Among a Group of College Freshmen," Research Quarterly, II (December, 1940), pp. 53-54.

[4]Warren C. Middleton and Donovan C. Moffett, "The Relationship of Height and Weight Measurements to Intelligence and to Dominance-Submission Among a Group of College Freshmen," Research Quarterly, II (December, 1940), p. 54.

Amar theorized that small built individuals are quicker than tall ones because weight decreases as the cube of the size, while force decreases as the square.[5]

C. H. McCloy, in the 1920's, collected data from many sources and studied the interrelationships statistically. His study dealt mainly with running, jumping, and throwing. The results proved that grade in school added little to the multiple relationships, and this theory was soon given up. Puberty was deemed important, but due to difficulty in obtaining reliable ratings it was dropped from consideration. Thus, the McCloy studies resulted in classification plans for boys and girls based upon combinations of age, weight, and height derived from multiple regression equations.[6]

Cureton stated that people with long arms and legs and short trunks might show great speed and endurance at light athletic work, because long third-class levers are noted for speed and range of motion.[7]

In contrast with Amar's earlier study, Miller, in 1952, stated that his data on the sixty-yard dash gives a good indication that speed is an innate factor not significantly related to body size or build.[8]

Anna S. Espenschade, in 1961, studied the relationship of age,

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[5]J. Amar, The Human Motor (London, 1920) quoted in William R. Pierson, "Body Size and Speed," Research Quarterly, XXXII (May, 1961), p. 197.

[6]C. H. McCloy, "Athletic Handicapping by Age, Height and Weight," American Physical Education Review, XXXII (1927), pp. 635-642.

[7]T. K. Cureton, "Mechanics of Track Running," Scholastic Coach, IV (February, 1935), p. 10.

[8]K. D. Miller, "A Critique on the Use of the Height-Weight Factors in the Performance Classification of College Men," Research Quarterly, XXIII (December, 1952), p. 402.

height, weight to performances of boys and girls on the California Physical Performance Test. She was to evaluate all these factors as basis for the grouping of students and for the establishment of norms for test performance. In her study 7,600 school children ranging in age from ten to eighteen years were tested. The results given in her test for boys show a climbing progression in all test scores. The mean scores of all boys were highly superior to the preceding year. The girls presented a different picture. Scores in the sit-ups and knee push-ups declined with the increased age of the subject, but increases by age occurred in dashes and broad jump. Her results state that all norms should be based on age alone.[9]

Florence D. Moudy, in 1965, investigated these relationships involving elementary school children: (1) age-movement time, (2) height-movement time, (3) weight-movement time. She figured the correlations, then compared the boys' scores with the girls'. She found that there was a negative correlation of .74 between age and movement time which was significant at the .01 level of confidence. A t-ratio of 11.3 for movement time was significant at the .01 level of confidence. She found a negative correlation of .492 between the height and movement time and .505 between weight and movement time which were significant at the .01 level of confidence. Comparing the sexes, she found boys faster than the girls in the movement time test. The mean movement time score for boys was .90 seconds, and girls had a mean movement time of .97 seconds.[10]

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[9] Anna S. Espenschade, "Restudy of Relationships Between Physical Performances of School Children and Age, Height, and Weight," Research Quarterly, XXXIV (May, 1963), pp. 144-153.

[10] Moudy, pp. 20-26.

I.Q. Studies. In the 1930's a study was made by Warren C. Middleton and Donovan C. Moffett. They found, "The correlation between height and intelligence for the group was .22 ± .03 (.25 ± .04 for the men and .29 ± .03 for the women)." There is a slight correlation with intelligence. "The correlation between weight and intelligence for the group is .15 ± .03 (.18 ± .04 for the men and .19 ± .04 for the women)." They added that "Weight does not correlate as highly with intelligence as does height. There is no sex difference in size of correlation between weight and intelligence."[11] The results of this study cannot be valid for the elementary school child because the subjects tested were all college freshmen.

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[11]Middleton and Moffett, p. 58.

CHAPTER III

METHODOLOGY

Subjects. Subjects for this study were one hundred male and female fourth grade students ranging in age from nine to thirteen years. Of the total number there were fifty-one girls and forty-nine boys. The students who served as subjects for this study came from two different elementary schools in Ponca City, Oklahoma. The schools tested were chosen by simple cluster sampling.[1] To utilize this simple cluster process, the names of each of the nine elementary schools were written on separate slips of paper, put into a small box, and then two names were drawn out. Through the use of statistical techniques results can be generalized to all fourth graders in the Ponca City School System.

One of the selected schools was Woodlands Elementary, located in the northeast part of Ponca City. This area contains many new homes, and its inhabitants would be considered in the upper-middle class, being professional people on a whole. All the Woodlands students tested were Caucasian.

The second school was Garfield Elementary which is located in an older section of the city and has a mixture of socio-economic groups although the largest percentage of families have minimal educations and

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[1]M. Gladys Scott, ed., "Populations and Samples," Research Methods in Health, Physical Education, and Recreation (Washington, D. C., 1959), p. 92.

low incomes. The Garfield subjects were composed of seventy-eight percent Caucasian, seventeen percent Indian, and five percent Negro students. No pupil from either school, known to have a physical handicap or an organic deficiency, was included in this study.

Test Procedure. These students were allowed to come three at a time into the health room of the school to get measured for height, to be weighed, and to take the movement time test.

All students were tested under similar conditions during the school day, at least one hour after meals. Since the students were in class, no strenuous physical activity took place before the test. Uniform directions were given to all subjects prior to testing during which time each was informed that while he was expected to do his best, the results of his efforts would have no bearing upon his physical education grade. In order to avoid the possibility of competition between subjects, test results were not shown to the subjects. The study was conducted in a nine-day period with the first two days spent measuring height and weight, obtaining the intelligence quotient, and administering the body movement time test to each student. Two days each were spent giving the leg strength test, body movement time test, and standing broad jump test. The fifty-yard dash and shuttle run tests were given on two separate days. With the exception of the I.Q. test, all tests given in this study were administered by the author.

ANALYSIS OF INDIVIDUAL TESTS

Shuttle Run. Subjects, dressed in street clothes and tennis shoes, took this test in the school gymnasium.

The testing equipment included two wooden blocks with the dimensions of 2" x 2" x 4" and an area marked for a thirty-foot runway. The starting and finish lines of this runway were designated by taped lines. A stopwatch was used for timing.

The blocks were placed behind one of the lines; the subject then stood behind the line opposite the blocks to begin the test. On the starting signal, "Ready? Go!" the subject ran to the blocks, picked up one, returned, and placed it behind the starting line. (He was not allowed to throw or drop the block at the starting line.) Immediately upon placing the block on the floor, he ran, picked up the second block, and carried it back across the starting line to complete the test.

The tester began recording a subject's time from the instant the "Go!" signal sounded and stopped the watch just as the subject crossed the finish line on the final run. Each subject had a rest period between trials. The period was not of a determined length since the investigator was calling the names from the class roll and rotating the students. The speed results were recorded three times to the nearest tenth of a second with the best of the three runs being used for the calculation.

Fifty-yard Dash. Testing for the fifty-yard dash took place outside on two perfect autumn days of above normal temperature; the wind was at a minimum. Students again ran in their street clothes and tennis shoes.

Testing followed this procedure. The student stood behind the starting line while the tester took a position at the finish line, using as equipment a stopwatch and record sheet. Preparatory to giving the start signal, the tester raised one hand as a warning to the child to get in a starting position; then he signaled the start of the test by bringing down his hand quickly, and hitting his leg. As the pupil crossed the finish line, the tester stopped the clock, both noting and recording the student's time.

The subject ran the fifty-yard dash three times with a rest period which varied in length due to the rotating of the class roll. The best time of the three tests was used as the correlation factor.

Standing Broad Jump. This test gives an indication of the strength, spring power, and agility of the child's legs.

The tester selected a tumbling mat to provide a level and padded surface for the child to land on. A tape measure was attached to the mat at a right angle to the take-off line in order to measure the length of the jump. The tester stood to the side with a yardstick to indicate the subject's point of impact after jumping. He then measured the results to the nearest inch. In judging the distance of the jump, the tester measured from the take-off line to the heel or any part of the body that touched the surface nearest the take-off line. Three tries were allowed, and the distance of the best jump was used in figuring the results.

The subject's actual procedure during the test followed this pattern. The pupil stood with his feet comfortably apart and with toes just behind the take-off line. Preparatory to jumping, the pupil should have had his knees flexed and should have swung his arms backward and forward in a rhythmical motion. As he jumped, his arms swung forcefully forward and upward as he pushed off from the balls of his feet. Students were familiar with this procedure in that the tester had explained and demonstrated the jump to all the class. The students also did a series of practice jumps.

Body Movement Time Test. The test required the total body to complete an execution of jumping onto an electric switch mat following a sound stimulus. This test utilized a device known as the Athletic Performance Analyzer (APA), manufactured by the Dekan Timing Device Company of Glen Ellyn, Illinois, a mechanism quite useful in measuring reaction and movement time. It consisted of an electric switch mat attached to an electronic chronoscope which measured time to the nearest one hundredth of a second.

In preparation for the movement time test, the subjects were allowed to come into the school health room three at a time. The instructions had previously been given to the whole group so only a brief review concerning the test was necessary. The tester had placed the analyzer on top of a desk; the switch plate attachment was located on the floor two feet from the controls and was taped to the floor to eliminate slipping. The location of the starting point was eighteen inches away from the switch mat with the starting line represented by a twenty-four inch length of tape. The tester stood between the controls and switch mat to proceed with the operation and to obtain a thorough view of the subjects.

The pupil stood in a ready position with knees bent, feet apart, and toes behind the starting line. His hands and arms were back for more accelerated movement from the upswing in preparation for the jump. The subject reacted to a sound stimulus produced by the APA. The tester gave the command "Ready" and pushed the button on the control panel. A delay-start circuit kept the subject from learning a definite rhythm of starting. The delay-start circuit was adjustable from one to six seconds. As the subject jumped to the switch mat, landing on both feet, he stopped the clock.

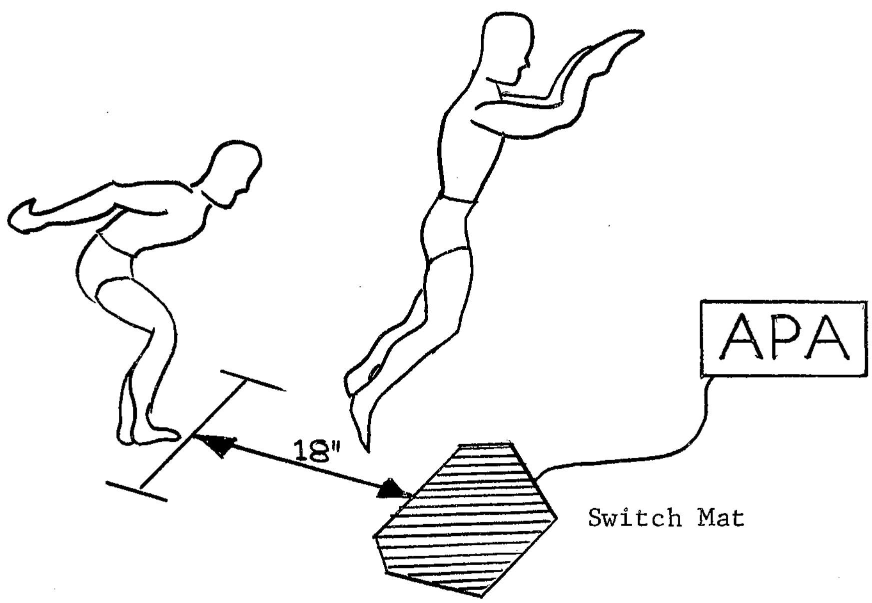

Figure 1. Body Movement Time Test

Equipment: Athletic Performance Analyzer and switch mat.

Starting Position: The subject stands in a ready position with knees bent, feet apart, and toes behind the starting line. His hands and arms were back for more accelerated movement from the up swing in preparation for the jump. On an auditory stimulus caused by the sounding of a buzzer from the APA, the subject jumped the 18-inch distance to the switch mat, landing on both feet, thus stopping the clock.

Trials: Subject made ten jumps. The mean of the last five was computed and considered as each subject's body movement time.

Each subject made ten jumps. All times were recorded, but only the last five scores were used to compute the mean.

Leg Strength Test. Plans for constructing this device were developed by Mary A. Heintz, in 1959. She reported that the apparatus showed a reliability of .90 (test-retest method) and validity of .75 (criterion Narrangansett back dynamometer).[2] The equipment for this test, called the tennometer,[3] consisted of a homemade apparatus which was constructed from a 2" x 12" board six feet long for the base or platform. The lever section was a 4" x 4" x 5' board connected with a metal hinge to the fulcrum, a 4" x 4" block bolted to the platform. Near the fulcrum and under the lever were the bathroom scales which were read in pounds. At the end opposite the scales the subject stood, straddling the lever with his feet on the edge of the platform. Attached to this end of the lever was a chain which was, in turn, attached to a padded bar that rested across the subject's thighs. The length of the chain was adjusted to fit each subject, determined by the distance from the platform to the top side of the subject's thighs when he bent his knees to an approximate 115° to 120° angle. To prevent the padded bar from slipping off the subject's thighs, the bar was secured by cotton webbing tied around the subject's waist.

When the subject was in knee-bent position and ready for the test, he applied pulling force to the bar by extending the knees, thus exerting force on the lever. Force was measured in pounds on the scales at the opposite end of the lever. The subject had three recorded trials with his best showing of leg strength being used for computing.

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[2]Mary A. Heintz, "Device for Testing Back Strength," Research Quarterly, XXXIII (December, 1962), p. 638.

[3]Figure 2, p. 17.

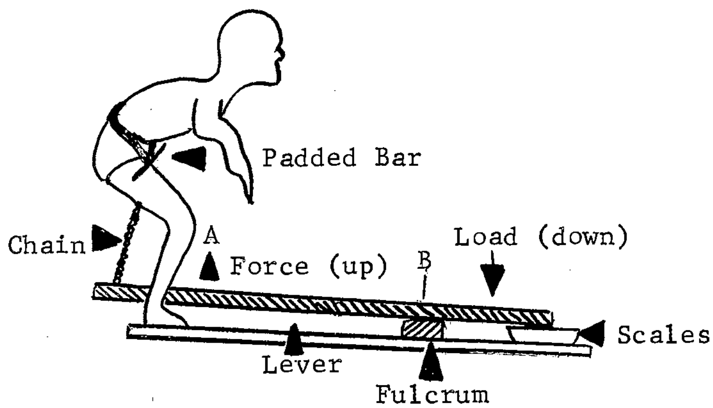

Figure 2. Leg Strength Test

Equipment: Leg strength testing apparatus and scales.

Starting Position: The subject stands straddling the lever with his feet at the edge of the platform. His knees are bent with a padded bar resting across the thighs. The bar is attached to the end of the lever directly under the subject. In addition, the bar is tied around the waist of the subject by a cloth belt to prevent slipping. When pupil is in knee-bent position and ready, he applies pulling force to the bar by standing straight up. Since there was a 3-1 ratio in distance AB-BC the scale reading was multiplied by 3 to get leg strength.

Trials: The subject has three recorded trials; the subject's best pull was used for computing.

Intelligence Quotient. The tester transcribed the individual intelligence quotient results from the subjects' cumulative folders, results based on the Stanford Achievement Test which the elementary school principal had administered two weeks prior to the testing for this study.

Victor H. Noll in his book Introduction to Educational Measurement cites the Stanford Achievement Test as holding a position of leadership in the field for thirty years and as still being probably one of the best known and most widely used batteries in existence.[4]

Analysis of Data. After the raw data was obtained, it was punched on IBM cards. The cards were then read into a digital computer, a computer using numbers, symbols, etc., consisting of coded digits to solve problems. A Fortran program was written to compute the mean movement time from the raw data. A second computer program was used to study correlations of the variables. This computer program based on a multiple correlation method of analysis was used to study the correlation of the various combinations of the variables. All work was done on an IBM 7040 digital computer which took only six seconds to perform the required calculations.

Means were computed for eighty-two of the one hundred subjects. The scores of the remaining subjects in this study were dropped in that these eighteen were retained students at some point in the early school years, thus making them significantly older than the other eighty-two students, lower in I.Q., stronger in leg strength, and much taller and heavier than the average of the remaining subjects. The

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[4]Victor H. Noll, Introduction to Educational Measurement, (Cambridge, 1957), p. 25.

eighty-two students were then used to compute the mean values for the mixed group of children and then for the groups of boys and girls separately. The author studied data for the difference between boys' and girls' I.Q., movement time, and leg strength.

The scores were then compared with the established norms of the AAHPER tests[5] and Moudy's results[6] for body movement time. The next step was to establish a Sigma scale table of leg strength norms which included three standard deviations on either side of the mean.

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[5]American Association of Health, Physical Education, and Recreation, Youth Fitness Test Manual (Washington, D. C., 1962).

[6]Moudy, p. 21.

CHAPTER IV

RESULTS

An analysis of the experimental data showed that significant correlations did exist between certain variables. A significant correlation means that it is reasonable to assume that a functional relationship exists between the variables. The determination of a meaningful functional relationship would require data over a wider age group and was not included in the scope of this research program.

The variables that do not show a significant correlation may be influenced by the fact that the data covers approximately only one elementary grade group. The lack of significant correlations indicated by this data should not be interpreted as a lack of significant correlation of the same variables over a wider age group. Significant correlations were found between the variables indicated by the special notation shown in Tables II, III, and IV at the end of this chapter.

I.Q. - Height, Age, Leg Strength. The negative correlations, significant at the 0.05 level of confidence were undoubtedly biased by the presence of data for students who were retained. Eighteen of the one hundred students had been retained in some earlier grade. These eighteen, then, were heavier, taller, and lower in I.Q. than most of the other eighty-two students tested.

Weight - Leg Strength. The positive correlations, significant at the 0.01 level of confidence for all three groups, indicated that heavier children tended to show more strength on the leg strength test; this was not a surprising result in that the same bias which affected the correlation of I.Q. to height, age, and leg strength was likely in this correlation.

I.Q. - Broad Jump. The positive correlation significant at the 0.01 level of confidence indicated that the boys with a higher I.Q. tended to jump farther.

Weight - Broad Jump. A significant correlation at the 0.05 level of confidence for the boys' group indicated that the lighter boys jumped farther. No significant correlation existed for the girls' group and mixed group.

Height - Leg Strength. A significant correlation at the 0.05 level of confidence for all three groups indicated that taller children had stronger legs.

Age - Broad Jump. A significant correlation at the 0.01 level of confidence for the boys' group indicated that younger boys jumped farther. No significant correlation existed for the girls' group or mixed group.

Leg Strength - Shuttle Run. A significant correlation at the 0.01 level of confidence for the girls' group indicated that girls with stronger legs ran the shuttle run faster. No significant correlation existed for the boys' group. The shuttle run is supposed to be a feat of agility, but it probably gives a measure of speed also.

Leg Strength - Fifty-Yard Run. A significant correlation at the 0.05 level of confidence for the boys' group and at the 0.01 level of confidence for the girls' group and for the mixed group indicated that children with stronger legs run faster.

Leg Strength Norms. A Sigma scale table for leg strength of fourth graders using the tennometer follows in Table I. The investigator constructed this table to give meaning to the raw data obtained in physical education tests.

TABLE I

SIGMA SCALE FOR LEG STRENGTH

Boys	(Aged 107-119 Months)		Girls
Sigma Scale	Pounds	Sigma Scale	Pounds
100	446	100	371
90	417	90	337
80	373	80	303
70	329	70	269
60	285	60	235
50	241	50	201
40	197	40	167
30	153	30	133
20	109	20	99
10	65	10	65
0	21	0	31
Number of Subjects - 38		Number of Subjects - 44	

TABLE II

CORRELATION FOR BOYS

	Independent Variables					Dependent Variables			
	I.Q.	Wt.	Ht.	Age	L.S.	M.M.T.	Shut. Run	50-Yd.	S.B.J.
I.Q.		-0.285	-0.351**	-0.572*	-0.346**	0.040	-0.025	-0.028	0.414*
Wt.			0.782*	0.430*	0.520*	0.078	0.019	-0.174	-0.395**
Ht.				0.413*	0.413*	0.140	-0.004	-0.213	-0.233
Age					0.231	0.144	0.033	0.069	-0.411*
L.S.						-0.051	-0.270	-0.336**	-0.019

* 0.01 Level of Confidence

**0.05 Level of Confidence

(To determine the significance of these correlations, see Table V, Appendix D, p. 51.)

TABLE III

CORRELATION FOR GIRLS

	Independent Variables					Dependent Variables			
	I.Q.	Wt.	Ht.	Age	L.S.	M.M.T.	Shut. Run	50-Yd.	S.B.J.
I.Q.		0.093	0.028	-0.457*	0.049	-0.309**	-0.016	0.094	0.164
Wt.			0.669*	0.207	0.308**	-0.056	0.178	0.080	0.137
Ht.				0.292**	0.392*	-0.084	0.159	0.093	-0.031
Age					0.109	-0.006	0.067	0.050	-0.077
L.S.						-0.247	-0.382*	-0.442	-0.027

* 0.01 Level of Confidence

**0.05 Level of Confidence

(To determine the significance of these correlations, see Table V, Appendix D, p. 51.)

TABLE IV

CORRELATION FOR MIXED GROUP

	Independent Variables						Dependent Variables			
	Sex	I.Q.	Wt.	Ht.	Age	L.S.	M.M.T.	Shut. Run	50-Yd.	S.B.J.
Sex		0.196**	-0.227**	-0.157	-0.180	-0.254**	0.226**	0.246**	0.104	0.049
I.Q.			-0.177	-0.230**	-0.540*	-0.230**	-0.078	0.029	0.055	0.149
Wt.				0.753*	0.389*	0.481*	-0.031	0.030	-0.079	0.038
Ht.					0.394*	0.428*	0.009	0.028	-0.088	-0.045
Age						0.230**	0.039	-0.002	0.038	-0.085
L.S.							-0.181	-0.352*	-0.385*	-0.029

* 0.01 Level of Confidence

**0.05 Level of Confidence

(To determine the significance of these correlations, see Table V, Appendix D, p. 51.)

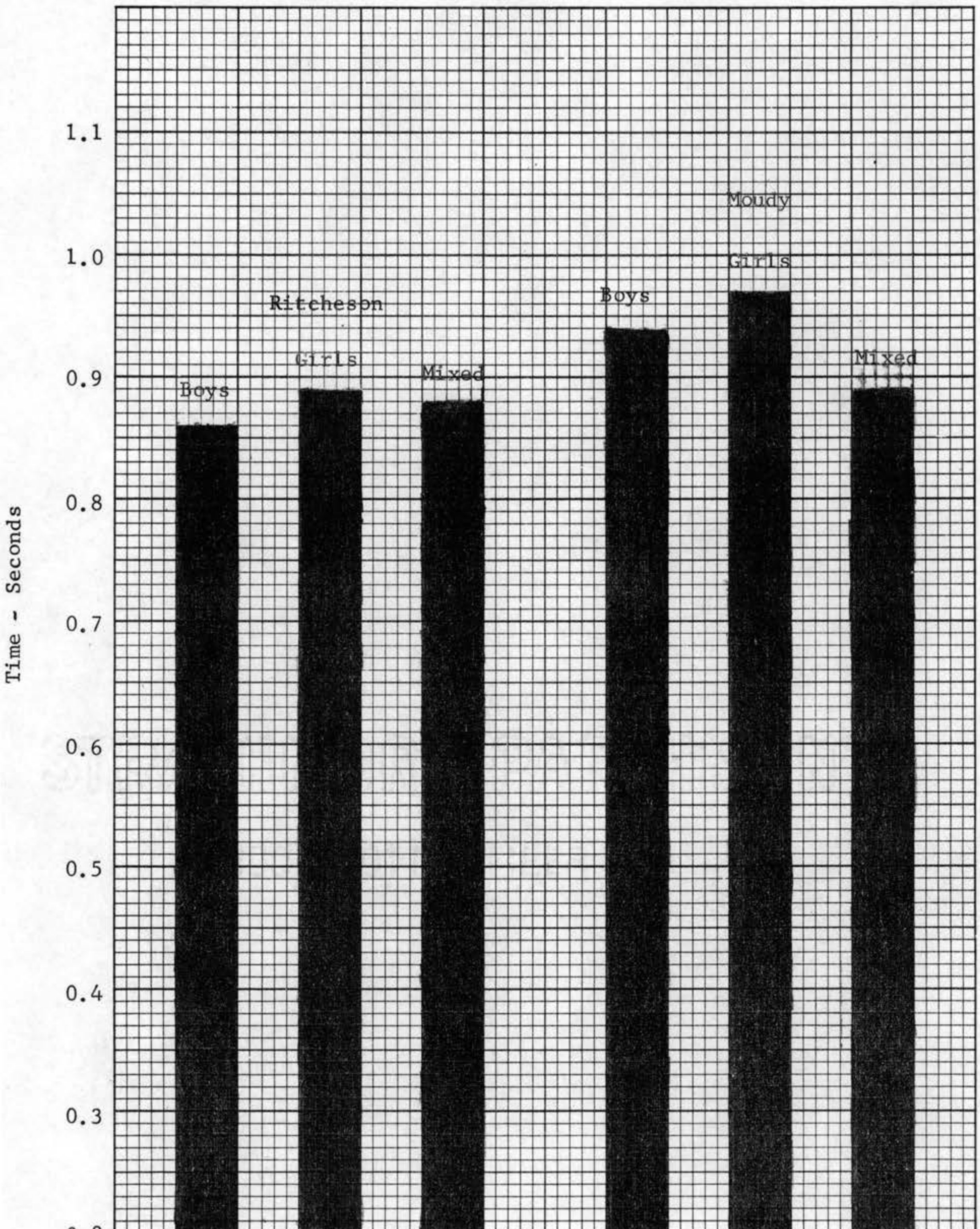

Figure 3. Mean Movement Time - Age 108-119 Months

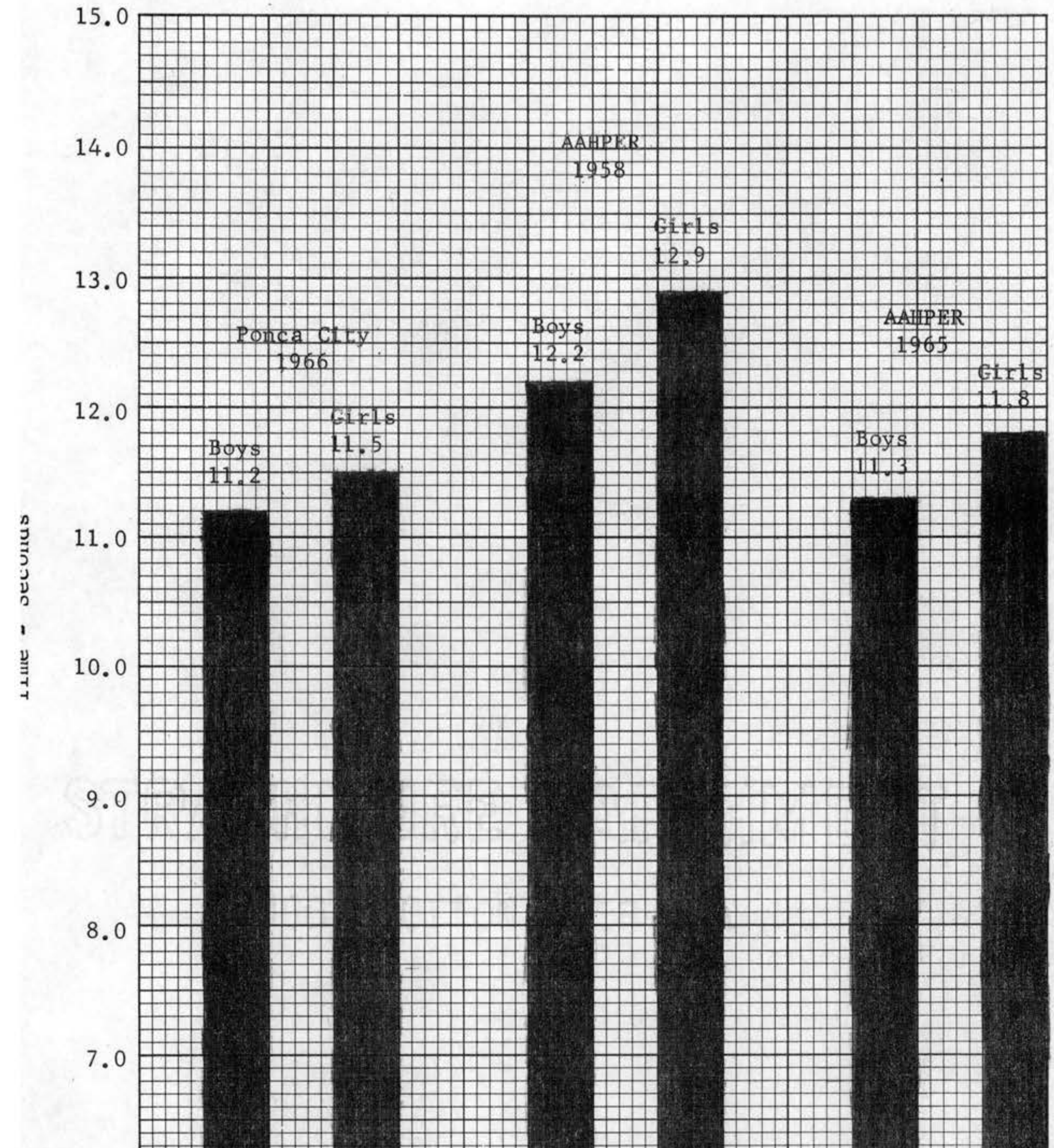

Figure 4. Shuttle Run Mean

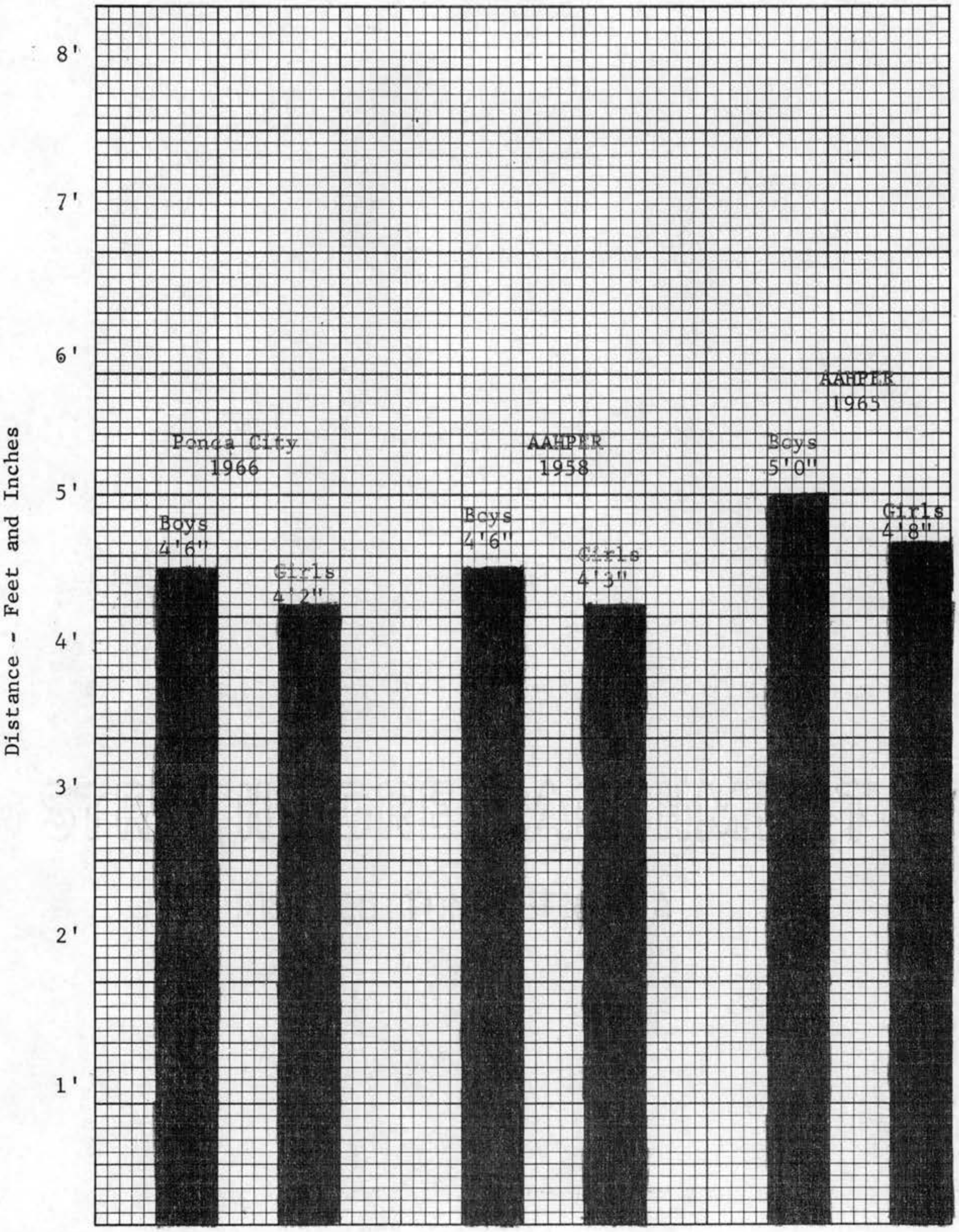

Figure 5. Standing Broad Jump

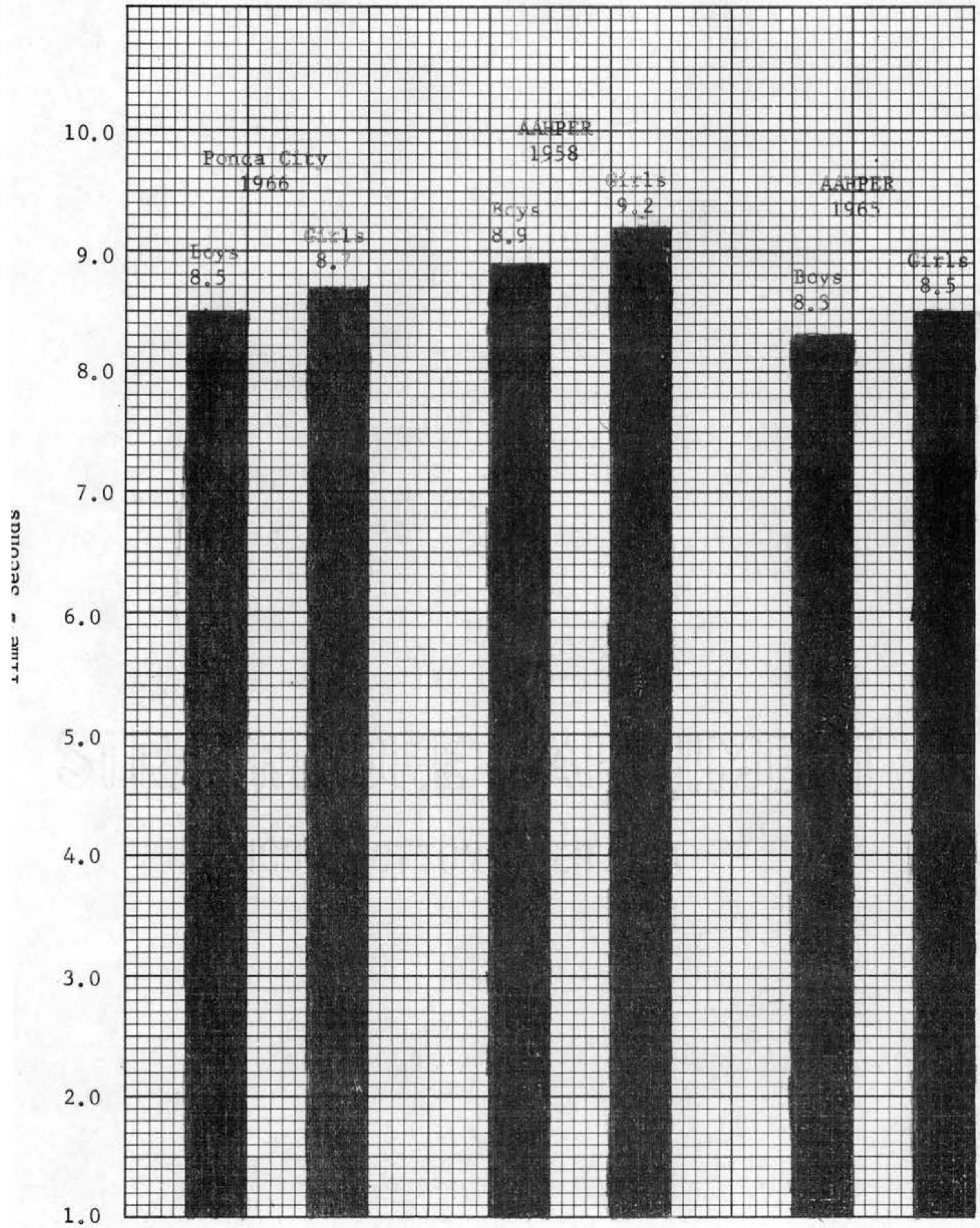

Figure 6. 50-Yard Dash Mean

CHAPTER V

CONCLUSIONS

The purpose of this study was to determine if a significant correlation existed between any of the measured variables. Sub-problems were to establish leg strength norms for fourth grade boys and girls, to establish or substantiate body movement time for fourth grade children, to compare levels of achievement of these boys and girls with the national norms on standing broad jump, shuttle run, and fifty-yard dash, and to determine if any difference exists between boys and girls of the same age group in body movement time and leg strength.

From the data collected and computed, the following conclusions were reached.

1. These were the significant correlations:

Boys		Girls	
a. I.Q. with Age	-.572	a. I.Q. with Age	-.457
b. I.Q. with S.B.J.	+.414	b. Wt. with Ht.	+.669
c. Wt. with Ht.	+.782	c. Ht. with L.S.	+.392
d. Wt. with Age	+.430	d. L.S. with S.R.	-.382
e. Wt. with L.S.	+.520	e. L.S. with 50-Yd.	-.442
f. Ht. with Age	+.413	f. I.Q. with M.T.	-.309
g. Ht. with L.S.	+.413	g. Ht. with Age	+.292
h. Age with S.B.J.	-.411	h. Wt. with L.S.	-.308

Mixed Group

At the .01 Level of Confidence.			At the .05 Level.		
a.	Wt. with Ht.	+.753	a.	Sex with I.Q.	+.196
b.	Wt. with Age	+.389	b.	Sex with Wt.	-.227
c.	Wt. with L.S.	+.481	c.	Sex with L.S.	-.254
d.	Ht. with Age	+.394	D.	Sex with M.T.	+.226
e.	Ht. with L.S.	+.428	e.	Sex with S.R.	+.246
f.	I.Q. with Age	-.540	f.	I.Q. with Ht.	-.230
g.	L.S. with S.R.	-.352	g.	I.Q. with L.S.	-.230
h.	L.S. with 50-Yd.	-.385	h.	Age with L.S.	+.230

2. The results of the leg strength test showed the mean for boys to be 240 pounds and for the girls, 199 pounds. A Sigma scale table was made in Chapter IV[1] to show norms for the elementary school boy and girl ranging in age from 107 to 119 months.

3. The mean movement time of elementary school children in this study was .88 seconds compared to the mean found by Moudy in 1964 of .94.

4. The subjects tested ranged in age from 107 to 119 months. The norms set by the AAHPER stops at ten years or 120 months. The subjects did compare well on the tests even though they were younger. For example, in the shuttle run boys ran 11.2 seconds compared to the AAHPER score of 11.3 seconds; the girls had a 11.5 second record, and the AAHPER, 11.8 seconds. In the standing broad jump boys measured 4'6", and AAHPER, 5'0"; the girls' norm was 4'0" compared to the AAHPER's 4'8". In the fifty-yard run the boys ran 8.5 seconds compared to the

[1] p. 22.

AAHPER's 8.3; the girls ran in 8.6 seconds while the AAHPER subjects ran in 8.5 seconds. (The AAHPER scores are based on the 1965 norms.)

5. Boys and girls of the same age group showed differences between their body movement times and in their leg strengths. In body movement time boys scored a .85 compared to the girls' .89. In leg strength the boys' mean was 240 pounds, whereas the girls' mean was 199 pounds.

Recommendations. When an electronic computer is to be used in correlating test results, it is advised that the investigator consult with individuals in charge of the computer before such tests are administered. Considerable time and money may be saved if the data is recorded in the most efficient form for the purpose of transcription to the cards on which it will be punched. Companies have set up computing centers with manuals of program abstracts which describe the various functions the computer will perform. If the investigator locates a program in which he is interested, he may send to the company for a copy of the complete program which describes in detail its purpose, method of functioning, limitations, and precautions. Copies of program details will also usually be available at the center where the computer is located.

In a correlation analysis study with as few as twenty variables, 190 intercorrelations would be present, imposing a terrific calculational burden even if an automatic calculator were available. The electronic computer can provide the means and standard deviations for each of the variables and the coefficients for all of the intercorrelations. In an analysis of variance problems, the computer can find the sums of squares for the various error estimates.

Further studies involving relationships or norms for any group of children should be based on age rather than on grade level. The author recommends that the raw data from this study and data from other studies be compiled to establish norms for children, aged 107 through 119 months, in leg strength and movement time. Investigators must remember that norms are established only to the fifth grade level by the American Association for Health, Physical Education, and Recreation.

A further recommendation for a study is a project to determine the fatigue factor in elementary school-aged children by testing in the morning and in the late afternoon of the same day in order to compare the differences in their times and distances.

The raw data from this study should be further analyzed for differences that might exist between students in the two schools.

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APPENDIX A

APPENDIX A

RAW DATA

Case	Sex	I.Q.	Wt.	Ht.	Age	M.M.T.	Shut. Run	50-Yd.	S.B.J.	L.S.
1	M	100	058	51.5	112	74	10.4	8.3	4'6"	80
2	M	099	057	50.0	108	87	12.0	9.1	3'11"	73
3	M	102	093	55.5	118	86	10.1	7.5	5'6"	105
4	M	116	051	50.5	111	85	11.3	8.5	4'8"	60
5	M	104	072	55.5	119	76	12.3	9.7	4'5"	50
6	M	140	060	51.5	113	99	11.8	9.0	4'6"	55
7	M	107	063	53.5	108	97	11.5	8.8	4'8"	100
8	M	105	072	54.5	118	73	10.1	7.9	5'5"	55
9	M	105	073	54.5	115	82	11.1	8.2	4'10"	74
10	M	102	095	53.5	119	89	11.9	9.1	4'9"	90
11	M	109	080	55.5	112	84	11.3	8.6	4'7"	104
12	M	128	065	53.5	107	84	11.3	9.1	5'1"	60
13	M	107	074	56.0	112	95	11.8	8.7	4'7"	55
14	M	097	057	53.5	114	80	12.0	8.6	4'5"	53
15	M	112	064	58.0	110	99	11.5	9.0	4'7"	94
16	M	108	055	52.0	117	72	11.0	8.5	4'9"	80
17	M	103	061	51.0	111	96	10.7	9.0	4'8"	95
18	M	131	056	51.5	116	81	11.0	8.5	5'1"	57
19	F	116	065	52.0	114	95	12.3	9.6	4'0"	70
20	F	107	060	52.5	111	101	12.7	9.3	3'3"	70
21	F	138	069	55.5	111	82	11.6	8.8	4'8"	70
22	F	117	061	53.5	113	95	12.0	9.3	4'0"	40
23	F	124	066	54.0	110	94	12.1	8.6	4'0"	83
24	F	142	077	56.5	110	96	11.6	8.6	4'6"	85
25	F	118	091	59.5	116	98	13.1	9.2	3'0"	92
26	F	124	059	49.5	108	94	11.8	9.2	3'7"	40

APPENDIX A

Raw Data (continued)

Case	Sex	I.Q.	Wt.	Ht.	Age	M.M.T.	Shut. Run	50-Yd.	S.B.J.	L.S.
27	F	114	063	53.0	109	100	12.5	9.8	4'2"	60
28	M	099	103	60.0	199	94	11.1	7.7	3'2"	142
29	F	107	057	54.0	108	108	12.0	9.8	4'6"	45
30	F	120	056	51.5	112	94	11.4	8.5	4'6"	40
31	F	103	059	51.5	118	82	10.4	8.3	4'6"	40
32	F	113	064	55.0	114	77	11.1	7.8	4'5"	70
33	F	126	077	53.5	112	88	11.2	8.4	4'0"	60
34	F	126	063	54.0	117	79	11.6	9.1	3'8"	58
35	M	100	069	52.5	128	87	11.1	8.6	3'6"	75
36	M	100	076	57.5	137	105	11.5	8.3	3'7"	65
37	F	102	063	52.5	110	96	11.5	8.9	3'6"	50
38	M	109	063	51.5	115	80	10.8	8.3	4'3"	47
39	F	097	060	53.0	109	92	11.6	8.9	3'6"	60
40	F	124	058	52.0	109	66	10.5	7.8	3'8"	86
41	F	112	098	56.0	119	81	10.9	9.0	3'2"	73
42	M	086	074	55.0	112	74	11.0	7.7	4'0"	110
43	F	129	077	53.5	116	80	13.0	9.3	3'0"	40
44	F	104	071	54.0	115	84	12.1	8.7	4'2"	47
45	F	096	064	54.5	127	84	12.5	8.4	4'0"	95
46	F	091	086	58.0	120	124	14.1	9.8	2'8"	50
47	M	108	063	53.0	109	73	10.4	7.7	3'11"	73
48	F	114	070	54.5	118	81	13.2	8.3	3'2"	81
49	M	129	091	58.0	111	89	10.7	7.9	4'4"	110
50	M	084	088	57.0	127	72	11.5	9.1	3'5"	60
51	F	110	071	53.0	113	104	13.0	10.0	2'9"	40
52	M	111	058	50.0	109	97	11.6	8.9	4'3"	40

APPENDIX A

Raw Data (continued)

Case	Sex	I.Q.	Wt.	Ht.	Age	M.M.T.	Shut. Run	50-Yd.	S.B.J.	L.S.
53	F	109	055	53.0	115	93	13.0	9.6	3'8"	38
54	M	095	108	62.0	122	76	11.1	7.3	3'10"	130
55	M	126	073	55.0	118	84	10.2	7.4	4'9"	67
56	M	102	051	50.0	128	82	11.5	8.2	3'5"	40
57	M	069	102	59.0	159	91	11.4	9.1	3'8"	160
58	F	102	059	52.0	117	97	11.0	8.4	3'8"	55
59	F	120	070	54.0	109	77	11.1	8.2	3'6"	63
60	M	103	078	54.0	111	81	12.2	8.9	3'7"	60
61	F	115	063	52.5	111	93	11.0	8.3	4'5"	80
62	F	103	055	51.5	110	92	12.4	9.2	3'6"	40
63	M	092	070	55.0	125	99	12.5	9.6	3'6"	75
64	M	118	077	54.5	116	103	12.5	8.6	3'4"	47
65	F	113	056	56.0	108	86	11.2	8.7	3'7"	85
66	F	120	058	51.0	113	95	11.7	8.5	4'1"	60
67	M	102	070	55.0	119	77	10.6	8.5	4'6"	90
68	M	095	089	58.0	122	84	10.3	8.3	4'4"	80
69	F	096	065	57.0	129	91	12.0	9.0	4'2"	65
70	F	102	072	55.0	109	78	10.5	8.0	4'8"	100
71	F	106	080	54.0	114	83	12.1	8.5	3'9"	85
72	F	107	068	55.0	117	80	11.3	8.2	4'2"	70
73	F	106	055	50.0	113	87	11.0	8.4	4'2"	50
74	F	108	063	54.0	116	94	11.5	7.7	4'2"	75
75	F	112	071	56.0	128	80	10.4	10.0	3'5"	100
76	F	100	064	54.0	115	90	10.0	7.3	4'9"	99
77	M	073	075	60.0	124	101	12.0	9.0	3'4"	55
78	M	113	079	55.0	115	80	11.2	9.0	4'5"	80

APPENDIX A

Raw Data (continued)

Case	Sex	I.Q.	Wt.	Ht.	Age	M.M.T.	Shut. Run	50-Yd.	S.B.J.	L.S.
79	M	088	059	51.0	117	81	10.0	7.6	4'11"	125
80	M	105	068	51.0	120	93	10.7	8.9	4'2"	50
81	M	131	075	54.0	107	111	12.0	8.6	4'7"	70
82	M	103	075	56.0	117	82	10.4	7.3	4'10"	95
83	M	105	083	60.0	124	95	10.5	8.0	4'11"	60
84	M	119	080	54.0	119	76	11.4	9.0	3'10"	80
85	F	101	065	54.0	119	97	11.2	8.2	4'6"	65
86	M	101	055	52.0	119	96	11.1	8.6	4'0"	65
87	F	114	069	55.0	109	97	10.9	7.3	4'6"	55
88	F	085	063	54.0	120	107	11.2	8.5	4'3"	53
89	F	100	074	55.0	125	98	10.9	8.0	4'4"	75
90	M	119	062	53.0	109	81	10.1	8.1	4'6"	75
91	F	110	062	54.0	115	83	10.0	7.5	4'3"	85
92	M	089	077	56.0	117	94	11.1	8.2	4'2"	130
93	F	133	069	54.0	108	84	10.0	7.9	4'5"	105
94	F	097	057	51.0	121	106	11.2	8.0	4'2"	60
95	M	119	068	53.0	110	86	11.4	8.1	4'6"	110
96	F	106	071	54.0	112	77	10.9	7.8	4'0"	93
97	F	099	064	50.5	116	102	11.5	7.8	4'4"	90
98	F	086	067	53.5	118	89	11.3	8.4	4'11"	72
99	M	104	057	52.5	116	90	11.6	9.5	4'5"	75
100	F	127	055	53.0	116	83	11.9	9.2	3'3"	50

APPENDIX B

APPENDIX B

REACTION AND MOVEMENT TIMER
-TOP VIEW-

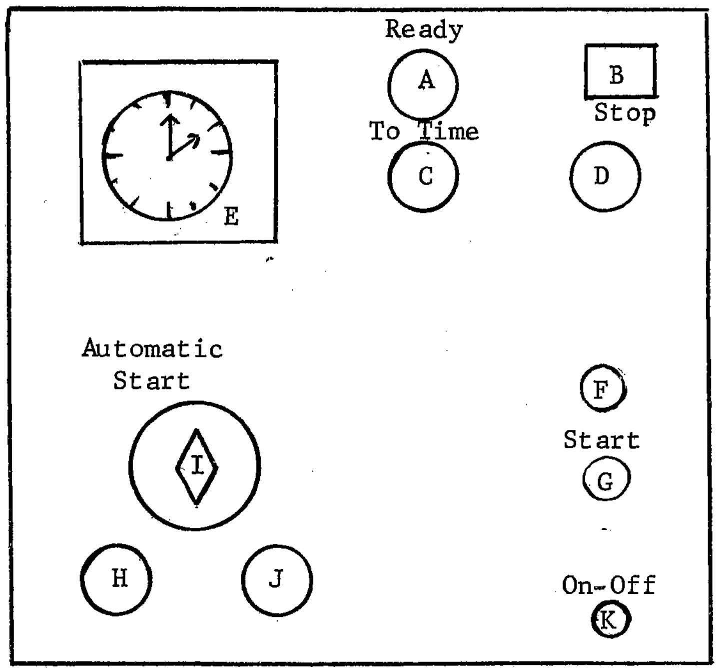

Figure 7. Control Panel of the APA

*A. Ready to Time Indicator
B. Line Stop Slip Switch
*C. Jack for Mat Stop
*D. Jack for Switch Stops
*E. Timer Reset
F. Jack for Start (Visual)
G. Button for Manual Start with Sound
*H. Get-Set Button
*I. Delay Adjustment
J. Control Cord Jack for Get-Set Switch
*K. Master Switch for "ON" and "OFF" and to Reset the APA

* Controls used in experiment.

APPENDIX B

BODY MOVEMENT TIME EQUIPMENT DIAGRAMS

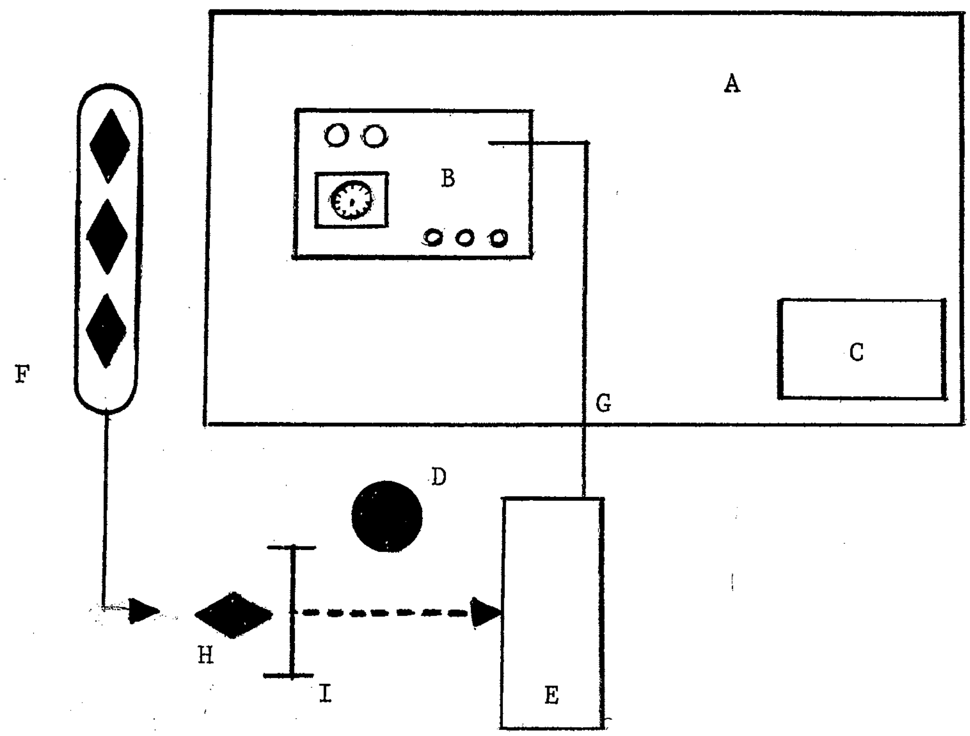

Figure 8. Body Movement Time Equipment Diagrams

A. Table
B. APA
C. Record Sheet
D. Tester
E. Floor Mat
F. Waiting Subjects
G. Cord
H. Subject
I. Take-off Line

APPENDIX B

LEG STRENGTH EQUIPMENT DIAGRAMS

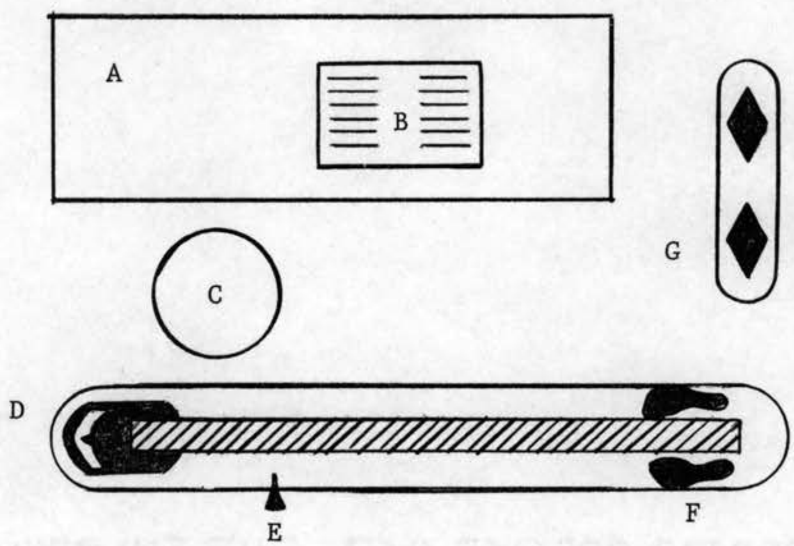

Figure 9. Subject and Equipment Arrangement for Leg Strength Test

A. Desk
B. Record Sheet
C. Tester
D. Scales
E. Lever
F. Subject
G. Subjects

A P P E N D I X C

APPENDIX C

MAIN FORTRAN PROGRAM

```
C     CORRELATION OF YOUTH TEST DATA BY H. V. RITCHESON
C     MAIN FORTRAN PROGRAM
      REAL    NO,  IQ,  MT,  MMT,  LS
      DIMENSION NO(100), SEX(100), IQ(100), WT(100), HT(100), AGE(100),
     1 MT(5,100), SHUTAL(100), RUN(100), BJFT(100), BJIN(100), LS(100),
     2  BJ(100) ,MMT(100)
   10 FORMAT ( F3.0, 1X, F1.0, 1X, F3.0,1X, F3.0,
     2                                  3X, F4.1, 1X, F3.0, 3X,
     3  5(2X,F3.0), 2X, F4.1, 1X, F4.1, 1X, F1.0, 1X, F2.0, 2X, F3.0 )
   20 FORMAT (1H0,  109H   NUMBER    SEX    IQ    WEIGHT  HEIGHT   AGE
     2 MMT      SHUTAL RUN    50 YARD RUN  BROAD JUMP  LEG STRENGTH     )
  201 FORMAT  ( 1H0,   11 ( 3X, F8.3) )
      DO 100 I = 1,100
  100 READ (5,10) NO(I), SEX(I), IQ(I), WT(I), HT(I), AGE(I),
     2 MT(1,I), MT(2,I), MT(3,I), MT(4,I), MT(5,I),
     3 SHUTAL(I), RUN(I), BJFT(I), BJIN(I), LS(I)
      DO 1 I=1,100
      MMT(I) = 0.0
      DO 1 J = 1,5
      MMT(I) = MMT(I)+ MT(J,I)
    1 MMT(I) = MMT (I) / 5.0
      DO 2 I=1,100
    2 BJ(I) = (BJFT(I) * 12.0) + BJIN(I)
      WRITE (6,20)
      WRITE(6,201)   (NO(I), SEX(I), IQ(I), WT(I),HT(I),AGE(I),MMT(I),
     2 SHUTAL (I), RUN(I), BJ(I), LS(I),   I = 1,100 )
      CALL CORE (SEX,WT)
      CALL CORE (SEX,HT)
      CALL CORE (SEX,AGE)
      CALL CORE (SEX,LS)
      CALL CORE (SEX,MMT)
      CALL CORE (SEX,SHUTAL)
      CALL CORE (SEX,RUN)
      CALL CORE (SEX,BJ)
      CALL CORE ( IQ,WT)
      CALL CORE ( IQ,HT)
      CALL CORE ( IQ,AGE)
      CALL CORE ( IQ,LS)
      CALL CORE ( IQ,MMT)
      CALL CORE ( IQ,SHUTAL)
      CALL CORE ( IQ,RUN)
      CALL CORE ( IQ,BJ)
      CALL CORE ( WT,HT)
      CALL CORE ( WT,AGE)
      CALL CORE ( WT,LS)
      CALL CORE ( WT,MMT)
      CALL CORE ( WT,SHUTAL)
      CALL CORE ( WT,RUN)
      CALL CORE ( WT,BJ)
      CALL CORE ( HT,AGE)
      CALL CORE ( HT,LS)
      CALL CORE ( HT,MMT)
      CALL CORE ( HT,SHUTAL)
      CALL CORE ( HT,RUN)
      CALL CORE ( HT,BJ)
      CALL CORE ( LS,MMT)
      CALL CORE ( LS,SHUTAL)
      CALL CORE ( LS,RUN)
      CALL CORE ( LS,BJ)
      CALL EXIT
      END
```

APPENDIX C

RESULTS FROM DIGITAL COMPUTER PROGRAM

*** REGRESSION ANALYSIS *** PAGE 1

RUN ID... youth test
PROBLEM ID... weight vs leg strength

INPUT DATA	weight X	leg strength Y		
NUMBER OF OBSERVATIONS =100	58.0000	80.0000		
	57.0000	73.0000		
	73.0000	105.0000		
	51.0000	60.0000		
	72.0000	50.0000	continued	
	60.0000	55.0000		
	63.0000	100.0000		
	72.0000	55.0000		
	73.0000	74.0000	73.0000	67.0000
	95.0000	90.0000	51.0000	40.0000
	80.0000	104.0000	102.0000	160.0000
	65.0000	60.0000	59.0000	55.0000
	74.0000	55.0000	70.0000	63.0000
	57.0000	53.0000	78.0000	60.0000
	64.0000	94.0000	63.0000	80.0000
	55.0000	80.0000	55.0000	40.0000
	61.0000	95.0000	70.0000	75.0000
	56.0000	57.0000	77.0000	47.0000
	65.0000	70.0000	56.0000	85.0000
	60.0000	70.0000	58.0000	60.0000
	69.0000	70.0000	70.0000	90.0000
	61.0000	40.0000	89.0000	80.0000
	66.0000	83.0000	65.0000	65.0000
	77.0000	85.0000	72.0000	100.0000
	91.0000	92.0000	80.0000	85.0000
	59.0000	40.0000	68.0000	70.0000
	63.0000	60.0000	55.0000	50.0000
	103.0000	142.0000	63.0000	75.0000
	57.0000	45.0000	71.0000	100.0000
	56.0000	40.0000	64.0000	99.0000
	59.0000	40.0000	75.0000	55.0000
	64.0000	70.0000	79.0000	80.0000
	77.0000	60.0000	59.0000	125.0000
	63.0000	58.0000	68.0000	50.0000
	69.0000	75.0000	75.0000	70.0000
	76.0000	65.0000	75.0000	95.0000
	63.0000	50.0000	83.0000	60.0000
	63.0000	47.0000	80.0000	80.0000
	60.0000	60.0000	65.0000	65.0000
	58.0000	86.0000	55.0000	65.0000
	98.0000	73.0000	69.0000	55.0000
	74.0000	110.0000	63.0000	53.0000
	77.0000	40.0000	74.0000	75.0000
	71.0000	47.0000	62.0000	75.0000
	64.0000	95.0000	62.0000	85.0000
	86.0000	50.0000	77.0000	130.0000
	63.0000	73.0000	69.0000	105.0000
	70.0000	81.0000	57.0000	60.0000
	91.0000	110.0000	68.0000	110.0000
	88.0000	60.0000	71.0000	93.0000
	71.0000	40.0000	64.0000	90.0000
	58.0000	40.0000	67.0000	72.0000
	55.0000	38.0000	57.0000	75.0000
	108.0000	130.0000	55.0000	50.0000

SUM OF X = 6877.0000 SUM OF X**2 = **********
SUM OF Y = 7294.000 SUM OF Y**2 = **********
SUM OF XY = **********

REGRESSION COEFFICIENTS
A = 4.2765
B = 0.9985
CORRELATION COEFFICIENT = 0.4811
COEFFICIENT OF DETERMINATION = 0.2315
COEFFICIENT OF NON-DETERMINATION = 0.7685
STANDARD DEVIATION OF REGRESSION = 21.2274

APPENDIX C

CORRELATION SUB-ROUTINE PROGRAM

```
C      CORRELATION SUBROUTINE FOR YOUTH'TEST DATA BY H. V. RITCHESON
       SUBROUTINE CORE ( X , Y )
       DIMENSION X(100), Y(100), RUNID(3), PROID(3), SUM(11)
     1  , SAVE (100)
       EQUIVALENCE (SX,SUM(1)),(SXS,SUM(2)),(SY,SUM(3)),(SYS,SUM(4)),
     1(SXY,SUM(5)),(A,SUM(6)),(B,SUM(7)),(R,SUM(8))
     2,(RS,SUM(9)),(RSN,SUM(10)),(STD,SUM(11))
  100 FORMAT (3A6)
  200 FORMAT ( 1H1)
  201 FORMAT ( 25X,27H*** REGRESSION ANALYSIS ***,19X,5HPAGE ,I3/
     220X,9HRUN ID...,3A6/20X,13HPROBLEM ID...,3A6//  11X,10HINPUT DATA
     3,32X,1HX,13X,1HY/15X,24HNUMBER OF OBSERVATIONS = ,I3,4X,F10.4,3X,
     4F10.4/ (46X,F10.4,3X,F10.4))
  202 FORMAT (//14X,11HSUM OF X = ,F10.4,7X,14HSUM OF X**2 = ,F10.4/
     214X,11HSUM OF Y = ,F10.3,7X,14HSUM OF Y**2 = ,F10.4/14X,
     312HSUM OF XY = ,F10.3//7X,23HREGRESSION COEFFICIENTS / 10X,4HA = ,
     4F10.4
     4    /10X,4HB = ,F10.4/7X,26HCORRELATION COEFFICIENT = ,F10.4/7X,31
     5HCOEFFICIENT OF DETERMINATION = ,F10.4/7X,35HCOEFFICIENT OF NON-DE
     6TERMINATION = ,F10.4/7X,35HSTANDARD DEVIATION OF REGRESSION = ,F10
     7.4)
       IPG = 0
       READ (5,100) RUNID
       WRITE(6,200)
       READ (5,100) PROID
       N = 100
       DO 22I=1,11
   22  SUM(I) = 0.0
       DO 3 I = 1,N
       SX = SX + X(I)
       SY = SY + Y(I)
       SXY=SXY+X(I)*Y(I)
       SXS=SXS+X(I)*X(I)
    3  SYS=SYS+Y(I)*Y(I)
       AN=N
       B=(AN*SXY-SX*SY)/(AN*SXS-SX*SX)
       CALLDVCHK(K)
       GO TO (6,4),K
    4  A=(SY-B*SX)/AN
       R=(AN*SXY-SX*SY)/SQRT((AN*SXS-SX*SX)*(AN*SYS-SY*SY))
       CALLDVCHK(K)
       GO TO (7,5),K
    5  RS=R*R
       RSN=1.0-RS
       STD = SQRT((SYS-A*SY-B*SXY)/AN)
       IPG = IPG + 1
       WRITE(6,201)IPG,RUNID,PROID,N,(X(I),Y(I),I=1,N)
       WRITE (6,202)SUM
       GO TO 9999
    6  B=9999999.999
       GO TO 4
    7  R=9999.99
       GO TO 5
 9999   CONTINUE
       RETURN
       END
```

APPENDIX D

APPENDIX D

TABLE V

CORRELATION COEFFICIENTS*

N	Probability		
	0.05	0.02	0.01
20	0.444	0.516	0.561
30	0.362	0.423	0.464
40	0.312	0.367	0.403
60	0.259	0.306	0.337
80	0.223	0.263	0.291
100	0.199	0.235	0.259

*This table is adapted from Table V of Hugh D. Young's Statisitcal Treatment of Experimental Data, published by McGraw-Hill Book Company, Inc., New York, 1962.

VITA

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