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A Study Of Tests Of Arm Strength For High School Girls

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by

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Also, the writer is particularly indebted to Superintendent Willie Lee Williams for permission to do the study at the Saint Paul High School, Greenville, Texas.

DEDICATION

To my wife - to my mother, father and to my brother this study is dedicated. Without their love, understanding and timeless efforts in helping me I would not have been able to reach this goal.

J. A. W.

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Chapter I

INTRODUCTION

Arm and shoulder strength have been shown to be of great importance in motor activities. It is nearly impossible to assess the arm strength of women by chinning and dipping, because, as a group, they are unable to perform more than one or two of either and a great many may not be able to do any. For this reason, and because of the prohibitive cost of special strength apparatus, methods to find simple means of measuring arm and shoulder strength should be investigated.

Statement of the Problem

The purpose of this study is threefold: To make an analysis of several selected performance tests in relation to strength; to select simple tests to be used when machine-testing devices or special apparatus are not available, and to evaluate and classify the certain tests as to performance relative to strength measured by the dynamometer.

Chapter II

REVIEW OF LITERATURE

The tests in this study are limited to the arm and shoulder-girdle strength in accordance with McCloy's[1] research showing arm strength to be as accurate a predictor of general motor ability as total strength.

In testing for general athletic ability, Cozen[2] used the composite judgement of a large number of persons in the profession and found that in the opinion of three individuals general athletic ability could be broken up into seven elements and number one was "Arm and Shoulder-girdle Strength".

Scott and French[3] found, in their study of one hundred and forty college women at the University of Iowa, that in the vertical pull with spring Scale, the test was less satisfactory than the test with the dynamometer.

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1 C. H. McCloy, "The Apparent Importance of Arm Strength in Athletics," The Research Quarterly, (March, 1934), pp. 3-11

2 Frederick W. Cozen, The Measurement of General Athletic Ability, Eugene, Oregon, (University of Oregon Press, 1929), p. 35

3 M. Gladys Scott and Esther French, Evaluation in Physical Education, (St. Louis: C. V. Mosby, 1950)

The relatively low relationship was reported to probably be due to different body positions.

Knowledge of the degree of difficulty of a test is valuable in devising a testing program because strength tests do not discriminate if they are too difficult for the group to be measured.

Marjorie Wilson's[1] research on performance tests used for measuring arm and shoulder-girdle strength were ranked according to difficulty by two methods: (1) A percentile ranking derived from super-imposed ogives with each range of measure graphed on the same horizontal axis, (2) the ratio of the means to the highest score in each distribution.

The Kellogg Strength Test[2] is one of the most complete tests of strength available. By means of the Kellogg Dynamometer the strength of almost any group of muscle can be measured. Although this method has high validity and reliability the apparatus is quite expensive.

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1 Marjorie Wilson, "A Study of Arm and Shoulder-girdle Strength of College Women in Selected Tests," Research Quarterly, 15:3, (October, 1944), pp. 258 - 267

2 J. H. Kellogg, "The Value of Strength Tests in the Prescription of Exercises," Modern Medicine Library II.

McCloy's[1] Strength Index study devised a method of scoring chinning and dipping which simplified the computation of actual strength from the number of chins or dips and body weight. Weights were added to the subject until chinning or dipping became an impossibility. Total strength then was equal to the individual weight plus the maximal weight that would allow for one chin or dip. Unfortunately this method can not be used for women.

Using Roger's short test as a criterion in her research, Wilson[2] found:

1. Strength can be measured by performance test with a relative high degree of validity according to the criterion used in this study.

2. Six batteries are very satisfactory and may be used interchangeably depending upon the time and equipment available.

3. Two batteries, the pull-up and weight-holding combination and the pull-up and basketball-throw combination, eliminate the use of any machine-testing device.

4. If time limitation is an important element in the testing program, the vertical pull and the push-up from the knees combination is suggested. The push-up test may be given as a mass test, with partners alternately scoring and performing the test. The vertical pull can be ad-

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1 C. H. McCloy, "A New Method of Scoring, Chinning and Dipping," Research Quarterly, 2: 132-143, (December, 1931)

2 Marjorie Wilson, "A Study of Arm and Shoulder-girdle Strength of College Women in Selected Tests," Research Quarterly, 15:3, (October 1944), pp. 258 - 267

ministered much more quickly than most individual tests.

5. The pull-up and push-up tests show the highest zero-order correlation with the criterion. These correlations may be some what high because both push-up and pull-up tests are a part of the criterion.

Chapter III

PROCEDURE

The subjects for these tests were high school girls who had engaged in athletics at St. Paul High, Greenville, Texas; athletic girls were selected as subjects in the belief that they could be motivated more readily to approximate maximal strength out put than could other girls of less intent. Twenty girls completed each of the tests.

A description of the tests follows:

1. Self-support

The subject stands on the floor, hands on back of two chairs, with arms straight and at the signal "go", pulls herself to suspended position as stop watch is started. Each subject is timed in seconds while in suspended position.

2. Straddle Pull-ups

The subject lies on the floor in horizontal position, facing upward with arms extended vertically. The assistant stands straddle the subject with hands downward to aid subject in test. Subject pulls up until chest touches the thighs of helper. Count was made of the dips properly executed.

3. Push-up from stool

The subject assumes a front leaning rest position with hands on a nineteen inch stool. From this position

the subject, with hips and back held in straight line, lowers her chest to the level of the chair by bending the elbows and returns to original position by straightening the arms. A count of complete dips, properly executed, was recorded.

4. Push-ups from sitting position

The subject sits on the floor with back resting against twelve inch high stool. Hands are placed on the stool and the body is lifted or pushed up by extending or straightening the arms and returns to original position by bending the elbows. Body assumes a leaning-rest position with arms behind and perpendicular to the body. Count was made of the number of complete dips, properly executed.

5. Vertical Pull with Dynamometer

A dynamometer with push-pull attachment was used in this test. The dynamometer was fastened to an adjustable cord and placed for each subject at such a height that when the subject grasped the lower handle the upper arm at a ninety degree angle with the lower arm and parallel to the floor. The subjects stood with heels and backs against the wall and pulled down as hard as possible without movement of the body. The score was the number of pounds registered on the dynamometer.

6. and 7. Push and pull

The test was made with the grip dynamometer using the push-pull attachment. The subjects held the apparatus

in front of the chest with one hand on each handle, with elbows bent and arms in a horizontal plane, and they pushed and pulled as hard as possible. The score was registered on the dynamometer in pounds.

Means and standard deviations were computed for all the tests. Zero order correlations for all tests were computed to show the relationship of all tests with each other. High correlations signified that the two tests were investigating the same elements. Zero order correlations were also computed, with age, height and weight, to determine if body size and maturity were factors in the testing.

The tests were arranged as to difficulty by the following method: The ratio of the mean to the highest score in each distribution for each test was computed. The ratios were arranged from the smallest to largest which was from most difficult to easiest.

Chapter IV

ANALYSIS OF DATA

Twenty girls were tested for arm strength using the following tests: self support, straddle pull ups, push ups from a stool, push ups from a sitting position, vertical pull with a dynamometer and push and pull using a dynamometer. These tests were described in detail in the Procedure, Chapter III, (page 6). The ranges, means and standard deviations are shown in Table I, (page 10). With the exception of test number 1 (Self support) which had a range of ninety-eight and two-tenths seconds (98.2) the ranges of the tests varied very little, twenty to thirty units. The same condition existed as to the range of the standard deviations (6.31 to 7.88) for tests 2 through 7 while test number 1 had a standard deviation of 24.28. These findings show that the validity of test 1 is questionable for some reason. It was probable that the large range and standard deviation of test 1 were due to the test being so easy that subjects were not motivated or challenged enough to do their best.

With the exception of three (1 and 3 (.570), 3 and 5 (.511), and 5 and 6 (.820)) all correlations of the performance tests were too low to show any relationship. This indicated that the various tests were all testing different

TABLE I

Table of Ranges, Means and Standard Deviations

Test	Range	Mean	Standard Deviation
1. Self support - two chairs	22.0-120.2	67.4	24.28
2. Straddle pull ups	6-26	16.2	6.31
3. Push ups from stool	1-23	10.5	5.74
4. Push ups from sitting position	3-32	16.1	7.13
5. Vertical pull - dynamometer	40-70	54.6	7.88
6. Push - dynamometer	36-66	56.4	7.36
7. Pull - dynamometer	50-74	59.3	6.82

TABLE II

Intercorrelations of Performance Tests and Dynamometer Tests of Strength

	1	2	3	4	5	6
1. Self-support						
2. Straddle pull ups	.220					
3. Push ups from stool	.570	.040				
4. Push ups from sitting position	.360	.364	.172			
5. Vertical pull - dynamometer	.111	.056	.511	.038		
6. Push - dynamometer	.051	.339	.099	-.024	.820	
7. Pull - dynamometer	-.045	-.245	-.121	.027	-.297	.086

elements of arm and shoulder strength or because of chance errors the test scores were not valid. An understanding of the correlation between tests 1 and 3 (.570) can be derived from a kinesiological analysis of these two tests. It could be easily shown that the same muscles were used in both tests. The relationship of test 3 to test 5 (.511) is not easily understood and should be investigated further. The high correlation coefficient (.820) for tests 5 and 6 is also difficult to understand in that one test requires the use of one arm while the other test requires the use of both arms. These tests should be investigated further using a larger number of subjects.

The correlation coefficients showing the relationship of anthropometric measurements and the various strength tests were all low except two, (see Table III) Straddle pull ups versus age (.520) and Vertical pull using dynamometer versus weight (.571). These two are not high enough to show even slight relationship and the smallness of the other coefficients reveals clearly that there was little or no relationship between body size or maturity and performance in the strength tests.

The ranking as to difficulty of the various tests is shown in Table IV, (page 14).

TABLE III

Relationship of Anthropometric Measurements to the Strength Test

	Age	Weight	Height
1. Self-support	-.282	.014	.258
2. Straddle pull ups	.520	-.183	.026
3. Push ups from stool	.092	.330	-.235
4. Push ups from sitting position	.022	-.308	-.210
5. Vertical pull - dynamometer	.082	.571	.108
6. Push with Dynamometer	-.426	.070	.449
7. Pull with Dynamometer	-.410	.486	-.160

TABLE IV

Test no.	Ranking	Strength Tests	Ratio
III	1	Push ups from stool	.457
IV	2	Push ups from sitting position	.503
I	3	Self support	.561
II	4	Straddle pull ups	.623
V	5	Vertical pull - dynamometer	.780
VI	6	Pull - dynamometer	.801
VII	7	Push - dynamometer	.855

Chapter V

SUMMARY

Twenty high school girls were used as subjects to analyze seven arm and shoulder strength tests. Range of scores, means and standard deviations were computed for all tests. Zero order correlations were computed for all strength tests to determine which of the tests were testing the same elements. Zero order correlations were also computed with strength tests and age, height and weight to determine if body size or maturity had any bearing on performance. The results showed six of the tests to be useful in assessing arm and shoulder strength in girls. These tests were ranked as to difficulty.

Chapter VI

CONCLUSIONS

1. Six of the tests analyzed in this study could be used to assess arm and shoulder strength of girls and women.

2. It is felt that many of the unexplained facts of this study could be justified or supported by repeating the study using more subjects.

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