

THE CORRELATION OF SHOULDER STRENGTH TO  
BASKETBALL FIELD GOAL SHOOTING PERFORMANCE

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by  
Frank Delano Blackburn  
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B

*George C. Mathon*

Approved for the Major Department

*James L. Byler*

Approved for the Graduate Council

272876

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## TABLE OF CONTENTS

CHAPTER	PAGE
I. INTRODUCTION . . . . .	1
Statement of the Problem . . . . .	3
Definition of Terms . . . . .	3
Official goal . . . . .	3
Shooting techniques . . . . .	3
Iso-scale test . . . . .	4
Court dimensions . . . . .	4
Diameter of the ring . . . . .	4
Square inch area of backboard . . . . .	4
Limitations of the Study . . . . .	4
II. REVIEW OF LITERATURE . . . . .	5
Research related to motor ability . . . . .	5
Research related to body size . . . . .	6
Research related to strength . . . . .	8
Research related to shooting accuracy . . . . .	9
Summary of Previous Research . . . . .	11
III. DESIGN OF THE STUDY . . . . .	13
Introduction . . . . .	13
Subjects . . . . .	13
Equipment and Facilities . . . . .	14
Testing Procedures . . . . .	15



CHAPTER	PAGE
Accuracy test . . . . .	16
Strength test . . . . .	18
IV. ANALYSIS OF DATA . . . . .	23
Statistical Comparison . . . . .	23
General Overview of Subjects . . . . .	23
Significant Difference Between Initial and Final Strength Tests . . . . .	24
Field Goal Accuracy Test in Goal Shooting . . . . .	27
Statistical Comparison of the Final Test Results of the Accuracy Group and the Strength Group . . . . .	28
V. FINDINGS, CONCLUSIONS, DISCUSSION, AND RECOMMENDATIONS . . . . .	29
Findings . . . . .	30
Conclusions . . . . .	30
Discussions . . . . .	31
Recommendations . . . . .	32
BIBLIOGRAPHY . . . . .	33
APPENDIX A: School Number One, Two, and Three . . . . .	36
APPENDIX B: Total Shots from each Position . . . . .	40
APPENDIX C: Results of Accuracy-Strength Test . . . . .	42
APPENDIX D: Positions of the Basketball Test . . . . .	44
APPENDIX E: Field Goal Accuracy Test Results for Each School . . . . .	46
APPENDIX F: Field Goal Accuracy and Strength Test Chart . . . . .	49

## LIST OF TABLES

TABLE	PAGE
I. Age, Weight, and Height of the High School Varsity Basketball Players of the Three Schools . . . . .	24
II. Initial and Final Means of Shoulder Strength of the Three Schools . . . . .	25
III. Field Goal Accuracy Test Results for all Three Groups . . . . .	26

## LIST OF FIGURES

FIGURE	PAGE
I. A Diagram Showing the Six Shots on the Floor From Which All Shots Were Taken . . . . .	20
II. Recording Chart Used to Score the Number of Successful Shots in One Days Session . . . . .	21
III. Iso-Scale which was used in the Strength Test . . . . .	22

## CHAPTER I

### INTRODUCTION

Basketball has been for many years a major activity in the interscholastic sports programs in Kansas high schools. There has been a generally favorable climate of encouragement exhibited by school administrators and faculty members for inter-school basketball. Competition substantiates the support and approval of interscholastic basketball. During the 1967-68 school year there were 455 schools participating in interscholastic basketball. At the end of the season there were eight teams competing for championships in the four classifications in Kansas.

Such interest as shown by statewide participation indicates the need for proper instruction by coaches. Teaching techniques in basketball and other activities must be adaptive to individual strengths and weaknesses. Among other things, the basketball coach must have knowledge of shoulder development in young boys before planning the objectives in a curricular or extra-curricular basketball course. It is immaterial if the basketball instruction received in the physical education classroom or in extra class activities culminates in a varsity game. What is important is that the pupil receives the proper kind of individual instruction that

is in keeping with his physical capabilities so that he will achieve some measure of success in his field goal shooting.

Drills are a very important part of basketball instruction and practice. If the drills are properly run, each individual can discover his own strengths and weaknesses. With the coach's help and the help of fellow teammates, the individual can strive to overcome his weaknesses. Dan Landry uses the medicine ball to aid in shoulder strength development. In this drill the players stand 12 feet apart and with a 12 pound ball, pass back and forth using the various passes that are taught. The players must use the proper form and pass the ball in a straight line, not an arc. The drill lasts for three minutes. Another drill that Landry uses is 15-20 fingertip push-ups.<sup>1</sup> These are only two of many possible drills to improve shoulder development.

The need for measures that would show the achievement of the individual in his performance within the game has been evident for some time. Bovard and Cozens emphasize this need when they state, "From the time of the general broadening of the physical education curriculum (about 1916), game activities have held a large place in our program and continual attempts have been made to measure the various techniques involved."<sup>2</sup>

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<sup>1</sup>Dan Landry, "Pre-practice Organization," Athletic Journal, XLVIII (September, 1967), p. 71.

<sup>2</sup>John F. Bovard and Fredrick W. Cozens, Tests and Measurements in Physical Education (Philadelphia and London: W. B. Saunders Company, 1938), p. 205.

It is obvious that shooting accuracy is an important technique in the game of basketball and a certain amount of shoulder development is necessary in performing the various types of goal shooting.

It is for this reason and the interest the researcher has in improving shooting accuracy that this study was conducted.

## I. STATEMENT OF THE PROBLEM

This was an investigation to determine the relationship between basketball shooting accuracy and shoulder strength of thirty male high school varsity basketball players in three senior high schools in the Topeka Public School system.

Specifically this study attempted to answer the following question: The degree of the relationship, if any, between the individuals shoulder strength and accuracy in basketball field goal shooting.

## II. DEFINITIONS OF TERMS

Official goal. A regulation basketball goal, eighteen inches in diameter, and ten feet above the playing surface.

Shooting techniques. The one hand push or jump shot can be made from either a moving or a stationary position. Whichever method is used, the shooter should maintain body balance and a comfortable position.



Iso-Scale test. A device used to test the shoulder strength of individuals, and to correlate this measurement with the person's age, height, and weight.

Court dimensions. Fifty feet inside sidelines by seventy-four feet.

Diameter of the ring. Eighteen inches in diameter, and ten feet above the playing surface.

Square inch area of the backboard. Rectangular backboard is seventy-two inches wide. Fan-shaped backboard is fifty-four inches wide.

### III. LIMITATIONS OF THE STUDY

The researcher limited the study to three orientation sessions with the basketball coaches from the various schools who were assisting him in the study and three actual testing sessions. The tests were conducted in mid-December 1967. During the week following the test, a discussion of the results of the test was conducted with each of the coaches or basketball teachers involved.

The researcher found that approximately forty-five minutes was necessary to conduct approximately ten boys at each school through a series of six stations in the test. Students were properly instructed as to the purpose of the test so that no over-interpretation or misinterpretation of "made" or "missed" field goals would be drawn by the students.

## CHAPTER II

### REVIEW OF THE LITERATURE

The review of literature will be categorized under the following headings: (1) motor ability; (2) body size; (3) strength; and (4) shooting accuracy.

#### I. PREVIOUS RESEARCH

Research related to motor ability. Several studies have been conducted comparing motor activities to various other factors including strength.

Larson made a study of twenty-seven test items and six well-known test batteries with the intent of determining which items were most important in measuring motor ability. The thirty-three test items and test batteries had in common four basic elements: dynamic strength, or strength determined by the ability to handle the body weight; static dynamometrical strength, or the ability to squeeze, push, pull, or lift as measured by the dynamometer; gross body coordination, demonstrated by the football kick and pass and baseball throw; and finally, abdominal strength. Larson found that dynamic strength yielded the most significant results in predicting which items best measure motor ability. Three dynamic strength test items were then chosen to compare with the



other six test batteries. These tests showed that they measured again the dynamic strength factor and three others, namely; gross body coordination and agility, motor educability, and motor explosiveness.<sup>1</sup>

The "Inventory of Motor Fitness" was developed by Cureton. The purpose of this battery was to differentiate ability in the several areas of emphasis in motor fitness. These areas of emphasis are balance, flexibility, agility, strength, power, and endurance. There are five test items in each of the categories named.<sup>2</sup>

Research related to body size. Another aspect which possibly should be involved in physical fitness testing is that of classifying subjects according to body size. For example, it would not seem reasonable to expect an individual with 225 pounds of weight on a frame five feet and ten inches in height to do as many chins on the horizontal bar as the individual weighing 175 pounds and six feet tall.

According to Cureton:

It may be postulated that the somatotyping (body typing) of young men is a fundamental procedure for body mechanics and physical fitness testers. This approach is necessary because almost every

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<sup>1</sup>Leonard A. Larson, "A Factor Analysis of Motor Ability Variable and Tests, with Tests for College Men," Research Quarterly, XII, (October, 1941), pp. 499-515.

<sup>2</sup>Thomas Kirk Cureton, Physical Fitness Workbook (St. Louis: C. V. Mosley Company, 1947).

type of physical fitness test ultimately must be normed or interpreted in terms of constitutional type.<sup>3</sup>

Bookwalter used the Wetzel Grid in connection with the Indiana State Physical Fitness Test for the Elementary Level to determine the relationship of body size and shape to physical performance. The Wetzel Grid used the factors of height and weight. These factors are plotted on a scattergram with the vertical axis calibrated for height in inches. The Indiana State Physical Fitness Test is composed of four items: straddle-chins, push-ups, squat thrust, and vertical jump.

Bookwalter concluded from his study that size and shape seem to have an influence on physical performance and that the very obese boys were the poorest performers. The thin and medium in physique who were very large performed equally well physically and the same was true of the smallest groups. Another conclusion was that the large and fat boys varied more in physical performance than the normal and thin boys.<sup>4</sup>

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<sup>3</sup>Thomas Kirk Cureton, "Body Build as A Framework of Reference for Interpreting Physical Fitness and Athletic Performance," Supplement, Research Quarterly, XI (May, 1941), p. 301.

<sup>4</sup>Karl W. Bookwalter, "The Relationship of Body Size and Shape to Physical Performance," Research Quarterly, XXIII (October, 1952), pp. 271-279.

Research related to strength. DiGiovanna set out to determine the relation of selected structural and functional measures to success in each of several sports, namely; baseball, basketball, football, gymnastics, tennis, and track and field. He also wanted to ascertain if there were patterns or combinations of these measures which were associated with success.

The test items included: structure--weight, standing height, sitting height, shoulder breadth, chest breadth, chest depth, hip breadth, arm span, and arm girth; strength--right grip, left grip, back force, leg force, arm-pulling force, arm pushing force, and total force; power--vertical jump (height attained minus standing height) and MacCurdy Physical Capacity Index.

The subjects used were 836 college men between seventeen and twenty-four years. The analysis of data revealed that the successful basketball players exhibited real and positive differences from the normal group in all test elements of structure, strength, and power except back force and arm push.

The study further revealed that the successful basketball players differentiated from the normal group by having much more explosive power; by being substantially larger in weight, height, sitting height, leg length, shoulder breadth, chest depth, and arm span; and by



having substantially greater arm pull and leg strength.<sup>5</sup>

Research related to shooting accuracy. Lindeburg and Hewitt attempted to discover if using a larger than regulation basketball would have an effect on shooting ability and ball handling. Twenty-six experienced male basketball players were tested on short shooting, foul shooting, passing, and ball handling with a regulation basketball and with an experimental ball. The experimental ball was 31 inches in circumference and weighed 22.5 ounces while the regulation ball was 29 3/4 inches in circumference and weighed 20.5 ounces. They found no significant differences between the two balls on short shooting, foul shooting, and dribbling. There was a significant difference (at the 1 per cent level of confidence) between the experimental ball and the regulation ball on the passing test.<sup>6</sup>

In an effort to determine the effect of practice in shooting at small goals upon the accuracy in shooting at official goals, Alley and Maaske used as subjects twenty-six members of a college freshman basketball squad. The small goal was fifteen inches in diameter opposed to an official

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<sup>5</sup>Vincent DiGiovanna, "The Relation of Selected Structural and Functional Measures to Success in College Athletics," Research Quarterly, XIV (May, 1943), pp. 198-215.

<sup>6</sup>Franklin A. Lindeburg and Jack E. Hewitt, "Effect of an Oversized Basketball on Shooting Ability and Ball Handling," Research Quarterly, VI (May, 1965), pp. 164-167.

goal of eighteen inches in diameter. Each subject shot fifty times from nine stations on the court, or a total of 450 shots to determine the matched groups. In addition to shooting during the practice sessions at their respective goals, the field goal and free throw shooting percentages were kept on each subject during their regular season games. At the end of the season, a post-test, conducted in the same manner as the pre-test, was given to determine the gains. Both groups made significant gains at the one per cent level in shooting accuracy as measured by the shooting tests. To determine if one group gained significantly more than the other, the analysis of co-variance was applied to the total scores made by each group on the initial and final shooting tests. The results showed the improvement in shooting accuracy for the small goal group was significantly greater than the improvement in shooting accuracy for the official goal group. Further analysis of the scores made by the two groups at the various shooting stations showed the greatest difference between the improvement in accuracy for the small goal group and the improvement in accuracy for the official goal group occurred with shots taken from stations located the farthest from the goal. This distance was twenty-three feet.<sup>7</sup>

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<sup>7</sup>Dr. Louis B. Alley and Paul M. Maaske, "To Improve Accuracy, Practice at Small Baskets," Athletic Journal, XLIII (September, 1961), p. 34.

## II. SUMMARY OF PREVIOUS RESEARCH

In summary, the studies cited indicate various factors which might be taken into consideration in determining the relationship between basketball shooting accuracy and shoulder strength. The review can be summarized in the following points:

1. Out of four basic elements found in test batteries, dynamic strength yielded the most significant result in predicting which items best measured motor ability.<sup>8</sup>

2. The size and shape of an individual seem to have an influence on physical performance.<sup>9</sup>

3. Successful basketball players exhibited real and positive differences from the normal group in test elements of structure, strength, and power except back force and arm pull.<sup>10</sup>

4. Successful basketball players differentiated from the normal group by having more explosive power; by being larger in weight, height, sitting height, leg length, shoulder breadth, chest depth, and arm span; and by having substantially greater arm pull and leg strength.<sup>11</sup>

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<sup>8</sup>Larson, op. cit.

<sup>9</sup>Cureton, op. cit.

<sup>10</sup>DiGiovanna, op. cit.

<sup>11</sup>DiGiovanna, loc. cit.

5. Using a ball larger in circumference and heavier, a significant difference was shown between the experimental ball and the regulation ball on a passing test but not on short shooting, foul shooting, and dribbling.<sup>12</sup>

6. When using a smaller than regulation goal, it was found that the small goal group improved more than the official goal group.<sup>13</sup>

7. The greatest difference between the small goal and official goal groups occurred with shots taken farthest from the goal.<sup>14</sup>

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<sup>12</sup>Lindeburg and Hewitt, op. cit.

<sup>13</sup>Alley and Maaske, op. cit.

<sup>14</sup>Alley and Maaske, loc. cit.



## CHAPTER III

### INTRODUCTION

The purpose of this study was to compare shoulder strength and field goal shooting accuracy in basketball. More specifically, the investigator attempted to answer the following questions: (1) Will strength improve shooting accuracy?; (2) Will size and strength improve shooting accuracy?; (3) Is there a correlation between shoulder strength and field goal shooting accuracy?

In an effort to compare the strength and size of basketball shooting for accuracy, three groups, experimental and control, practiced shooting field goals, at designated places on the floor, immediately followed by a strength test with an Iso-scale to determine shoulder strength.

#### I. SUBJECTS

The subjects used in this study were thirty-male students from the three city high schools, Topeka West High, Topeka High, and Highland Park High, who were varsity basketball team members of the 1967-68 basketball season. The ages of the subjects ranged from fourteen to eighteen, and were in the grades of ten to twelve. The subjects were selected from the top ten basketball players at each school regardless



of grade or position, these ten were considered to be the best at that school during this test period.

The subjects were selected because they have proven ability and less variable shooters, and that the variability of their shots would less likely be affected by fatigue or practice.

For the duration of the study, the same uniform (basketball trunks, athletic supporters, basketball shirts, and gym shoes) was required of all subjects.

## II. EQUIPMENT AND FACILITIES

This study was conducted in the gymnasiums of Topeka High, Topeka West High, and Highland Park High, using a regulation goal, eighteen inches in diameter and ten feet from the floor, attached to a glass backboard.

The data gathering devices used in this study consisted of:

- (1) Regulation basketball, Spaulding 500.
- (2) Two charts, one for posting field goal accuracy, one for posting the strength test (see appendix F).
- (3) Iso-scale, "Professional Model", which determined the shoulder strength of each subject (Figure III, page 22).

The scores were recorded on individualized sheets at the completion of each subject's shooting and strength test

and posted on the charts at the end of that particular shooting session. All recording and posting of scores was handled by the researcher.

### III. TESTING PROCEDURE

At least two weeks previous to the testing period each basketball coach of the three schools was personally contacted and the study was discussed. Permission was obtained for the time and player to be a part of the study. A follow up letter was sent to the coach describing the study in more detail as to the kind, number, and position of shots that were to be taken.

The actual testing at all three high schools was preceded by a strength test which is explained in part V of this chapter.

The warmup period preceding each days testing was uniform as to the length of time and type of activity, and consisted of the following:

- (1) The ball was regulation size.
- (2) The ball with which the subjects practiced was the one which was to be used in the sequence of shooting for the day.
- (3) The time allotted for the warmup was 10 minutes.
- (4) All shots taken during the warmup were attempted from assigned spots, but in no definite order.

It was, however, suggested that sample shots be taken from each spot during the warmup period to insure familiarity.

- (5) The subjects were dressed appropriately in the basketball practice uniform.
- (6) As an additional warmup procedure before testing each subject, the subject dribbled around the out of bounds line of the basketball court.
- (7) At the conclusion of the field goal accuracy test, an Iso-scale test was given to measure the shoulder strength of each subject.

#### IV. ACCURACY TEST

To insure each set of shots would be taken from the same locations on the floor, spots were marked at the places here described and as indicated by Figure 1. Starting from a position directly under the basket (point O) successive "X's" were placed at a beginning mark of 22 feet right of the basket, and at 16, 14, 6, 16, 22, feet distances from the basket.

These lines described angles with the baseline of the basketball court: one line through point B and at a 0 degree angle to the baseline on the right of the goal, one line

through point B and at a 45 degree angle to the baseline on the right of the goal, one line through point B and at a 90 degree angle to the baseline, one line through point B and at a 135 degree angle to the baseline, one line through point B at a 180 degree angle to the baseline on the left-hand side of basket.

Throughout the remainder of the discussion, testing will be explained from a vantage point in the center of the court and looking at the goal.

The total number of positions as described above from which shots were taken was six. With all the data completed, the 30 subjects who participated in the study took a total of 360 shots.

The shooting procedure during actual testing was the same each day and for each of the subjects, and was executed in the following manner:

- (1) Shots were taken from right to left, first from the 22 foot distance, then the 16 foot distance, 14 foot distance, 20 foot distance, 16 foot the left of the basket.
- (2) A one-handed shot was taken from each of the six spots in the manner described above.
- (3) Each subject was required to complete the above procedure, making a total of 12 shots individually, 120 shots per-school, and a grand total of 360 shots taken.



To speed up each days workout the subjects had only to shoot the ball. The attempt at the basket whether made or missed was rebounded for each subject.

#### V. STRENGTH TEST

An Iso-scale test was given to each participant before and after the shooting test. This is a test of each subject's shoulder strength, and to correlate this measurement with the subject's age, height, and weight, figure III, page 22.

Before the Iso-scale test was administered and explained to all the subjects' convenience the Iso-scale would show how the test was to be conducted. It was further explained in the same manner to all three high schools, how the Iso-scale was to be employed, which was accomplished in the following manner:

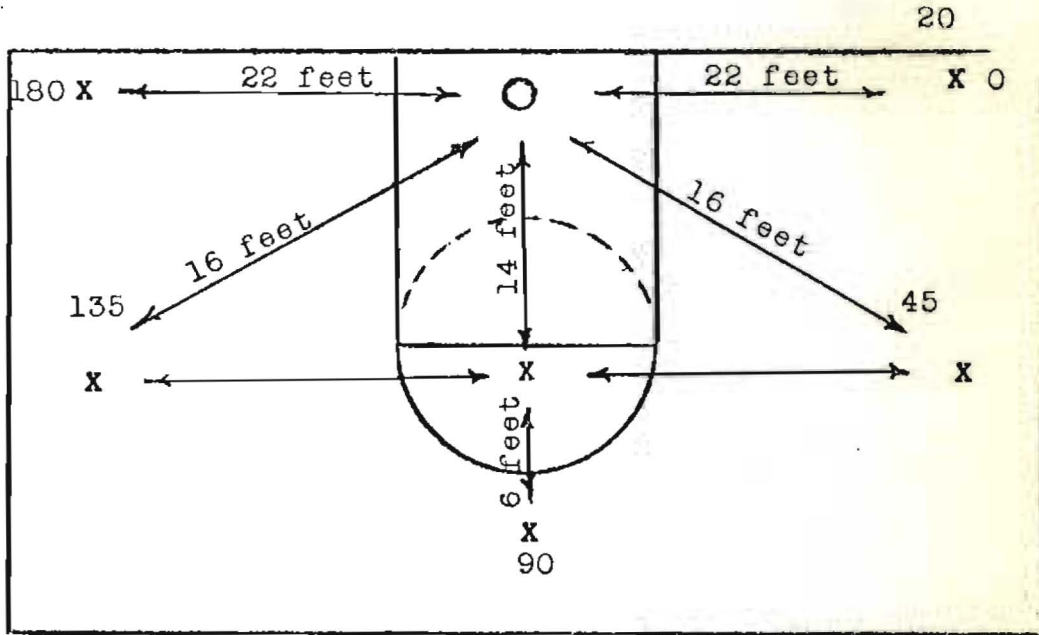
- (1) The Iso-scale was placed in the middle of the gymnasium floor so that the recorder was in a central position for the strength test.
- (2) One subject was chosen for an example of how the Iso-scale was to be used.
- (3) The explanation of the Iso-scale was to be used with the example subject included the following:
  - a. Step onto the Iso-scale and place feet directly in middle of rubber based platform

- b. Legs and knees are to be kept straight while taking test.
- c. The Iso-scale strap was then measured to the middle of the subject's face for correct height.
- d. The aluminum bar was then inserted into the strap with the correct height now measured off.
- e. On signal from the recorder the subject was to begin his strength test by using the press method.
- f. The method used was the military press, which in relationship to the body the bar was placed at eye level with the palms out.
- g. The conclusion of the strength test was ended when the subject no longer could add pounds to his total strength test.

The results of the final test of all three groups were compared and the differences determined. The difference between the scores of the three groups on the test were subjected to a group comparison to determine the significant difference between the means of the subject as to strength and accuracy results.

FIGURE I  
BASKETBALL TEST

KEY  
 Basket Made  
 Overshot Basket  
 Hits Rim or Backboard  
 Did not reach Basket  
 Under-Shot Basket



STRENGTH TEST

1 -  
 2 -

NAME -

AGE -

HEIGHT -

WEIGHT -

SCHOOL -

GRADE -

FIGURE II  
 THE RECORDING CHART USED  
 TO SCORE THE NUMBER OF  
 SUCCESSFUL SHOTS IN  
 ONE DAYS SESSION

NAME: \_\_\_\_\_ HEIGHT: \_\_\_\_\_  
 DATE: \_\_\_\_\_ WEIGHT: \_\_\_\_\_

<u>KEY</u>	<u>Trial - One</u>	<u>One - Handed</u>
X - Basket Made	22 ft. X	X
X - Overshot Basket	16 ft. X	X
XI - Hits Rim or Backboard	14 ft. X	X
X. - Did not reach Basket	20 ft. X	X
X - Under-Shot Basket	16 ft. X	X
	22 ft. X	X

<u>Trial - Two</u>	<u>Iso - Scale</u>
	1st attempt -
	2nd attempt -
	Average -

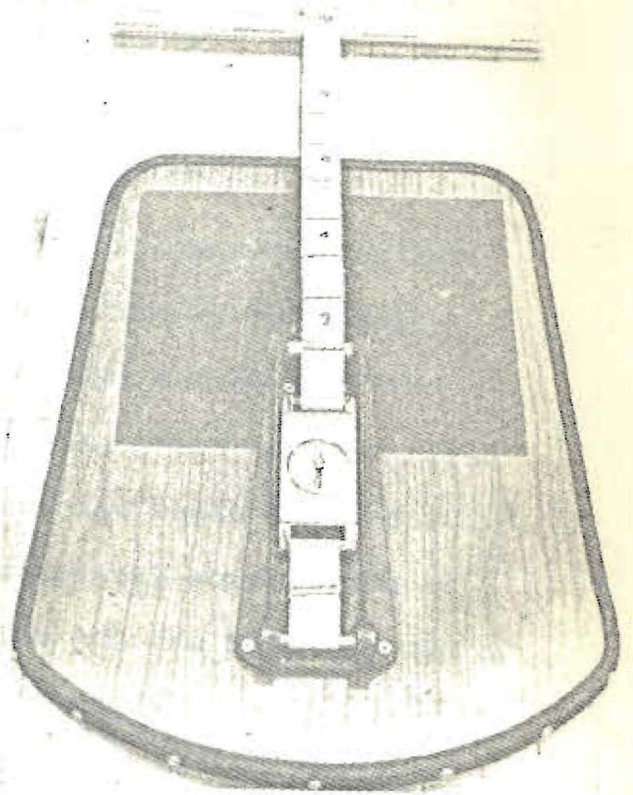
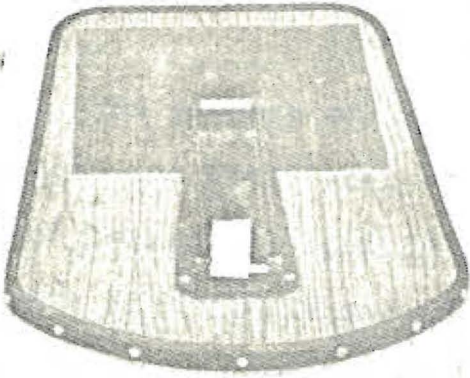


FIGURE III

THE ISO-SCALE WHICH WAS USED IN THE STRENGTH TEST

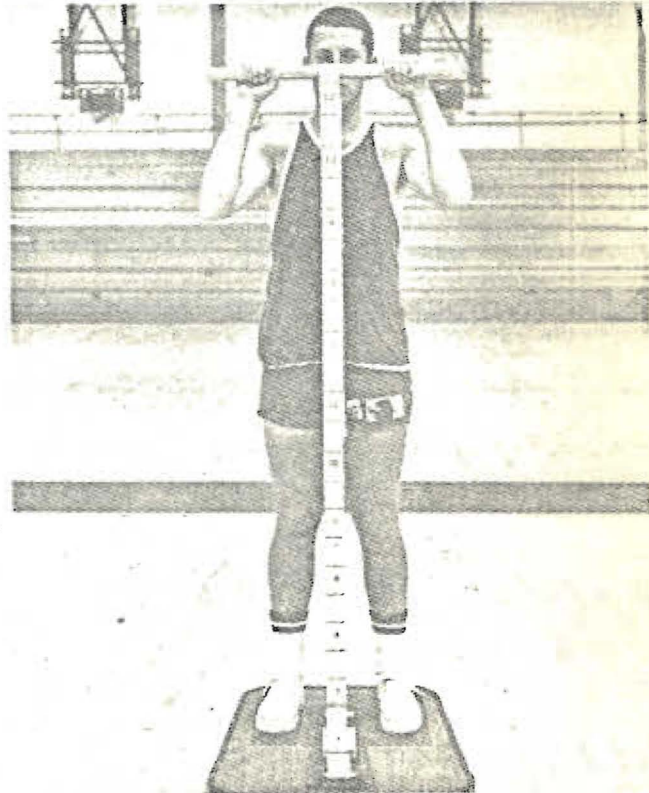
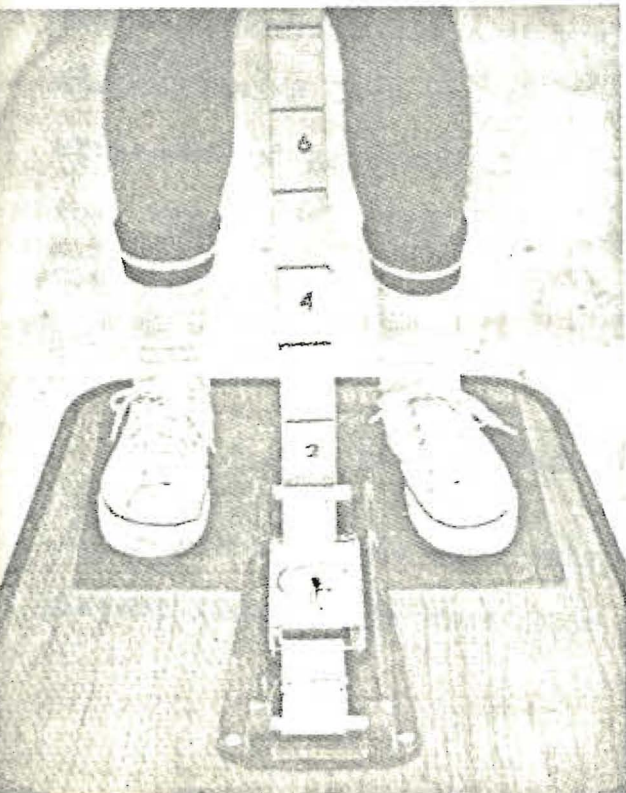
THE ISO-SCALE IN PARTS

THE ISO-SCALE TOGETHER



FOOT PLACEMENT ON THE ISO-SCALE

THE MILITARY PRESS



## CHAPTER IV

### ANALYSIS OF DATA

The purpose of this study was to compare shoulder strength and field goal shooting accuracy of male high school basketball varsity players. The scores were the results of a single bout of a military press and the field goal accuracy from six positions on the basketball court. The scorers were subjected to statistical computation to yield the coefficient of correlation and the significance of the difference between uncorrelated means.

#### I. STATISTICAL COMPARISON

In answer to the problem concerning the relationship between shoulder strength and field goal shooting accuracy; the following data was obtained from the final tests of strength and accuracy for the three test schools. The final test consisted of each of the thirty subjects shooting six field goals from various floor positions and taking an Iso-scale strength test.

#### II. GENERAL OVERVIEW OF SUBJECTS

The subjects were thirty-male basketball varsity players from Topeka West High School, Topeka High School,

and Highland Park High School. All were members of the varsity basketball team and were either in the tenth, eleventh, or twelfth grades during the winter semester, 1967-68.

The average age for all subjects was 16.73 years with a deviation of .78 and a range of 15 to 18. (Table I).

The height of the varsity basketball players was 72.43 inches with a standard deviation of 2.73 and a range of 67 inches to 78 inches. (Table I).

Body weight for the varsity basketball players had a mean of 165.13 and a standard deviation of 15.52. The range here for all three high schools was 136 to 220. (Table I).

TABLE I

AGE, WEIGHT, AND HEIGHT OF THE HIGH SCHOOL VARSITY BASKETBALL PLAYERS OF THE THREE SCHOOLS

SCHOOL	N	AGE	WEIGHT	HEIGHT
1	10	16.80	163.50 lb.	71.30 in.
2	10	16.60	166.40 lb.	72.60 in.
3	10	16.80	165.50 lb.	73.40 in.

### III. SIGNIFICANT DIFFERENCE BETWEEN INITIAL AND FINAL STRENGTH TESTS

A comparison of the data of the initial and final mean scores of the total number (30) of the strength test



were computed to find the significance of the difference between correlated means. The computation yielded a t score of .35 which was far from being significant at any level of confidence. (Table II)

School one had a mean difference of 13.00 yielded a SE difference of 5.21. When the t of 2.49 was found with 9 degrees of freedom, this t resulted in a highly .05 significance for school one. (Table II)

School two had a mean of 21.5 difference, and a SE difference of 6.44. When the t of 3.26 was found with 9 degrees of freedom, this t resulted in a .05 and .01 significance for school two. (Table II)

School three had a mean difference of 4.0 and a SE difference of 7.36. When the t of 5.43 was found with 9 degrees of freedom, this t again was significant with .05 and .01 for school three. (Table II)

TABLE II

THE INITIAL AND FINAL MEANS OF SHOULDER STRENGTH  
OF THE THREE SCHOOLS

SCHOOL	N	INITIAL	FINAL	DIFFERENCE	SEF DIFF	t	P
1	10	127.00	140.00	13.0	5.21	2.49	.05
2	10	174.50	196.00	21.5	6.44	3.26	.05
							-.01
3	10	161.50	165.50	4.0	7.36	5.43	.05
							-.01

t needed for .05 level of confidence - 2.26

t needed for .01 level of confidence - 3.25

TABLE III

FIELD GOAL ACCURACY TEST RESULTS  
FOR ALL THREE GROUPS

BASKETS MADE					
SCHOOL	N	MEAN	SD	VARIANCE	RANGE
1	10	1.40	1.07	.30	0 to 3
2	10	1.70	1.06	.00	0 to 3
3	10	2.00	1.49	.30	0 to 4
OVERSHOT BASKET					
1	10	.10	.31	.01	0 to 1
2	10	.10	.31	.01	0 to 1
3	10	.70	.67	.03	0 to 2
HIT RIM OR BACKBOARD					
1	10	3.50	1.71	.34	1 to 6
2	10	3.30	1.33	.14	2 to 6
3	10	2.70	1.33	.46	1 to 5
DID NOT REACH BASKET					
1	10	.20	.42	.06	0 to 1
2	10	.40	.70	.14	0 to 2
3	10	.40	.70	.14	0 to 2
UNDERSHOT BASKET					
1	10	.80	1.03	.24	0 to 3
2	10	.50	.70	.06	0 to 2
3	10	.40	.70	.16	0 to 2

#### IV. FIELD GOAL ACCURACY TEST IN GOAL SHOOTING

The raw scores of each subject and the total scores of each test from the final shooting test are presented (See Appendix A, page 36). The difference in the scores was obtained by subtracting the total score of the three test groups. Table III, page 26.

The frequency distribution, means, and standard deviations were determined for the accuracy test. The range on the accuracy test was from 0 to 4, or 4 attempts made; and 0 to 2 or two times the individual overshot the basket; 1 to 6 or 6 shots hit the rim or backboard; 0 to 2 or twice the ball did not reach the basket; and 0 to 3 or three times the ball was under-shot at the basket. The means were found on the results of the six shots taken (See Table III, page 26),  $\bar{X}$  Basket Made had a mean of 1.70,  $\bar{X}$  Overshot Basket with a mean of .30, XI Hit Rim or Backboard a mean of 3.16, X. Did Not Reach Basket had a mean of .26, and  $\bar{X}$  Under-Shot Basket with a mean of .56; and the standard deviations were 1.20, .53, 1.46, .52, and .81.

The difference between the standard deviation and the mean of the field goal shooting accuracy test was calculated to determine if the difference would persist upon repeated experiments. Table III, page 26.

V. STATISTICAL COMPARISON OF THE FINAL TEST RESULTS  
OF THE ACCURACY GROUP AND THE STRENGTH GROUP

In an effort to answer the question: Does strength actually help field goal shooting accuracy?; the results of the final test of the three groups were analyzed. The final test for all three groups consisted of each subject shooting six shots at various positions on the floor, and a strength test using the Iso-scale. The results of each group were compared to determine the existent relationships.

The raw scores of each subject and the total scores of each group on the final shooting test are presented (See Appendix E, page 46, and Table III, page 26).

The frequency distributions, means, and standard deviations were determined for all three groups on the shooting test. The range of the three groups was from 0 to 10, or 10 shots made; and 0 to 4 or 4 times the basket was overshot; 0 to 17 or 17 times the rim or backboard was hit; 0 to 4 or 4 times the ball did not reach the basket; and 0 to 7 or 7 times the ball was undershot at the basket. The means were found to be  $\bar{X}$  Basket Made had a mean of 1.70,  $\bar{X}$  Overshot Basket with a mean of .30,  $\bar{X}$  Hit Rim or Backboard a mean of 3.16,  $\bar{X}$  Did Not Reach Basket had a mean of .26, and  $\bar{X}$  Undershot Basket with a mean .56; and the standard deviations were 1.20, .53, 1.46, .52, and .81 for the three groups.

## CHAPTER V

### FINDINGS, CONCLUSIONS, DISCUSSION AND RECOMMENDATIONS

The purpose of this study was to investigate and compare the relationship of shoulder strength to basketball shooting accuracy of tenth, eleventh, and twelfth grade boys. The subjects used in this study were varsity basketball players from Topeka West High School, Topeka High School, and Highland Park High School.

The Iso-scale was administered to thirty basketball players as a measure of shoulder strength, and correlated to field goal shooting.

Specifically, the investigator attempted to answer the following questions: (1) Will field goal shooting be improved with shoulder strength?; (2) Will field goal shooting be improved with body size?; (3) Is there a correlation between shoulder strength and field goal shooting accuracy?

In an effort to answer the above questions, the following tests for accuracy were conducted: (1) Final shot taken from twenty-two feet out on baseline; (2) Final shot taken from sixteen feet out and forty-five degree angle; (3) Final shot taken from fourteen feet out and ninety degree angle; (4) Final shot taken from twenty feet out and ninety



degree angle; (5) Final shot taken from sixteen feet out and one-hundred thirty-five degree angle; (6) Final shot taken from twenty-two feet out and to the left of basket and one-hundred and eighty degree angle.

## I. FINDINGS

Within the limitation, the findings of the study are as follows:

1. The correlation between shoulder strength and field goal accuracy did produce significant results.
2. Shoulder strength is important and can improve field goal accuracy.
3. A comparison between body size and field goal shooting accuracy was significant.

## II. CONCLUSIONS

The following conclusions resulted from this study:

1. The relationship between shoulder strength and field goal accuracy as measured by this study of tenth, eleventh, and twelfth grade varsity basketball players was related.
2. The least amount of strength by a school showed the shooting accuracy was not significant.
3. Body size and field goal shooting relationship was existent in most all cases.

4. The least amount of improvement in field goal shooting accuracy was shown in the final tests of all three groups.

5. The group that showed a relationship of shoulder strength and field goal shooting accuracy also had the best won and lost record during the 1967-68 basketball season.

6. The group that showed a relationship of shoulder strength and field goal shooting accuracy and was next in shoulder strength had the second best won and lost record during the 1967-68 basketball season.

7. The group that had the poorest shoulder strength and field goal shooting accuracy also had the poorest won and lost record during the 1967-68 basketball season.

### III. DISCUSSION

The results of this study showed improvement in favor of the strength-field goal accuracy group, this improvement was statistically significant.

The small number of subjects used in this study had a definite influence upon the significance of improvement between the three groups.

The results of this study are somewhat in agreement with the findings of Alley and Maaske (page 10) in that some improvement in shooting from various positions on the court did occur.

## IV. RECOMMENDATIONS

1. Studies should be made to determine if an increase in strength brings about improvement in reaction time, eye hand coordination, timing, and agility.

2. Further investigations should be made with the Iso-scale to determine the difference between the Initial and Final Test.

3. Further investigations should be made using a larger number of subjects and a wider range of ages to investigate the relationship between shoulder strength and field goal accuracy.

4. Finally, a study might be conducted comparing skilled and unskilled students, using the Iso-scale and shooting test, in an effort to determine what effect past play experience would have upon the results of the study.

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SCHOOL NUMBER THREE EQUALS 301-310

I. D.	Wt.	Ht.	Age	Gr.	St.	1	2	3	4	5
301	136	67	17	3	125-135	3	1	2	0	0
302	156	74	16	2	130-145	0	0	5	1	0
303	160	70	17	2	150-185	3	0	3	0	0
304	155	72	16	2	160-155	4	1	1	0	0
305	180	70	17	2	210-165	3	2	1	0	0
306	170	78	17	3	145-115	3	1	2	0	0
307	158	74	16	2	150-150	0	1	4	0	1
308	185	77	17	3	125-150	2	1	2	0	1
309	165	75	17	3	155-155	0	0	3	1	2
310	220	77	18	3	265-300	2	0	4	0	0

APPENDIX B

TOTAL SHOTS FROM EACH POSITION

I. TOTAL SHOTS:

- 1 - Baskets Made - 51/30-1.70
- 2 - Overshot Basket - 9/30-.30
- 3 - Hit Rim or Backboard - 96/30-3.16
- 4 - Did not reach Basket - 8/30-.26
- 5 - Under-Shot Basket - 17/30-.56

II. TOTALS FROM EACH POSITION:

SCHOOL	POSITION	BASKET MADE	OVERSHOT BASKET	HIT RIM OR BACKBOARD	DID NOT REACH BASKET	UNDER SHOT BASKET
100	1	3	0	7	0	0
200	1	3	0	7	0	0
300	1	1	1	7	0	1
100	2	1	1	4	0	4
200	2	0	1	5	2	2
300	2	1	2	6	0	1
100	3	1	0	6	1	2
200	3	5	0	5	0	0
300	3	5	1	3	0	1
100	4	4	0	6	0	0
200	4	5	0	5	0	0
300	4	5	1	4	0	0
100	5	2	0	6	1	1
200	5	1	0	5	2	2
300	5	2	2	3	2	1
100	6	3	0	7	0	0
200	6	3	0	6	0	1
300	6	6	0	4	0	0
<b>TOTALS</b>	<b>6</b>	<b>51</b>	<b>9</b>	<b>96</b>	<b>8</b>	<b>16</b>

APPENDIX C



RESULTS OF ACCURACY-STRENGTHTESTSCHOOL-100

Strength Test I. 145-115-S/D-10.06--S/D Total 35.01

II. 175-115-S/D-20.83--S/D Total 45.37

## Accuracy Test

Baskets Made	Total -14-Mean - 1.40-S/D-1.07
	Total Mean - 1.70-S/D-1.20

SCHOOL-200

Strength Test I. 230-150-S/D-24.22--S/D Total 35.01

II. 285-150-S/D-43.48--S/D Total 45.37

## Accuracy Test

Baskets Made	Total -17-Mean - 1.70-S/D-1.06
	Total Mean - 1.70-S/D-1.20

SCHOOL-300

Strength Test I. 265-125-S/D-43.87--S/D Total 35.01

II. 300-125-S/D-50.66--S/D Total 45.37

## Accuracy Test

Baskets Made	Total -20-Mean - 2.00-S/D-1.49
	Total Mean - 1.70-S/D-1.20

APPENDIX D

BASKETBALL TESTKEY

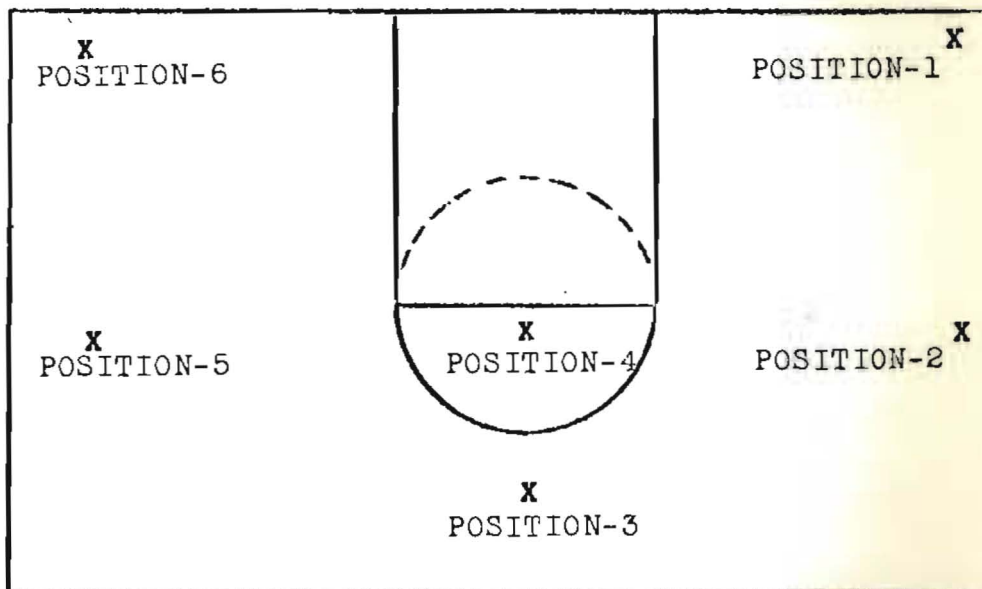
Basket Made

Overshot Basket

Hits Rim or Backboard

Did not reach Basket

Under-Shot Basket



APPENDIX E

FIELD GOAL ACCURACY TEST RESULTS  
FOR EACH SCHOOL

KEY: Basket Made - 5 points  
 Hit Rim or Backboard - 4 points  
 Overshot Basket - 3 points  
 Did Not Reach Basket - 2 points  
 Under-Shot Basket - 1 point

TOTAL -30 points

(On six baskets made)

SCHOOL ONE

STUDENT NUMBER	POSITION						TOTAL
	1	2	3	4	5	6	
101	4	1	5	5	5	4	24
102	4	4	4	4	4	4	24
103	4	4	4	5	4	4	25
104	5	1	1	5	4	5	21
105	5	3	1	4	1	4	18
106	4	1	4	4	5	4	22
107	5	1	4	4	4	5	23
108	4	4	4	5	4	5	26
109	4	4	4	4	2	4	22
110	4	5	2	4	4	4	23

SUB-TOTAL - 228



## SCHOOL TWO

STUDENT NUMBER	POSITION						TOTAL
	1	2	3	4	5	6	
201	4	4	5	4	5	5	27
202	5	3	5	5	4	4	26
203	4	2	5	5	2	4	22
204	5	2	4	5	4	4	24
205	4	4	4	4	1	4	21
206	5	4	4	5	4	4	26
207	4	4	4	4	4	4	24
208	4	1	4	5	4	5	23
209	4	4	5	4	1	1	19
210	4	1	5	4	2	5	21
SUB-TOTAL							- 223

## SCHOOL THREE

STUDENT NUMBER	POSITION						TOTAL
	1	2	3	4	5	6	
301	4	4	5	5	3	5	26
302	4	4	4	4	2	4	22
303	4	4	5	5	4	5	27
304	4	5	3	5	5	5	27
305	4	3	5	5	3	5	25
306	5	3	5	4	4	5	26
307	1	4	4	2	4	4	19
308	3	4	5	4	1	5	22
309	4	1	1	4	2	4	16
310	4	4	4	5	5	4	26
SUB-TOTAL							- 236

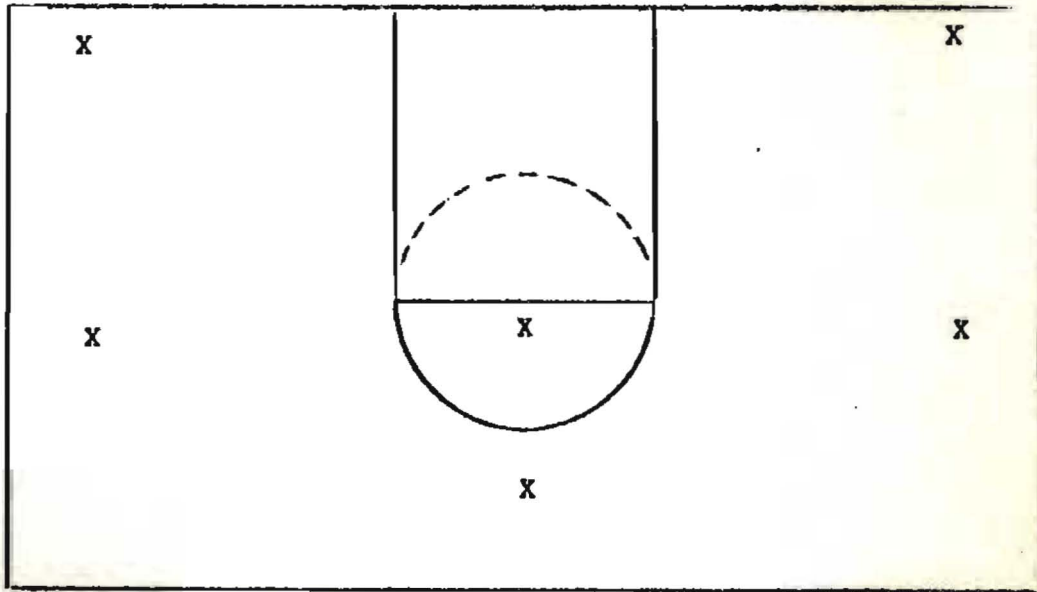
APPENDIX F

BASKETBALL TEST

50

KEY

- Basket Made
- Over-shot Basket
- Touches Rim or Backboard
- Did not reach Basket
- Under-Shot Basket



STRENGTH TEST

1 -

2 -

---

NAME -

AGE -

HEIGHT -

WEIGHT -

SCHOOL -

GRADE -