1975

The Construction of a Racquetball Skills Test Battery for Beginning College Women

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THE CONSTRUCTION OF A RACQUETBALL SKILLS TEST BATTERY FOR BEGINNING COLLEGE WOMEN

BY

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A thesis submitted
in partial fulfilment of the requirements for the
degree Master of Science, Major in
Health, Physical Education and Recreation,
South Dakota State University

1975

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This thesis is approved as a creditable and independent investigation by a candidate for the degree, Master of Science, and is acceptable for meeting the thesis requirements for this degree. Acceptance of this thesis does not imply that the conclusions reached by the candidate are necessarily the conclusions of the major department.

Thesis Adviser Date

Head, Health, Physical Education, and Recreation Department Date

ACKNOWLEDGEMENTS

The investigator would like to express sincere thanks to Dr. Neil Hattlestad for his guidance and assistance in this thesis, and to Professor Glenn E. Robinson for his support throughout the project.

Appreciation is extended to Dr. Lee Tucker, Associate Professor of Agriculture and Biological Sciences, for his valuable statistical assistance, and to Norma Boetel for her guidance and support.

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TABLE OF CONTENTS

PAGE

LIST OF TABLES

Chapter I

INTRODUCTION

Significance of the Study

The sport of racquetball has rapidly gained popularity throughout the country. Racquetball evolved from the game of paddleball, and confusion in the use of these two terms continues to exist. Paddleball is played with a solid paddle and a Pennsylvania 100 ball which has a pin hole through the surface. Racquetball is played with a strung racquet and a Seamless 558 ball. The recently organized (1968) International Racquetball Association sponsors singles and doubles competition for men and women of all ages, from under nineteen(Juniors) to over forty(Masters).[1] Racquetball has also experienced rapid growth in popularity among college women as a recreational and fitness activity. This growth has resulted in an increased demand for basic instruction courses in racquetball. A review of existing skills tests disclosed a lack of tools for the assessment of racquetball skills. There is a definite need to devise valid, reliable tests to aid in teacher evaluation of the student and self-evaluation in racquetball.

Statement of the Problem

The purpose of this study was to develop a battery of skills

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[1]Chuck Leve, Inside Racquetball (Chicago: Henry Regnery Co., 1973), pp. 5-6.

tests that would accurately measure playing ability of college women enrolled in beginning classes of racquetball.

Hypotheses

1. There will be no significant relationships between scores achieved on selected skills tests in racquetball, and standing attained in a round-robin tournament.

2. A multiple regression equation to significantly predict standing in a round-robin tournament cannot be developed.

Delimitations and Limitations

1. Twenty-five female subjects enrolled in two basic instruction classes in racquetball were selected for this study.

2. The time allotted for the class precluded playing regulation length games in order to complete a round-robin tournament.

3. Games were played to eleven points instead of the legal twenty-one points. All other official rules were followed.

4. No effort was made to limit practice outside of class.

5. The courts at S.D.S.U. were not of official size. The courts measured 20' x 36' x 15'.

6. The time allotted for the class precluded control of the order of administration of individual test items.

Definition of Terms

Construct. The skills or traits which compose a complete or total test of an attribute.[2]

Fault serve. Any two of the following are faults and result in a loss of serve: foot fault, short serve, long serve, two-side serve, ceiling serve.

Kill shot. A shot that hits the front wall and rebounds too close to the floor to be returned.

Service line. A line parallel to and five feet in front of the short line.

Short line. A line midway between and parallel with the front and back walls.[3]

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[2]Ted A. Baumgartner and Andrew S. Jackson, Measurement for Evaluation in Physical Education (Boston: Houghton Mifflin Co., 1975), p. 88.

[3]Leve, op. cit., pp. 84-87.

Chapter II

REVIEW OF LITERATURE

A review of the literature revealed that no skills tests have been devised for the game of racquetball. It was also ascertained that few investigations have been conducted in the related sports of handball and paddleball. This review was divided into three sections: literature related to construction of skills tests, literature related to racquetball fundamentals, and literature related to handball and paddleball tests.

Literature Related to Construction of Skills Tests

Skills testing has been widely used as an evaluative tool in physical education for over forty years. There is general agreement among authorities in the area of tests and measurement with respect to criteria to be considered in the construction and evaluation of skills tests.

Scott and French have suggested the following general criteria for constructing effective measurement tools. Tests should:

1. Measure important abilities
2. Be like game situations
3. Encourage good form
4. Involve one performer only
5. Be interesting and meaningful
6. Be of suitable difficulty
7. Differentiate between levels of ability

8. Provide accurate scoring
9. Provide a sufficient number of trials[1]

Barrow and McGee concur with the above mentioned criteria and cite, as further practical considerations in the selection and construction of tests, cost of equipment, economy of time, and ease of administration.[2]

Johnson and Nelson list seven criteria for the selection and evaluation of tests. These were:

1. Is the test easy to administer?
2. Does the test require expensive equipment?
3. Can the test be administered in a relatively short period of time?
4. Can the test be used as a drill during practice sessions?
5. Does the test require several trained testers?
6. Can the test be easily and objectively scored?
7. Is the test challenging and meaningful?[3]

Reliability, the consistency with which the test measures what it measures, is an important aspect of all measurement tools. The most commonly used method of establishing internal reliability in skills tests is the split-half method.[4] The reliability of tests can be affected by numerous factors. Baumgartner and Jackson described the following

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[1]M. Gladys Scott and Esther French, Measurement and Evaluation in Physical Education (Dubuque, Iowa: Wm. C. Brown Co., 1959), pp. 10-32.

[2]Harold M. Barrow and Rosemary McGee, A Practical Approach to Measurement in Physical Education (Philadelphia: Lea and Fefiger, 1971), pp. 49-50.

[3]Barry L. Johnson and Jack K. Nelson, Practical Measurements for Evaluation in Physical Education (Minneapolis: Burgess Publishing Co., 1974), pp. 46-50.

[4]Scott, op. cit., p. 85.

classification system proposed by Zuidema (1969) of factors influencing test reliability. They also stated that reliability coefficients should be calculated from a large number of scores (at least one-hundred) as it is easy to obtain extremely high or low correlation coefficients with a small group.[5]

Category of factors	Illustrative sources of imperfect reliability
Characteristics of the subjects	Range of talent: motivation; good day vs. bad day; learning; forgetting; fatigue
Characteristics of the test	Length; difficulty; discriminative power; trial homogeneity; number of performers
Characteristics of the testing situation	Instructions; environment; class organization class management; warm-up opportunity
Characteristics of the measurement process	Nature of measurement instrument; selection of scoring unit; precision; errors in measurement; number of trials; recording errors
Characteristics of the evaluator(s)	Competencies; confidence in test; concentration on task; familiarity with instrument; motivation; number of evaluators
Characteristics of the mode of statistical estimation	Breakdown of observed score variance into true score and error score variance, with retest design; error source is variation within individuals between days. Does not include within day variance. With split-trial design; variation within individuals between trials. Does not include between-day variance or variance between grouped trials.[6]

[5]Ted A. Baumgartner and Andrew S. Jackson, Measurement for Evaluation in Physical Education (Boston: Houghton Mifflin Co., 1975), p. 76.

[6]Ibid., p. 77.

Validity, the degree to which a test measures what it claims to measure, is another important aspect of a measurement tool. There are several different types of validity, but the one having most application to the construction of a skills test battery is construct validity. Baumgartner and Jackson defined a construct as "the skills or traits which compose a complete or total test of an attribute."[7] According to Safrit, playing ability in a given sport can be called a construct and, because of the complexities of the playing ability construct, one or two tests would not be adequate measures. She further stated that, "It seems certain that there are some personal attributes that are related to taking skill tests that are not relevent to playing ability in a game situation, and vice versa."[8] Analysis of variance, regression, and intercorrelation of tests are all statistical techniques applicable to analysis of constructs.[9]

Literature Related to Racquetball Fundamentals

Allsen and Witbeck cited several aspects of the game of racquetball as being important to good playing ability. A sound forehand and backhand, keeping the eyes on the ball, the kill shot, and the ability to direct the power serve toward the back corner are all important to

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[7]Baumgartner and Jackson, op. cit., p. 88.

[8]Margaret J. Safrit, Evaluation in Physical Education (Englewood Cliffs: Prentice-Hall, Inc., 1973), p. 116.

[9]Ibid., p. 113.

success in playing racquetball.[10] They also stated that "good form will enable a player to play a better game by hitting the ball harder; the ball can also be directed as desired."[11]

Leve concured with Allsen and Witbeck's opinion of the important fundamentals of the game and added that the two most effective places to hit the power serve are next to the wall just behind the short line or low and deep to the backhand corner.[12]

Fleming and Bloom suggested that the power serve should cause the ball to "rebound off the front wall and land as close to the rear corner of the court as possible . . . optional placement of the power serve . . . as close behind the short line as possible."[13] They also say that "the kill shot is a must if you desire to become a good player."[14]

Literature Related to Handball and Paddleball

Racquetball and handball have many characteristics in common such as rules, court size, basic strategy, and some differences such as

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[10]Phillip E. Allsen and Alan Witbeck, Racquetball / Paddleball (Dubuque: Wm. C. Brown Co., 1972), pp. 5-25.

[11]Ibid., p. 5.

[12]Chuck Leve, Inside Racquetball (Chicago: Henry Regnery Co., 1973), p. 25.

[13]William A. Fleming and Joel A. Bloom, Paddleball and Racquetball (Pacific Palisades: Goodyear Publishing Co., Inc., 1973), pp. 54-55.

[14]Ibid., p. 63.

ball size and the use of both hands as opposed to one racquet.[15] The similarities between handball and racquetball led the experimenter to review literature related to handball skills testing.

According to Tyson, the following is a complete list of handball related tests.[16] The present investigator added Millozi's work to bring the list up to date.[17]

Date	Author	Items Tested
1935	Clevett	Speed of arm movement, Back wall return, Service placement
1937	Edgren and Robinson	Fifteen-second volley, Front wall placement, Ten-second volley, Serve placement, Back wall return
1937	Friermood	Subjective rating
1938	Schiff	Subjective rating
1949	McCachren	Serve placement, Sixty-second volley, Front wall placement
1949	Cornish	Thirty-second volley, Front wall placement, Back wall placement, Power, Serve placement
1952	Reinbach	Continuous volley to thirty hits, Front wall placement, Back wall placement, Serve placement

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[15]Richard Robertson and Herbert Olson, Beginning Handball (Belmont, California: Wadsworth Publishing Co., Inc., 1969), pp. 11-13.

[16]Kenneth Woodrow Tyson, "A Handball Skill Test for College Men" (unpublished Master of Science thesis, University of Texas, Austin, 1970), pp. 8-15.

[17]Frank C. Millonzi, "The Development and Validation of a Handball Skill Test" (unpublished Master of Science thesis, University of Wisconsin, LaCrosse, 1972), pp. 18-26.

Date	Author	Items Tested
1952	Simos	Thirty-second volley from five, eight, and eleven feet
1960	Griffith	Sixty-second volley, Sixty-second free-for-all, Knox Penny Cup Test
1967	Pennington, et al.	Thirty-second volley, Front wall placement, Back wall placement, Power, Serve placement, Thirty-second shuttle run, Grip Strength
1970	Tyson	Thirty-second volley, Front wall placement, Ceiling shot placement, Back wall placement
1972	Millonzi	Ceiling shot placement, Front wall placement, Thirty-second volley, Back wall placement, Serve placement, Fly kill, Cross corner kill, Power, Overhand pass shot, Return of serve, Grip strength, Thirty-second shuttle run.

The classic work in handball skills test development is that of Cornish who used the thirty-second volley, front wall placement, back wall placement, power, and serve placement tests. Cornish used the number of points a player scored, minus the number of points scored against him (plus points) as his criterion. Cornish correlated the test results with the total number of plus points scored by each student in a twenty-three game round-robin and found a correlation of .667 for the thirty-second volley and serve placement tests; the power test had a correlation of .58.[18]

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[18]Clayton Cornish, "A Study of Measurement of Ability in Handball" Research Quarterly Vol. 20, no. 2 (May, 1949), pp. 215-222.

Pennington et al., expanded Cornish's test using the same markings but breaking the skills down to dominant and non-dominant hands and adding the thirty-second shuttle run and grip strength tests. The games in their round-robin tournament varied from standard scoring procedure in that a point was scored every time there was a fault, so that on each serve either the server or receiver scored a point; service was exchanged in the normal manner. The first player to score fifteen points won. An average of ten games were played by each participant. High correlations were found between the participants' average score per game and serve placement (.711), serve placement and wall volley (.791), serve placement, total wall volley and back wall placement (.802). The authors used the Wherry-Doolittle test selection method.[19]

Millonzi also replicated the work of Cornish with very similar results. He included the thirty-second shuttle run, but found a low correlation (.41) between the test and the criteria.[20]

Paddleball is also closely related to racquetball. The rules and court size are identical; the primary difference being that paddleball is played with a solid wooden paddle and an official paddleball ball and that the wooden paddle does not give the control and speed that the stringed racquet gives.[21]

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[19]G. G. Pennington et al., "A Measure of Handball Ability" Research Quarterly Vol. 38, no. 2 (May, 1967), pp. 247-253.

[20]Millonzi, op. cit., pp. 18-26.

[21]Allsen, op. cit., p. 4.

Gurney developed a battery of skills tests for paddleball consisting of a serve test in which each participant was given five trials on each of five different types of serve; a thirty-second volley for forehand and another for backhand which were then totaled for the participants score; a front wall placement test; and a back wall recovery test. The tests were correlated with a criterion of games won in a round-robin tournament resulting in a validity correlation of .558 and a reliability correlation of .80. No intercorrelations were calculated. The author devised his own court divisions for scoring which were quite different from the Cornish scoring divisions and did not give as large a range of scores as the Cornish divisions.[22]

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[22]Walden O. Gurney, Jr., "A Paddleball Skills Test for College Men" (unpublished Master of Science thesis, Brigham Young University, 1966).

Chapter III

METHODS AND PROCEDURES

Organization and Source of the Data

The study was conducted during the Spring Semester of 1974-1975 at South Dakota State University. Twenty-five female students enrolled in two selected racquetball classes in the Fitness and Lifetime Activities Program were the subjects chosen for this investigation. The subjects ranged in age from eighteen to twenty-five years and had no previous experience with racquetball. The classes met for nine weeks, two times a week for approximately 35 minutes. Racquetball/Paddleball by Allsen and Witbeck from the Brown Physical Education Activities Series was the resource book used by members of these classes.

The subjects received four class periods of instruction in racquetball fundamentals. These fundamentals included the forehand and backhand strokes, the power serve to the forehand and backhand sides, the kill shot, the passing shot, back wall retrieval and court position. After these experiences the subjects were given a battery of four test items as a pre-test followed by ten class periods of additional instruction and play, culminating in the administration of the test items as a post-test. Between tests the subjects participated in a round-robin tournament which consisted of games played to eleven points and which allowed the investigator to rank the subjects according to playing ability.

The tests included in the battery were selected or developed by the experimenter after a review of literature related to racquetball, handball, paddleball, and skill test construction; an inquiry to the American Alliance of Health, Physical Education, and Recreation concerning the development of racquetball skills tests in their skills test program; discussion with experienced racquetball players; and experimentation and pilot studies conducted by the investigator. Other criteria established for the selection of test items included; (1) ease of administration, (2) minimum loss of instructional time, (3) use of inexpensive equipment and (4) permanent markings would not be required.

The tests selected for administration were the thirty-second volley, serve placement, front wall placement, and speed of movement. Diagrams and directions for test administration are presented in Appendix A.

Collection of the Data

Thirty-second volley. The thirty-second volley has been established as a test having a reasonable level of validity in tennis (.61), which requires the use of an implement similar to that used in racquetball. Edgren and Robinson, M^{c}Cachren, Cornish, Leinbach, Simos, Griffith, Pennington, et al., and Tyson all included some type of wall volley in their handball skills tests, obtaining validity coefficients ranging

from .60 to .87.[1] Since tennis and handball are both related to racquetball, the present experimenter included a thirty-second volley. The investigator included this test in a pilot study administered to fifteen subjects enrolled in a beginning racquetball class at S.D.S.U. during the Fall Semester, 1974-1975. The pilot study was used to determine administrative feasibility and clarity of directions. The subjects were given fifteen seconds to practice immediately prior to testing. Two trials were given and the subjects score was the total of both trials. Data were recorded as the total number of successful hits against the front wall.

Serve placement. The power serve has been regarded by racquetball authorities as an important skill and was therefore included in tests employed by Edgren and Robinson, M^{c}Cachren, Cornish, Leinback, Millonzi, and Pennington et al. in various handball tests with validity coefficents as high as .71.[2] Gurney's paddleball battery also included a series of serve placement tests.[3] The only court markings available to

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[1]Kenneth Woodrow Tyson, "A Handball Skill Test for College Men" (unpublished Master of Science thesis, University of Texas, Austin, 1970), pp. 8-15.

[2]Ibid.; see also Frank C. Millonzi, "The Development and Validation of a Handball Skill Test" (unpublished Master of Science thesis, University of Wisconsin, LaCrosse, 1972), pp. 18-26.

[3]Walden O. Gurney, Jr., "A Paddleball Skills Test for College Men" (unpublished Master of Science thesis, Brigham Young University, 1966), pp. 13-14.

the experimenter were those used by Cornish; Pennington et al.; and Gurney.[4] The experimenter believed that these markings were inadequate in that Gurney's would not provide sufficient differentiation in ability and might be quite discouraging to a beginner; the Cornish test was designed for a larger than regulation court, for handball, and might not provide sufficient differentiation in ability for racquetball. After deliberation and experimentation the investigator decided to divide the court from the short line to the back wall in two parallel sections one foot wide from the side wall toward the center of the court. These two sections were subsequently divided into four equal sections providing eight possible scoring areas on each side of the court and a ninth area in the remaining area behind the short line. In order to consider the power aspect of the serve without calling for a judgement by the scorer, the investigator placed a line on the front wall seven feet from the floor. Any serve hitting above that line was scored as a zero. The investigator included this test in a pilot study administered to fifteen subjects enrolled in a beginning racquetball class at S.D.S.U. during the Fall Semester, 1974-1975. The pilot study was used to determine administrative feasibility and clarity of directions. The subjects received ten trials with no practice immediately beforehand. Data were recorded as the total of scores achieved on each trial.

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[4]Clayton Cornish, "A Study of Measurement of Ability in Handball" Research Quarterly Vol. 38, no. 2 (May, 1949), pp. 215-222; see also G. G. Pennington et al., "A Measure of Handball Ability" Research Quarterly Vol. 38, no. 2 (May, 1967), pp. 247-253; see also Gurney, loc. cit.

Front wall placement. The ability to execute a kill shot is also considered to be an important skill for a racquetball player to acquire. McCachran; Cornish; Leinback; Pennington et al.; Tyson; and Millonzi included some type of front wall placement in their handball tests.[5] Gurney included a similar item in his paddleball test battery.[6] Available validity coefficients indicated a range from .51 to .84. The investigator felt that designations used in these tests used areas at least three feet by three feet and the paddleball test had minimum sized markings of one and one-half feet by three feet. After experimentation and observation by the investigator two parallel lines were marked on the front wall, the first eight inches from the floor and the second eight inches above the first. The investigator included this test in a pilot study administered to fifteen subjects enrolled in a beginning racquetball class at S.D.S.U. during the Fall Semester, 1974-1975. The pilot study was used to determine administrative feasibility and clarity of directions. The subjects received ten trials with no practice immediately beforehand. Data were recorded as the total of scores achieved on each trial.

Speed of movement. Playing ability in racquetball is a complex construct which seems to include the ability to move quickly and efficiently from one area of the court to another. Pennington et al., Millonzi, and

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[5]Tyson, loc. cit.; see also Millonzi, loc. cit.

[6]Gurney, op. cit., pp. 15-16.

Griffith attempted to measure this concept in their handball tests. Pennington, et al. and Millonzi used a thirty-second shuttle run, and Griffith used the Knox Penny-cup Test which has been validated as related to basketball playing ability.[7] Both tests yielded low validity coefficients thus eliminating these two tests from consideration. The present researcher devised a simple speed of movement test that was designed for a racquetball court, required little time or equipment and appeared to test this aspect of the construct. The investigator included this test in a pilot study administered to fifteen subjects enrolled in a beginning racquetball class at S.D.S.U. during the Fall Semester, 1974-1975. The pilot study was used to determine administrative feasibility and clarity of directions. The subjects were given two trials, with the best of the two being the score. Data were recorded in seconds to the nearest tenth of a second. (Complete instructions in appendix.)

To meet the criteria dealing with expense of equipment and permanent markings the experimenter used a heavy grade of plastic to mark the serve placement test. Heavy cord, dyed a color contrasting with the walls, was used for the lines of the serve placement and front wall placement tests. The plastic target and cord were taped securely in place when needed for testing and were easily removed at the end of the class period. A large cardboard tube was securely taped to a frame and used as a ball chute for the second group on the front wall placement test. White, eight and one half inch by eleven inch paper with red

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[7]Pennington, loc. cit.; see also Millonzi, loc. cit.; see also Tyson, loc. cit.

numbers printed on it was taped to the walls in specific positions and the starting and finishing box was taped on the floor for the speed of movement test.

The tests were administered in two class periods of approximately thirty-five minutes each, requiring a total of four class periods for both pre-test and post-test administration using four courts. The subjects were divided into groups of three or four. A scorer and an assistant scorer were randomly selected from each group and scored both the pre-tests and post-tests. The scorekeepers and assistants were taken to each test area and given specific instructions concerning where to stand and how to score (see individual test instructions in Appendix A). The administrator read the same set of instructions to all students. Each student received a score sheet on which her scores were recorded. These sheets were returned to the test administrator at the end of each class period. The thirty-second volley was administered first to all subjects. Two courts were used to test serve placement, one to test front wall placement and one to test speed of movement. As each group completed one test they went to another.

The present researcher served as the timer for the thirty-second volley and speed of movement tests. The same steel tape was used throughout for all measurements. The same stop watch was used throughout for all timings.

Official balls meeting the criteria of a sixty-five to seventy inch bounce from a one-hundred inch drop were used throughout the testing period.

Chapter IV

ANALYSIS AND DISCUSSION OF RESULTS

Organization of the Data for Analysis

The battery of skill tests considered in the present investigation was developed to test playing ability in racquetball. Seven variables were analyzed through a step-wise multiple regression technique for two groups of subjects. Data were collected through the use of a pre-test and a post-test. The variables were serve placement, front wall placement, thirty-second volley, speed of movement, tournament standing, height, and weight. Tournament standings were used as the dependent variable, and the remaining six variables were independent. Each independent variable was listed in order of entry based upon a multiple regression analysis. The mean, standard deviation, and zero order correlation were computed for each group and for both sets of data. Each step of the regression equation yielded values for error of estimate, multiple correlation, and variance. An electronic computer was used to facilitate the speed and accuracy of the statistical analysis. Reliability correlation coefficients were calculated by the present investigator using the Raw Score Method as suggested by Neilson and Jensen, and adjusted by the Spearman-Brown prophecy formula.[1] Raw data obtained from subjects on test variables are found in Appendix B.

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[1]A. P. Neilson and Clayne R. Jensen, Measurement and Statistics in Physical Education (Belmont: Wadsworth Publishing Co., Inc., 1972), pp. 18-20.

Analysis of Data

The means and standard deviations of variables are presented in Table I. Group I and Group II were comparable in height, the mean for Group I being 64.8 inches while the mean for Group II was 65 inches. The standard deviation was 1.7 inches for Group I and slightly larger, 2.3 inches, for Group II. The mean weight for Group I was 138.9 pounds with a standard deviation of 27.3 pounds and the mean weight for Group II was 128.1 pounds with a standard deviation of 14.3 pounds. The pre-test data did not yield consistent differences in mean scores between the two groups, however, Group I had slightly larger standard deviations for all but the front wall placement test. Throughout the post-tests, Group I had consistently better mean scores and consistently larger standard deviations than Group II.

The matrices of zero order correlations are presented in Tables II through V. The .05 level of significance for Group I was .55, for Group II, .50. The data from pre-tests and post-tests for Group I yielded significant correlations from both tests between front wall placement and thirty-second volley (.83, .78); thirty-second volley and tournament standing (.68, .77); speed of movement and weight (.76, .73); and height and weight (.69). The post-test data from Group I yielded additional significant correlations between serve placement and front wall placement (.70), and between front wall placement and tournament standing (.78). In the pre-test matrix for Group II it was observed that only the correlation between the thirty-second volley and

TABLE I

MEANS AND STANDARD DEVIATIONS
OF VARIABLES

Variables	Mean		Standard Deviation
Pre-test			
Group I*			
1 Serve Placement	8.54545		5.33598
2 Front wall Placement	16.09090		5.48552
3 Thirty-second Volley	23.63635		10.77286
4 Speed of Movement	11.07272	seconds	1.14463
5 Tournament Standing	6.00000		3.31663
6 Height	64.81818	inches	1.66242
7 Weight	138.90909	pounds	27.30000
Group II**			
1 Serve Placement	9.14286		2.38124
2 Front wall Placement	15.42857		6.42966
3 Thirty-second Volley	21.71428		7.53890
4 Speed of Movement	11.72857	seconds	.56898
5 Tournament Standing	7.50000		4.18330
6 Height	65.00000	inches	2.32048
7 Weight	128.14285	pounds	14.33048
Post-test			
Group I*			
1 Serve Placement	12.36364		6.15260
2 Front wall Placement	16.09090		8.52590
3 Thirty-second Volley	27.27272		10.60274
4 Speed of Movement	11.10908	seconds	1.02416
5 Tournament Standing	6.00000		3.31663
6 Height	64.81818	inches	1.66242
7 Weight	138.90909	pounds	27.30000
Group II**			
1 Serve Placement	9.57143		3.65249
2 Front wall Placement	13.85714		4.83349
3 Thirty-second Volley	24.57143		5.76079
4 Speed of Movement	11.15714	seconds	.62106
5 Tournament Standing	7.50000		4.18330
6 Height	65.00000	inches	2.32048
7 Weight	128.14285	pounds	14.33048

* Group I = 11 subjects
** Group II = 14 subjects

TABLE II

CORRELATION MATRIX*

Variables**	1	2	3	4	5	6	7
Pre-test Group I							
1	1.00000	0.39102	0.51872	-0.17087	-0.61026	-0.37099	0.07520
2		1.00000	0.82979	-0.15087	-0.37376	0.01296	0.19438
3			1.00000	-0.35771	-0.68011	-0.18833	-0.00828
4				1.00000	0.70595	0.39653	0.75547
5					1.00000	0.45342	0.35231
6						1.00000	0.68486
7							1.00000

* .05(11) level of significance = .55

** 1 Serve Placement
2 Front wall Placement
3 Thirty-second Volley
4 Speed of Movement
5 Tournament Standing
6 Height
7 Weight

TABLE III

CORRELATION MATRIX*

Variables**	1	2	3	4	5	6	7
Post-test Group I							
1	1.00000	0.69893	0.47507	-0.06564	-0.50476	-0.06133	0.24134
2		1.00000	0.78290	-0.31619	-0.77801	-0.33032	0.10874
3			1.00000	-0.23416	-0.77065	-0.48482	-0.10424
4				1.00000	0.66828	0.40046	0.72930
5					1.00000	0.45342	0.35231
6						1.00000	0.68486
7							1.00000

* .05(11) level of significance = .55

** 1 Serve Placement
2 Front wall Placement
3 Thirty-second Volley
4 Speed of Movement
5 Tournament Standing
6 Height
7 Weight

TABLE IV

CORRELATION MATRIX*

Variables**	1	2	3	4	5	6	7
Pre-test Group II							
1	1.00000	0.03589	0.26383	-0.34389	-0.27799	-0.34803	-0.25988
2		1.00000	0.49467	-0.40522	-0.27741	0.44855	0.20132
3			1.00000	-0.42296	-0.54392	-0.06156	-0.25948
4				1.00000	0.30379	-0.11652	0.41833
5					1.00000	0.19018	-0.00898
6						1.00000	0.38168
7							1.00000

* .05(14) level of significance = .50

** 1 Serve Placement
2 Front wall Placement
3 Thirty-second Volley
4 Speed of Movement
5 Tournament Standing
6 Height
7 Weight

TABLE V

CORRELATION MATRIX*

Variables**	1	2	3	4	5	6	7
Post-test Group II							
1	1.00000	0.31434	0.65230	-0.72423	-0.48330	-0.05446	-0.26474
2		1.00000	0.65236	0.06955	-0.20924	0.37721	0.13914
3			1.00000	-0.20548	-0.42453	0.12084	0.18250
4				1.00000	0.60696	0.16547	0.32572
5					1.00000	0.19018	-0.00898
6						1.00000	0.38168
7							1.00000

* .05(14) level of significance = .50

** 1 Serve Placement
2 Front wall Placement
3 Thirty-second Volley
4 Speed of Movement
5 Tournament Standing
6 Height
7 Weight

tournament standing was significant (.54). Significant correlations in the post-test matrix for Group II were observed between serve placement and thirty-second volley (.65); serve placement and speed of movement (.72); front wall placement and thirty-second volley (.65); and speed of movement and tournament standing (.61). The only significant correlation common to both groups on the pre-test was between the thirty-second volley and tournament standing. The only significant correlations common to both groups on the post-test were between front wall placement and thirty-second volley, and speed of movement and tournament standing.

The order of entry for the independent variables and percentage of variance accounted for are presented in Table VI. The minimum amount of variance necessary to contribute significantly at the .05 level for Group I on the pre-test was 44.09 and on the post-test was 41.36. The multiple regression analysis of pre-test data for Group I indicated that only the speed of movement variable was statistically significant ($54.82 > 44.09$), accounting for 49.8 percent of the variance. The serve placement variable was not statistically significant ($27.16 < 44.09$) but accounted for an additional 24.2 percent of the variance. The six variables together accounted for 88.1 percent of the variance in the pre-test scores for Group I. The analysis of post-test data from Group I indicated that the only statistically significant variable was front wall placement ($66.58 > 41.36$) which accounted for 60.5 percent of the variance. The speed of movement variable was not statistically significant ($21.80 < 41.36$) but accounted for 19.8 percent of the variance. Front wall placement, speed of movement, and thirty-second

TABLE VI

ORDER OF INDEPENDENT VARIABLES AND PERCENT VARIANCE ACCOUNTED FOR

	Rank Order of Variables	Variance (%)	Sum of Variance (%)	R
Pre-test				
Group I	4	49.8	49.8	.71
	1	24.7	74.5	.86
	3	5.9	80.4	.90
	2	3.4	83.8	.92
	7	1.0	84.8	.92
	6	3.4	88.1	.94
Group II	3	29.6	29.6	.54
	6	2.5	32.0	.57
	7	5.4	37.4	.61
	4	5.7	43.1	.66
	1	.1	43.2	.66
	2	.1	43.3	.66
Post-test				
Group I	2	60.5	60.5	.78
	4	19.8	80.3	.90
	3	7.3	87.6	.94
	1	.9	88.6	.94
	6	.2	88.7	.94
	7	.2	88.9	.94
Group II	4	36.8	36.8	.61
	3	9.4	46.2	.68
	1	6.2	52.4	.72
	6	2.3	54.7	.74
	2	1.8	56.4	.75
	7	2.0	58.4	.76

volley, together, accounted for 87.6 percent of the variance in the post-test scores for Group I. The minimum amount of variance necessary to contribute significantly at the .05 level for Group II on the pre-test was 128.86, and on the post-test was 94.39. The analysis of data for Group II showed none of the variables to be significant on either the pre-test or the post-test. The regression equations developed from this study are presented in Tables VII-X.

The analysis of test reliability using the Raw Score Method is presented in Table XI. The thirty-second volley yielded a reliability coefficient of .90 from pre-test data and .76 from post-test data. The speed of movement test yielded a reliability coefficient of .62 from pre-test data and .95 from post-test data. The serve placement and front wall placement tests had coefficients of .29 and .39, respectively, from the pre-test data, and .60 and .75 from the post-test data. The composite reliability coefficient was .55 for the pre-test and .77 for the post-test.

Discussion of Results

The two hypotheses stated that: (1) there will be no significant relationships between scores achieved on selected skills tests in racquetball, and standing attained in a round-robin tournament, and (2) a multiple regression equation to significantly predict standing in a round-robin tournament cannot be developed.

The thirty-second volley and speed of movement tests both correlated significantly with the criteria of tournament standing; however, their intercorrelation coefficient was only -.23. This

TABLE VII

REGRESSION EQUATIONS DEVELOPED TO EVALUATE RACQUETBALL PLAYING ABILITY

Regression Equation	Standard Error of Estimate	Multiple Correlation	Variance Accounted*
Pre-test			
Group I			
1. $Y_1 = 2.05X_4 - 16.65$	2.46	.71	54.8
2. $Y_1 = 1.80X_4 - .31X_1 - 11.21$	1.87	.86	27.2
3. $Y_1 = 1.56X_4 - .23X_1 - .09X_3 - 7.11$	1.75	.90	6.5
4. $Y_1 = 1.39X_4 - .21X_1 - .19X_3 + .21X_2 - 6.40$	1.72	.92	3.7
5. $Y_1 = 1.79X_4 - .20X_1 - .19X_3 + .24X_2 - .02X_7 - 8.55$	1.83	.92	1.1
6. $Y_1 = 2.58X_4 - .08X_1 - .17X_3 + .24X_2 - .08X_7 + .80X_6 - 62.26$	1.81	.94	.03

* Total Variance 110.00 (Independent variables are idenfified on p. 23.)
MS Variance 4.54
$F_{.05}(1,3) = 10.13$

Minimum variance needed to contribute significantly to the equation = 45.99

TABLE VIII

REGRESSION EQUATIONS DEVELOPED TO EVALUATE RACQUETBALL PLAYING ABILITY

Regression Equation	Standard Error of Estimate	Multiple Correlation	Variance Accounted*
Post-test			
Group I			
1. $Y_1 = -.30X_2 + 10.87$	2.20	.78	66.6
2. $Y_1 = -.25X_2 + 1.52X_4 - 6.94$	1.64	.90	21.8
3. $Y_1 = -.11X_2 + 1.54X_4 - .14X_3 - 5.61$	1.40	.94	8.0
4. $Y_1 = -.06X_2 + 1.62X_4 - .14X_3 - .08X_1 - 6.12$	1.45	.94	1.0
5. $Y_1 = -.06X_2 + 1.67X_4 - .15X_3 - .07X_1 - .10X_6 - .09$	1.58	.94	.2
6. $Y_1 = -.11X_2 + 1.26X_4 - .14X_3 - .06X_1 - .30X_6 + .02X_7 + 14.69$	1.75	.94	.2

* Total Variance 110.00 (Independent variables are identified on p. 23.)
MS Variance 4.08
$F_{.05}(1,3) = 10.13$

Minimum variance needed to contribute significantly to the equation = 41.36

TABLE IX

REGRESSION EQUATIONS DEVELOPED TO EVALUATE RACQUETBALL PLAYING ABILITY

Regression Equation	Standard Error of Estimate	Multiple Correlation	Variance Accounted*
Pre-test			
Group II			
1. $Y_1 = -.30X_3 + 14.05$	3.65	.54	67.3
2. $Y_1 = -.30X_3 + .28X_6 - 4.50$	3.75	.57	5.6
3. $Y_1 = -.33X_3 + .46X_6 - .08X_7 - 5.21$	3.77	.61	12.2
4. $Y_1 = -.28X_3 + .62X_6 - .12X_7 + 2.19X_4 - 37.83$	3.79	.66	12.9
5. $Y_1 = -.28X_3 + .59X_6 - .11X_7 + 2.09X_4 - .07X_1$ - 34.45	4.02	.66	.2
6. $Y_1 = -.28X_3 + .57X_6 - .11X_7 + 2.17X_4 - .07X_1$ + $.02X_2$ - 33.71	4.29	.66	.1

* Total Variance 227.00 (Independent variables are identified on p. 23.)
MS Variance 21.51
$F_{.05}(1,6) = 5.99$

Minimum variance needed to contribute significantly to the equation = 128.86

TABLE X

REGRESSION EQUATIONS DEVELOPED TO EVALUATE RACQUETBALL PLAYING ABILITY

Regression Equation	Standard Error of Estimate	Multiple Correlation	Variance Accounted*
Post-test			
Group II			
1. $Y_1 = 4.09X_4 - 38.11$	3.46	.61	83.8
2. $Y_1 = 3.66X_4 - .23X_3 - 27.70$	3.34	.68	21.4
3. $Y_1 = 5.90X_4 - .43X_3 + .62X_1 - 53.57$	3.29	.72	14.0
4. $Y_1 = 5.74X_4 - .46X_3 + .63X_1 + .28X_6 - 69.55$	3.39	.74	5.2
5. $Y_1 = 6.02X_4 - .37X_3 + .65X_1 + .38X_6 - .17X_2 - 79.00$	3.52	.75	4.1
6. $Y_1 = 5.93X_4 - .27X_3 + .50X_1 + .50X_6 - .21X_2 - .05X_7 - 79.37$	3.68	.76	4.5

* Total Variance 227.50 (Independent variables are identified on p. 23.)
MS Variance 15.76
$F_{.05}(1,6) = 5.99$

Minimum variance needed to contribute significantly to the equation = 94.39

TABLE XI

RELIABILITY OF TESTS

Thirty-second Volley	
Pre-test	.90
Post-test	.76
Serve Placement	
Pre-test	.29
Post-test	.60
Front Wall Placement	
Pre-test	.33
Post-test	.75
Speed of Movement	
Pre-test	.62
Post-test	.95

supports the concept that the traits these measures test are mutually exclusive.

A significant correlation between the thirty-second volley and tournament standing is consistent with results obtained by Cornish (.67), Pennington, et al. (.68), Griffith (.80), Tyson (.87), and Millonzi (.85) who included a thirty-second volley in their tests of handball ability.[2] It appeared to the present investigator that the thirty-second volley was the most valid and reliable variable tested in this study. It was interesting to note, however, that this variable accounted for 29.6 percent of the variance of the pre-test data for Group II but no more than 9.4 percent of the variance for either group on remaining pre-test or post-test data. This indicated that although the thirty-second volley has a high degree of reliability and validity it may not be an important factor in playing ability. The speed of movement variable also had a high reliability coefficient (.95), and correlation coefficients of .71 from pre-test of Group I, .67 from post-test data of Group I, and .61 from post-test data of Group II. This variable accounted for 49.8 percent of the variance from pre-test data on Group I, 5.7 percent of the variance from pre-test data on Group II, 19.8 percent of the variance from post-test data on Group I, and 36.8 percent of the variance from post-test data on Group II. Since these

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[2]G. G. Pennington, et al., "Measure of Handball Ability" Research Quarterly Vol. 38 no. 2 (May, 1967), pp. 247-253; see also Kenneth Woodrow Tyson, "Handball Skill Test for College Men" (unpublished Master of Science thesis, University of Texas at Austin, 1970), pp. 247-253.

results explained a greater percentage of the total variance than the other independent variables, it appeared that the speed of movement test devised for this study is related to success in playing racquetball. Several other investigators have attempted to relate agility, as measured by the thirty-second shuttle run and the Knox Penny-Cup test, to playing ability in handball; Pennington, et al., Griffith, and Millonzi found correlations of .41 between the agility measure and a criteria of tournament standing.[3] It would seem that the test devised for this investigation is highly specific to racquetball.

The investigator expected higher correlations with the criterion from both the serve placement and front wall placement tests based on the results of other handball skill test investigations. Cornish found a correlation of .53, and Pennington, et al. found a correlation of .71 for a serve placement test; and Cornish found a correlation of .51, and Pennington, et al. a correlation of .37 for a front wall placement test.[4] Several other investigators in this area included both types of tests; however, they either used a different statistical treatment or failed to include a statistical analysis of any type.[5] The investigator

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[3]Pennington, loc. cit.; see also Tyson, loc. cit.; see also Frank C. Millonzi, "The Development and Validation of a Handball Skill Test" (unpublished Master of Science thesis, University of Wisconsin at LaCrosse, 1972), pp. 18-26.

[4]Pennington, loc. cit.; see also Clayton Cornish, "A Study of Measurement of Ability in Handball" Research Quarterly Vol. 20 no. 2 (May, 1949), pp. 215-222.

[5]Tyson, loc. cit.

felt that the tests for serve and front wall placement might yield a higher correlation with playing success in more advanced players. These are tests of accuracy and might be improved in both validity and reliability by increasing the number of trials.[6]

The multiple regression analysis did not yield a statistically significant regression equation to predict tournament standing. The differences in means and standard deviations seem to indicate a greater degree of heterogeneity in Group I than in Group II. This could have resulted in more accurate tournament standings for Group I than for Group II using the eleven point game as compared with the regulation twenty-one point contest. More accurate standings could have resulted in the higher percentage of variance explained for Group I than for Group II.

On the basis of the results of this study, the investigator rejected the hypothesis that there will be no significant relationships between scores achieved on selected skills tests in racquetball, and standing attained in a round-robin tournament; and failed to reject the hypothesis that a multiple regression equation to significantly predict standing in a round-robin tournament cannot be developed.

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[6]M. Gladys Scott and Esther French, Measurement and Evaluation in Physical Education (Dubuque: Wm. C. Brown Co., 1959), p. 18.

Chapter V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of this study was to develop a battery of skills tests that would measure playing ability of college women enrolled in beginning classes of racquetball, and to develop a regression equation which could be used to predict standing in a round-robin tournament.

Twenty-five female students enrolled in two beginning racquetball classes during the Spring Semester of 1974-1975 at South Dakota State University were tested on serve placement, front wall placement, thirty-second volley, and speed of movement. These independent variables, along with height and weight, were subjected to analysis using a multiple regression technique. The dependent variable was standing achieved in a modified round-robin tournament.

The results of the study showed significant correlations between the thirty-second volley and tournament standing; speed of movement and tournament standing; and thirty-second volley and front wall placement. The results of the multiple regression analysis from Group I and Group II were too inconsistent to be able to draw any definite conclusions.

Conclusions

Based on the results of this study, and within the limitations thereof, the investigator concluded:

1. Only two of the variables investigated relate significantly to tournament standing. They are speed of movement and thirty-second volley.

2. Tournament standing cannot be predicted with statistical significance from the results obtained in this study.

Recommendations

Based on the results of this study, the investigator proposes the following recommendations for further study.

1. That further study be conducted employing the same design, but that a larger number of subjects be used.

2. That this study be replicated employing a regulation length game or match to determine tournament standing.

3. That intermediate or advanced players be used as subjects in a study employing the same design.

4. That investigations be conducted concerning the speed of movement aspect of playing ability in racquetball.

5. That this study be replicated using only the thirty-second volley and speed of movement variables.

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APPENDICES

Appendix A

TEST ADMINISTRATION

Speed of Movement

Equipment: Stop Watch

Markings: A box 1½' x 1½' in the center of the floor using the short line as the front edge of the box should be outlined in tape or painted on.

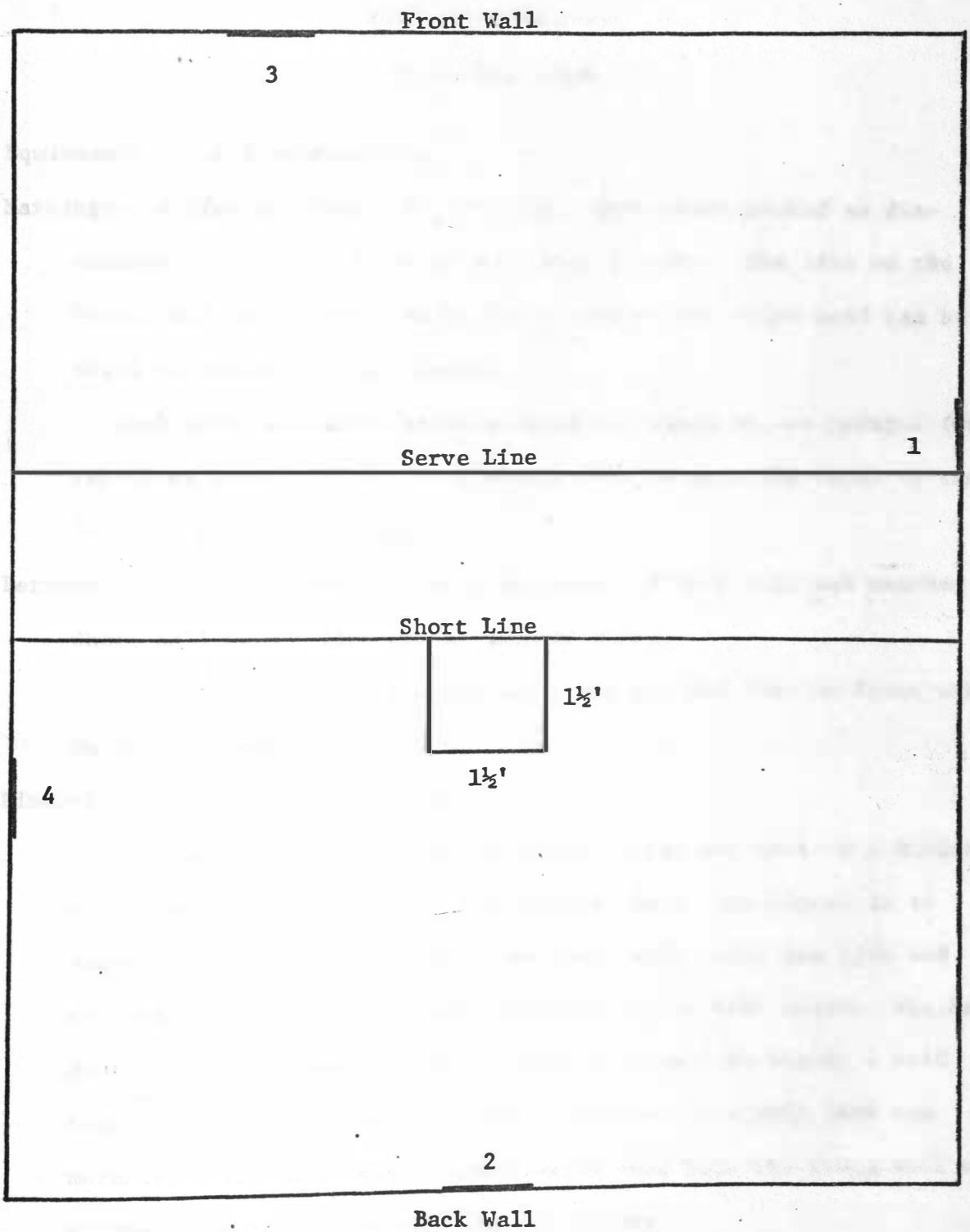
A rectangle 8½" x 11" with the bottom edge 4' from the floor on each wall in the following order and position: 1, right wall with right edge even with serve line; 2, back wall in center of court; 3, front wall with right edge four feet from center; 4, left wall with right edge five feet from short line. Paper, taped and clearly marked, is adequate.

Personnel: Timer

Directions to be read to student:

Stand with both feet in the box facing the front wall. I will say "Ready, Go". On the command, "Go", move as quickly as you can to each number on the walls in order. You must touch the rectangle with the number in it with one or both hands. You must touch one or both feet in the box between each number. When both feet are completely in the box after you have touched number four I will stop the watch. Your score is the time registered between Go and placing both feet in the box. You will have two trials.

SPEED OF MOVEMENT



Appendix A

TEST ADMINISTRATION

Serve Placement

Equipment: 1 or 2 racquetballs

Markings: A line on front wall, 7' high. Back court marked as diagrammed. Lines should be no more than ½" wide. The line on the front wall can be taped on or heavy contrasting color cord can be taped or fastened tautly across.

Back court markings can be painted on, taped on, or painted (or taped) on heavy plastic which should then be securely taped to the floor to prevent shifting.

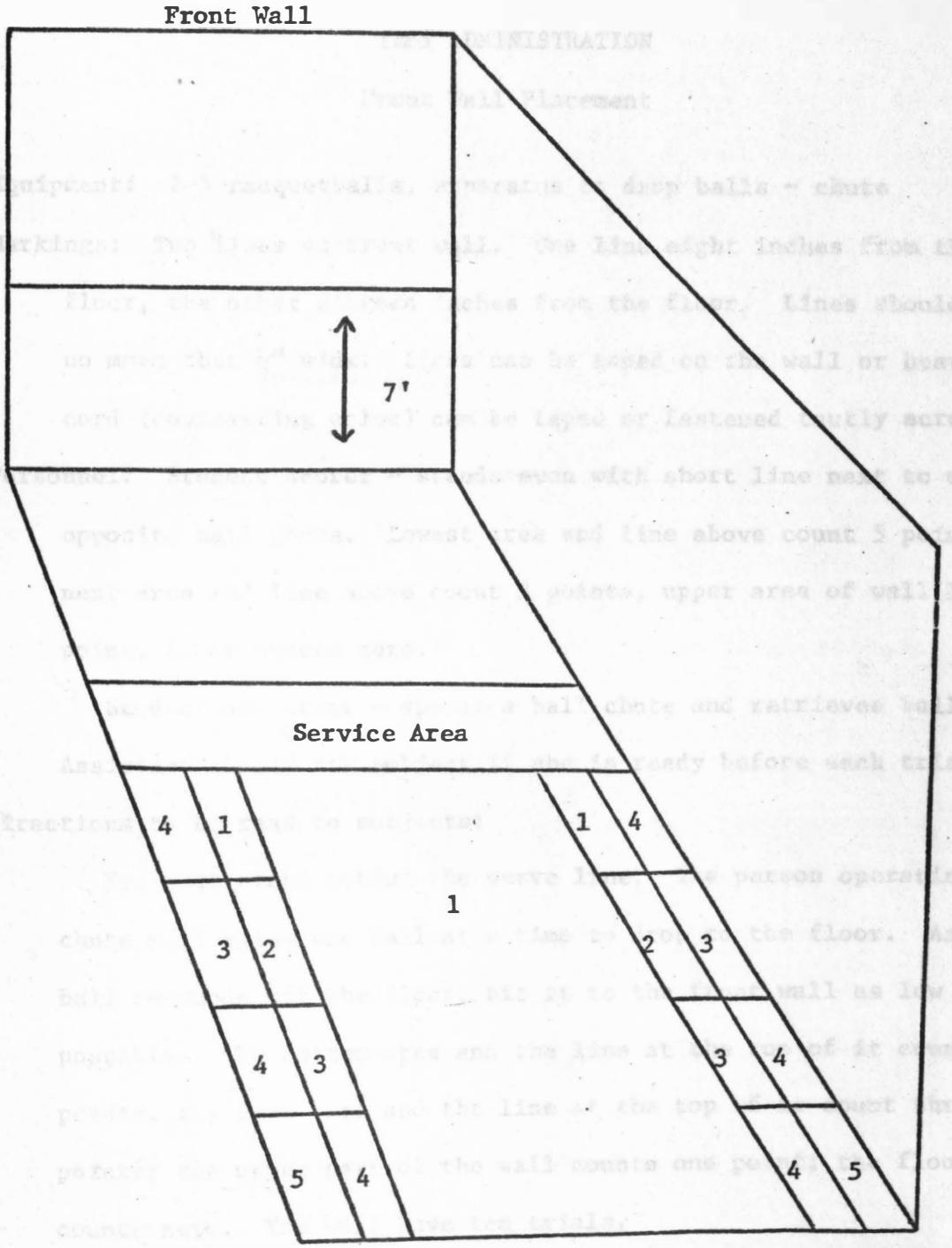
Personnel: Student scorer - stands at center of back wall and watches where ball hits - line counts highest score.

Student assistant - records score and watches line on front wall. On line is good.

Directions to be read to subjects:

You may stand anywhere in the service area and move to a different position within the service area at any time. The object is to serve the ball so that it hits the front wall below the line and rebounds into the highest numbered area in the back court. The ball must hit on or below the line on the front wall to score; a ball that hits above the line is counted as zero. You will have one more trial for each long or short serve that hits the front wall on or below the line. You will have 10 trials.

SERVE PLACEMENT



Appendix A

TEST ADMINISTRATION

Front Wall Placement

Equipment: 2-5 racquetballs, apparatus to drop balls - chute

Markings: Two lines on front wall. One line eight inches from the floor, the other sixteen inches from the floor. Lines should be no more than ½" wide. Lines can be taped on the wall or heavy cord (contrasting color) can be taped or fastened tautly across.

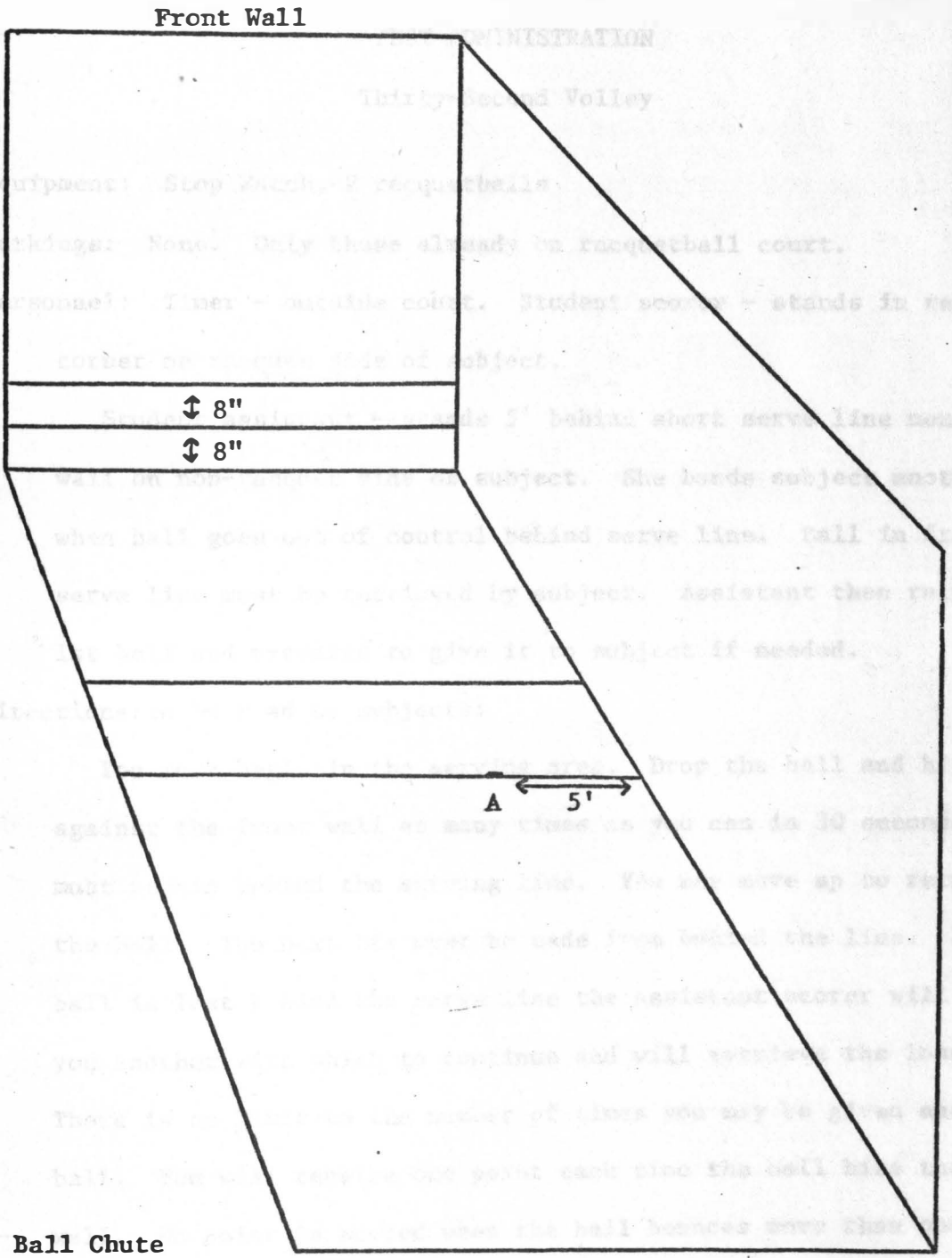
Personnel: Student scorer - stands even with short line next to wall opposite ball chute. Lowest area and line above count 5 points, next area and line above count 3 points, upper area of wall 1 point, floor counts zero.

Student assistant - operates ball chute and retrieves balls. Assistant should ask subject if she is ready before each trial.

Directions to be read to subjects:

You must stand behind the serve line. The person operating the chute will allow one ball at a time to drop to the floor. As the ball rebounds off the floor, hit it to the front wall as low as possible. The bottom area and the line at the top of it count five points, the next area and the line at the top of it count three points; the upper part of the wall counts one point; the floor counts zero. You will have ten trials.

FRONT WALL PLACEMENT



A. Ball Chute

Appendix A

TEST ADMINISTRATION

Thirty-Second Volley

Equipment: Stop Watch, 2 racquetballs

Markings: None. Only those already on racquetball court.

Personnel: Timer - outside court. Student scorer - stands in rear corner on racquet side of subject.

Student assistant - stands 5' behind short serve line next to wall on non-racquet side of subject. She hands subject another ball when ball goes out of control behind serve line. Ball in front of serve line must be retrieved by subject. Assistant then retrieves 1st ball and prepares to give it to subject if needed.

Directions to be read to subjects:

You must begin in the serving area. Drop the ball and hit it against the front wall as many times as you can in 30 seconds. You must remain behind the serving line. You may move up to retrieve the ball. The next hit must be made from behind the line. If the ball is lost behind the serve line the assistant scorer will hand you another with which to continue and will retrieve the lost ball. There is no limit to the number of times you may be given another ball. You will receive one point each time the ball hits the front wall. No point is scored when the ball bounces more than once before being hit. No point is scored when the ball hits the floor

Appendix A

Thirty-Second Volley (continued)

before hitting the front wall. You will be allowed 15 seconds of practice immediately before your first trial. You will have 2 consecutive 30 second trials.

Appendix B

RAW DATA OBTAINED ON THE TEST VARIABLES FOR THE TWENTY-FIVE SUBJECTS USED IN THE STUDY

	Pre-tests Serve Placement	Front wall Placement	Thirty-second Volley	Speed of Movement	Post-tests Serve Placement	Front wall Placement	Thirty-second Volley	Speed of Movement	Tournament Standing	Height	Weight
Group I											
B.A.	7	16	24	104	6	10	26	110	7	66	138
B.B.	6	7	11	112	6	10	17	110	9	66	130
S.G.	7	16	22	108	13	10	25	111	4	66	135
D.K.	4	18	21	132	19	12	12	126	11	68	195
S.M.	7	16	25	116	14	10	27	116	8	62	105
N.N.	8	13	10	131	4	12	25	131	10	65	175
A.P.	10	19	18	99	8	13	27	99	6	64	116
T.R.	6	24	41	103	19	26	34	103	3	65	140
D.S.	12	9	20	106	16	28	29	100	2	63	130
M.V.	23	25	45	108	22	33	54	113	1	64	155
K.W.	4	14	23	99	9	13	24	103	5	64	109
Group II											
J.C.	14	19	24	110	15	10	32	102	2	64	140
N.F.	12	31	36	114	16	28	35	110	6	67	126
K.H.	12	10	25	108	15	14	29	104	7	64	100
D.H.	9	12	9	120	7	14	25	117	11	65	150
R.K.	11	8	15	120	8	11	24	119	12	64	113
C.L.	9	14	26	115	13	11	23	105	3	66	125
R.L.	7	16	20	121	6	17	23	113	1	66	135
P.M.	9	17	26	116	9	12	20	109	4	63	115
M.M.	9	12	31	125	10	15	28	112	5	61	138
N.N.	7	21	18	117	8	9	13	110	14	67	130
L.R.	8	15	10	126	7	13	25	121	10	67	145
J.S.	8	13	18	116	7	9	17	109	9	61	110
S.S.	8	6	20	124	5	14	22	122	13	66	130
J.T.	5	22	26	110	8	17	28	109	8	69	137