EFFECT OF A CIRCUIT TRAINING PROGRAM ON BADMINTON SKILL OF FRESHMAN COLLEGE WOMEN

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We hereby recommend that the thesis prepared under our supervision by JULIA WEDAMAN entitled EFFECT OF A CIRCUIT TRAINING PROGRAM ON BADMINTON SKILL OF FRESHMAN COLLEGE WOMEN

be accepted as fulfilling this part of the requirements for the Degree of Master of Arts.

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CHAPTER I

GENERAL OVERVIEW OF THE STUDY

According to Hooks, the modern philosophy of physical education is good, but it is not meeting the needs of the American people because it is based on the idea that one can play his way into good physical condition.[1] Therefore, the program of physical education should be supplemented with a program of weight training or some comparative conditioning exercises that overload all of the major muscle groups of the body and subject them to vigorous exercises.[2] A combination of the two programs should be inaugurated in schools so that our students will be better able to participate in and enjoy all physical education activities.[3] They should learn early that the proper procedure is to condition to play, because they will not always be able to play to condition.[4]

In some physical education classes young women are urged to develop strength and skill through exercises. Most

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[1]Gene Hooks, Application of Weight Training to Athletics (New Jersey: Prentice-Hall, Inc., 1962), p. 220.

[2]Payton Jordan and Bud Spencer, Champions in the Making (New Jersey: Prentice-Hall, Inc., 1968), pp. 250-272; R. E. Morgan and G. T. Adamson, Circuit Training (London: G. Bell and Sons, 1961), pp. 24-30.

[3]Thomas Kirk Cureton, Physical Fitness and Dynamic Health (Ohio: Dial Press, 1965), p. 68.

[4]Hooks, op. cit.

classwork, however, is pointed toward the skills and strength exercises are neglected. The importance of strength should not be overlooked. In many sports activities strength is a prerequisite to being able to perform a skill, therefore, by increasing her strength in the desired area the individual also enhances her chance to compete well.

In many women's physical education classes, conditioning is believed desirable for most activities. The process of conditioning requires more speed, strength, and endurance than will be required for the activity during actual competition.[1]

A different type of conditioning is needed for each activity. Skipping rope will help condition the boxer to keep up on his toes, but it would have little value for football. Distance running will develop endurance in the legs and increase deep breathing, but the long, swinging, rhythmic pattern of a distance runner has no use in football.[2]

A brief review of the two principles of overlearning and overloading seems in order to establish the justification for the present study which is concerned with the result of a progressive circuit training program on beginning badminton skill of undergraduate women students. The question is

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[1]James Poole, Badminton (California: Goodyear Publishing Company, 1969), p. 90.

[2]Charles A. Pease, Body Building (New York: The Ronald Press Company, 1963), p. 202.

whether special overload practice activities are more or less effective in developing skill than traditional practice methods. In this study one group of college women used the traditional method of playing badminton, which is essentially practice or overlearning without conditioning. The second group concentrated not only on playing badminton but also on a preconditioning program which included the principle of overload.

The two principles of overlearning and overloading are basic to training. Overlearning is induced by repetition and overloading by resistance. Both of these principles are a necessity in improving skill and performance.[1]

Overlearning is applying oneself to the acquisition of a skill or knowledge beyond the point at which one can say it has been learned.[2] It appears that overlearning is generally advantageous to transfer.[3]

Experimental studies show that overlearning results in more complete retention over a longer period of time than practice that ceases at the point of initial learning. The advantage of overlearning depends upon the thoroughness of the

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[1]David K. Brace, Health and Physical Education (New York: A. S. Barnes and Company, 1948), p. 174.

[2]Harold W. Bernard, Psychology of Learning and Teaching (New York: McGraw Hill Book Company, 1965), p. 485.

[3]Ibid.

initial learning.[1] The skills of swimming or skating are not readily forgotten because practice usually continues after acquisition of the skill.

Singer claims that:

> The gain from overlearning decreases as additional practice continues: 100 to 200 per cent overlearning is better than 50 per cent overlearning, but the additional gain is not proportional to the extended effort. It is therefore recommended that overlearning be confined to from half to double the number of repetitions required for original learning.[2]

When using drills, the instructor must be sure that the students can execute the basic skills first. Once the correct movements are instilled in the beginner, practice through drills will help the individual to perform even better. "Great stress has been placed on drills and practicing until one can perform blindfolded."[3] According to Oxendine, once performers learn skills so well that they become automatic, conscious effort can be devoted to incorporating the skills into a game situation.[4] For example, the badminton player who has learned the skill of smashing so well that she does not have to think about how the skill is executed, may then

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[1]Robert N. Singer, Motor Learning and Human Performance: An Application to Physical Education Skills (New York: Macmillan Company, 1968), p. 200.

[2]Ibid.

[3]Joseph B. Oxendine, Psychology of Motor Learning (New York: Appleton-Century-Crofts, 1968), p. 117.

[4]Ibid.

concentrate on hitting the shuttlecock into a desirable spot on the court.

Overloading is defined as any exercise that exceeds in intensity or duration the demands regularly made on the organism.[1] Regardless of how much a muscle is used it will not become stronger unless it is overloaded and made to overcome progressively increased resistance. This principle of increasing weight with increasing strength is called progressive resistance exercise by Dr. Thomas L. DeLorme and Dr. Arthur L. Watkins, who are recognized authorities on weight training.[2]

The important variable in applying this principle is not the total amount of work done, but the amount done in a unit or time--the intensity. Light exercises, such as arm swinging, contribute very little toward strength development regardless of their duration or frequency, since they are not, or quickly cease to be, an overload.

The training program must include activities which place the muscles in sufficient overload for the development of optimum strength necessary for successful performance of the skills involved. According to Dayton, the overload

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[1]Robert P. Sorani, Circuit Training (Dubuque, Iowa: William C. Brown Company, 1966), p. 2.

[2]Benjamin Ricci, Physical and Physiological Conditioning for Men (Dubuque, Iowa: William C. Brown Company, 1966), p. 20.

should extend the physiological limits to the extent necessary to produce training effect in the body systems upon which the stress from competition is placed.[1]

The teacher of physical education, as well as the teacher of all academic disciplines in the field of education, should use the best teaching methods that are available. Including a conditioning program in the area of physical education is considered a desirable teaching method.[2] The following examples of the use of conditioning show how this concept has been used successfully throughout the country.

Ten or fifteen years ago many of the best golfers would have been shocked if anyone suggested that any player could improve his game by conditioning exercises, isometrics, and weight lifting. The idea then was that a sound golf swing depended almost solely upon grace and coordination. Arnold Palmer, Gary Player, Jack Nicklaus, and particularly Doug Sanders have relatively compact and abrupt swings compared to those of the old-timers. The modern swing is a controlled swing, and to control it one needs strength and a sense of touch. Palmer, Nicklaus, Sanders, Player, and most highly

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[1]O. William Dayton, Athletic Training and Conditioning (New York: Ronald Press Company, 1965), p. 41.

[2]James Poole, Badminton (California: Goodyear Publishing Company, 1969), p. 90; Bud Wilkinson, Modern Physical Fitness (New York: Barnes and Noble, 1969), p. 4.

skilled golfers have well-developed backs and extraordinarily developed forearms, wrists, and hands.[1]

Among expert players, tennis is as much a game of stamina as it is of skill.[2] To be in condition to play tennis, one needs to have a combination of strength and stamina. A strong wrist and hand are needed to grip the tennis racket properly. The arms and shoulders must be strong enough to give power to the game, and the legs have to be tough and tireless.

John T. Bower, the snow skiing coach of Middleburg College in Vermont, believes that the most frequent cause of skiing accidents is "the poor physical condition" of the skier. If the skier is not in shape two undesirable things may occur. First, he may not have any fun--or at least he will not have as much fun as he had hoped to have--because his body just will not do the things he wants it to do. Secondly, if he is not in shape the skier greatly increases his chance of getting hurt.[3]

According to Counsilman, Indiana University swimming coach, a dry land exercise program, when properly designed and followed, can build strength and flexibility faster than

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[1]Wilkinson, op. cit., p. 55.

[2]Ibid., p. 66.

[3]Kenneth Anderson, The Field and Stream Guide to Physical Fitness (New York: Holt, Rinehart and Winston, Inc., 1969), p. 110.

these traits can be built by training with swimming alone.[1] "The use of heavy resistive exercises is now accepted practice for competitive swimmers."[2]

The method of conditioning that aims to increase muscular strength and endurance and circulo-respiratory endurance is called circuit training. Circuit training has enjoyed an increasing popularity in recent years. It is usually credited as beginning at the University of Leeds, London, where it developed out of a search for a method of fitness training that would appeal to students, and at the same time, contribute toward muscular and circulo-respiratory development. This new method of presenting exercises was first developed and put into practice in 1953 by R. E. Morgan and G. T. Adamson, both staff members at the University of Leeds. Circuit training has since been a continuous part of their physical education program.[3]

There are three main characteristics of circuit training, the last of which distinguishes it from other exercise programs:

1. It aims at the development of muscular and circulo-respiratory fitness.
2. It applies the principle of progressive overload.
3. It enables large numbers of performers to train at the same time by employing a circuit of consecutively numbered exercises around which each performer

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[1]James E. Counsilman, The Science of Swimming (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1968), p. 277.

[2]Ibid.

[3]Sorani, op. cit., p. 1.

> progresses, doing a prescribed allocation of work at each exercise, and checking his progress against the clock.[1]

Probably the greatest value of this method of training lies in its extreme adaptability to a great variety of situations. One can safely say that a circuit program could be designed to fit almost any individual, or group of individuals, under almost any circumstances.[2]

In a circuit training program each performer works his way around the circuit a prescribed number of times (usually three), performing repetitions of exercises which are well below his maximum. Since his repetition of any single exercise does not exhaust him, he can proceed quickly to each succeeding station in a continuous effort to equal or reduce his previous time for the three laps. The cumulative stamina effect of such training becomes quite obvious. On the second and third laps, due to the effects of fatigue, the repetitions will more nearly approximate the maximum overload performance of which the performer is capable.[3]

Some of the distinctive and desirable qualities to be found in circuit training are stated by Sorani as follows:

1. The most distinctive feature of circuit training is its complete adaptability to a number of varying situations.

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[1]Morgan and Adamson, op. cit., pp. 31-32.

[2]Ibid.

[3]Sorani, op. cit., p. 4.

2. Progression is assured. The individual is always working at his present and progressive capacity and at his own work rate.
3. Circuit training provides a series of progressive goals that can be achieved step by step thus supplying added incentive.
4. The time factor provides built-in motivation encouraging one to push himself and do better.
5. As a method of training (under optimum conditions), circuit training utilizes three variables--load, repetitions, and time--which other methods of training do not provide.
6. While circuit training seems best suited for all-around development, it is flexible enough to allow bias towards more specific aspects of fitness, and can be used to produce varying kinds and degrees of fitness.
7. Circuit training gives the satisfaction of participating in a vigorous bout of activity in a relatively short period of time.
8. The circuit layout, moving from station to station, can offer variety and is appealing to some people.
9. When used in class situations, the student knows in advance just what he will be required to do. Consequently, he can work on his own or within the group without being directed by the instructor.
10. Circuit training also has real potential in the field of medical rehabilitation.[1]

Circuit training has been used by some physical education teachers as a pre-conditioning program for different sports. The aim of circuit training should be on training or conditioning the body to be fit for an efficient performance.[2] Circuit training should not be allowed to dominate the program and occupy too large a percentage of the total time devoted to the activity. In most instances, the amount of time spent on the circuit would be very small in comparison with that which would be given to skill development. By maintaining proper

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[1] Ibid., pp. 4-6.

[2] Ibid., p. 42.

ratio between these two phases of the program, there should be excellent progress.

The following are examples of some exercises that might be included for various sports.

A basketball circuit could include the following exercises: "weighted ball passing, repeated wall-passing from behind various restraining lines (speed), repeat jumping, grabbing and pulling down a suspended ball, jumping tips against the backboard, or maze dribble."[1]

A circuit for a pole vaulter could include sprints while carrying a pole, distance hand walking, speed inverted pull-ups or rope climbing, and numerous high-bar pull-overs without touching the bar.[2] A shot putter could design a circuit which would include exercises that closely resemble his movements throughout his performance. Some of the exercises could include supporting a bar bell or dumb-bell while sprinting backwards with one leg, pressing a dumb-bell horizontally, and initiating puts using a wall pully or a dumb-bell.[3]

Similar circuits, such as the foregoing, are just a few of the many that could be used. Circuits can be given for badminton, track and field, volleyball, modern dance and wrestling. A circuit training program can be designed for

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[1] Ibid., p. 43.

[2] Ibid.

[3] Ibid.

any sport, following a careful consideration of the analysis of the sport.[1]

There is a need for physical education teachers to improve their methods of teaching badminton. Badminton has become a sport loved by both sexes at all age levels. It has also been advocated and endorsed as one of the five sports by the National Lifetime Sports Foundation.[2] As previously indicated, circuit training can be used successfully as a method of conditioning for any sport, including badminton, a sport which demands the greatest skill, speed and stamina of even the best trained athlete. According to Davidson and Gustavson, "a badminton player uses more arm action in one game of singles than does a baseball pitcher in a nine-inning game, where the average number of pitches is 100."[3] A running back or end when playing a full sixty minutes of a football game does not run as far as a top-flight badminton player competing in one game of singles.[4]

Circuit training is a method of fitness training that aims to increase muscular strength and endurance and circulo-respiratory endurance.[5] Strength can be developed for the arm

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[1]Ibid.

[2]Joanna Virginia Hicks, "The Construction and Evaluation of a Battery of Five Badminton Skill Tests" (unpublished Doctor's Dissertation, College of Health, Physical Education, and Recreation, Texas Woman's University, Denton, Texas, 1967).

[3]Kenneth R. Davidson and Lealand R. Gustavson, Winning Badminton (New York: A. S. Barnes and Company, 1953), p. 4.

[4]Ibid.

[5]Sorani, op. cit., p. 2.

action and endurance for the running required in the sport of badminton through the method of conditioning called circuit training.[1]

Statement of the Problem

The investigator studied the relationships between a beginning badminton class with a progressive circuit training program and a beginning badminton class without a progressive circuit training program. Forty-six undergraduate students enrolled in required physical education classes at the Texas Woman's University, Denton, Texas, during the fall semester of 1969-1970 took part in the study.

Definitions and/or Explanations of Terms

The following definitions and/or explanations of terms were established for use in the present study:

1. Circuit Training: Circuit Training is defined as "a method of fitness training which appeals to students and contributes toward muscular and circulo-respiratory development."[2] It utilizes the three variables of load, repetitions, and time which other methods of training do not provide. In this study, circuit training was used as a training program to determine if it would enhance badminton playing ability through development of endurance and strength in certain muscle groups.

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[1] Ibid., p. 42.

[2] Morgan and Adamson, op. cit., p. 6.

2. Circuit: A circuit is defined as "the area about which a number of carefully selected exercises, arranged and numbered consecutively, are set up."[1] In this study, six different badminton-oriented exercises comprised the circuit.

3. Fixed Circuit: A fixed circuit is defined as "a circuit that has been planned in advance by a qualified person, or persons, with the exercises, doses, progression steps, and target times established and posted."[2] The fixed circuit used in this study consisted of the following exercises: wrist roll, agility run, overhead press, wall volley, overhead hit, and pushups. Alternate exercises are as follows: sit-ups, shuttle run, jump rope, upright rowing, and bent rowing.

4. Overlearning: Overlearning is defined as "applying oneself to the acquisition of a skill or knowledge beyond the point at which one can say it has been learned."[3] In this study overlearning was used with both groups of subjects.

5. Overloading: Overloading is defined as "any exercise that exceeds in intensity or duration the demands regularly made on the organism."[4] In this study overloading was used strictly with the progressive circuit training group.

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[1]Sorani, op. cit., p. 2.

[2]Ibid., p. 64.

[3]Bernard, op. cit., p. 485.

[4]Sorani, op. cit., p. 2.

6. Skill: Skill is defined as "the ability of the individual to perform in a specified sport."[1]

Limitations of the Study

The present study was subject to the following limitations:

1. A total of forty-six undergraduate students enrolled in required physical education classes at the Texas Woman's University, Denton, Texas.

2. Badminton skill as measured by two valid and reliable badminton skill tests.

3. The skill testing as administered by one qualified physical education teacher.

4. The class instruction as given by one qualified physical education teacher.

Purposes of the Study

The general purpose of the study was to determine if a significant difference exists between a badminton class with a progressive circuit training program and a badminton class with no circuit training program. Specifically, the following hypotheses will be tested:

1. There is no significant difference between pre-test scores and post-test scores of the control group upon the Clear Test.

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[1]Donald K. Mathews, Measurement in Physical Education (Philadelphia and London: W. B. Saunders Company), p. 155.

2. There is no significant difference between pre-test scores and post-test scores of the experimental group upon the Clear Test.

3. There is no significant difference between pre-test scores and post-test scores of the control group upon the Smash Test.

4. There is no significant difference between pre-test scores and post-test scores of the experimental group upon the Smash Test.

5. There is no significant difference between the difference scores from the pre-test scores and the post-test scores for the experimental group and the control group upon the Clear Test.

6. There is no significant difference between the difference scores from the pre-test scores and the post-test scores for the experimental group and the control group upon the Smash Test.

Hartlett's test of homogeneity was used at the beginning of the study to determine if the two groups were equated in badminton skill with respect to standard deviation or homogeneity. The six hypotheses of the investigation were tested through the application of a test of significance--four analyses of variance for equal groups and two analyses of variance for unequal groups.

Survey of Related Literature

A review of previous studies disclosed that the present study does not duplicate any preceding investigation. The following review of completed research is confined to related studies which may be of assistance in the understanding and development of the present study.

A. Nunney[1] conducted an investigation which was designed to determine the relationship between circuit training and the improvement of endurance, speed, weight, and strength of swimmers during a six-week training period. The subjects comprised two groups of twelve college men from an intermediate swimming class at the University of California, Los Angeles, who were equated on the basis of distance swum in a fifteen-minute endurance test using the front crawl only. The two volunteer groups were tested on their speed when swimming thirty-three and one-third yards. The individuals height, weight, and ability to perform dips, chins, vertical jumps, and push-ups were also taken into consideration.

The experimental group combined circuit training and swimming in the program, but the control group had swimming only. The experimental group used a circuit that consisted of six activities; four in which weights were used, and two which did not use weights.

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[1]Deret N. Nunney, "Relation of Circuit Training to Swimming," Research Quarterly, Vol. XXXI (May, 1960), pp. 188-99.

The difference between the means of the first and second tests, their significance, and standard deviations, were compiled for both experimental and control groups for all factors. The experimental group was then compared with the control group using the critical ratios. Tables were prepared so that comparisons could be made between both groups.

Nunney concluded that the experimental group made significant gains in swimming endurance and speed, weight, chins, and push-ups, but did not improve significantly in dips or vertical jumps. The control group made significant gains in swimming endurance and weight, but did not improve significantly in swimming speed, chins, dips, vertical jump, push-ups, or height. The control group had a marked tendency to lose strength while the experimental group made greater gains than the control group in weights and chins. There were no significant differences between the groups in swimming endurance, dips, vertical jump, or push-ups. Nunney found that the evidence appeared to justify the generalization that it was possible to combine a circuit training program with a swimming program without detrimental effect on swimming improvement. The gains in swimming endurance and speed made by the experimental group suggest that this combination was beneficial. The findings of this study showed that weight training was not detrimental to athletic performance in any way.

Subjects using weight training, as part of circuit training, increased their ability in swimming endurance and speed, chins, and push-ups.

B. Carr,[1] in 1962, completed an experimental study in which she analyzed the effect of a five-minute period of isometric contractions and the effect of a fifteen-minute period of progressive body conditioning exercises on selected aspects of physical fitness and badminton achievement of eighty-one college women enrolled in three beginning badminton classes at the University of Washington in Seattle, Washington, during the winter quarter of the academic year of 1962-1963.

Experimental Group A consisted of twenty-one subjects who received a fifteen-minute period of progressive body conditioning exercises. Experimental Group B consisted of thirty subjects who received a five-minute period of isometric contractions at the beginning of each class meeting in conjunction with the regular instructional unit of badminton. A control group consisted of thirty subjects receiving a traditional instructional unit of beginning badminton. The classes were held for thirty-nine minutes, meeting twice a week for five weeks.

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[1]Norma Jane Carr, "The Effect of Isometric Contraction and Progressive Body Conditioning Exercises on Selected Aspects of Physical Fitness and Badminton Achievement of College Women" (unpublished Master's thesis, Department of Health, Physical Education, and Recreation, University of Washington, Seattle, Washington, 1962).

The instruments used for evaluating physical fitness and the selected badminton skills were administered both before and after the instructional period. The indicators of physical fitness included: (1) curl-up as a measure of abdominal strength; (2) pull-ups as a measure of arm and shoulder girdle strength; (3) squat-thrusts as a measure of endurance; (4) toe-touch as a measure of flexibility; and (5) the Illinois Agility Run[1] as a measure of agility. The indication of selected badminton skill included the Miller Wall Volley Test[2] and the Scott and French Badminton Serve Test.[3] The investigator also administered the Fox Badminton Knowledge Test.

The effect of the instructional unit was ascertained by testing the differences between the pre-test and post-test results of each group. The use of a t-test provided information as to the significance of the difference between groups in their physical fitness, badminton skill, and badminton knowledge before instruction and after instruction.

Carr concluded that the series of isometric and body conditioning exercises participated in by the subjects during

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[1]Thomas Kirk Cureton, Frederick Kasch, John Brown and W. G. Moss, Physical Fitness Appraisal and Guidance (St. Louis: The C. V. Mosby Company, 1947), Chapter 13.

[2]Frances A. Miller, "Badminton Wall Volley Test," Research Quarterly, Vol XXII (May, 1951), pp. 208-213.

[3]Gladys M. Scott and Ester French, Measurement and Evaluation in Physical Education (Dubuque, Iowa: William C. Brown Company, 1959), pp. 144-147.

the study for five and fifteen minutes respectively did not cause a significantly greater improvement in physical fitness among the students than did the groups having only badminton instruction. All three groups improved significantly on the Miller Wall Volley Test and the control group improved significantly on the short serve test.

C. Rogers,[1] in 1962, completed an experimental study to determine the relationships between selected physical fitness skills and selected basketball skills for ninety-nine freshman college women enrolled in four physical education classes at Tarleton State College, Stephenville, Texas. The subjects were tested before and after participating in seven weeks of fifty-minute classes which met three times weekly. During the preliminary testing of the students' physical fitness and basketball skills the investigator divided the subjects into groups. Four individual classes were established empirically, and the investigator presented different instructional programs to each group: basketball and isometric exercises to Group I, basketball to Group II, conditioning exercises and basketball to Group III, and conditioning exercises to Group IV.

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[1]Bettejoe Rogers, "A Study of the Relationships Between Selected Physical Fitness Skills and Selected Basketball Skills of Freshman Women Students Enrolled in Physical Education Classes at Tarleton State College, Stephenville, Texas, during the Spring Semester of the Academic Year 1961-1962" (unpublished Master's thesis, College of Health, Physical Education, and Recreation, Texas Woman's University, Denton, Texas, 1962).

Rogers statistically processed the data obtained from the initial and final administrations of the physical fitness skills tests and of the basketball skill tests. Methods of managing the data included the determination of the significance of the gains within each group and a comparison of the gains between the groups.

The findings of the study showed that none of the four training programs, as developed for the specific investigation, was superior to any other in the development of both physical fitness skills and basketball skills as measured by the selected tests. Significant differences were found between Group IV, who took part in conditioning exercises, and the other three groups on the pull-ups and squat thrust test, indicating that the activities participated in by Group IV were superior in developing arm and shoulder-girdle strength and in the development of leg strength and agility as measured by the selected tests. However, members of Group IV were significantly inferior to the other three groups on the items measuring basketball skills.

D. Harris,[1] in 1963, completed an experimental study in which she evaluated the effects of three-minute periods of agility activities on basic badminton skill improvement of thirty-four

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[1]Dorian Elizabeth Harris, "The Effect of Selected Agility Activities on Badminton Playing Ability of Women at the University of Oregon" (unpublished Master's thesis, Department of Health, Physical Education, and Recreation, University of Oregon, Eugene, Oregon, 1963).

college women enrolled in two beginning badminton classes during the fall semester of the academic year of 1962-1963 at the University of Oregon in Eugene, Oregon. The study was conducted for nine weeks with classes meeting three times each week for a total of thirty-five minutes.

The badminton-agility group, which was arbitrarily chosen, included seventeen women who participated in a series of agility activities each class meeting for three-minutes after receiving badminton instruction. The badminton group received thirty-five minutes of beginning badminton instruction including basic skills, rules, elementary strategy, and etiquette at each class meeting for nine weeks.

Several instruments were used in the collection of data. Badminton skill was evaluated by the Lockhart-McPherson Badminton Volley Test[1] and agility was measured by the Scott Obstacle Race.[2] On the second day of class the initial tests of agility and badminton were administered. Following seven weeks of instruction the tests were readministered.

Analysis of the data entailed comparing the groups at the beginning and at the end of the experimental period. To determine whether the differences between the means of the

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[1]Ailene Lockhart and Frances A. McPherson, "Lockhart-McPherson Badminton Volley Test," Research Quarterly, Vol. II (December, 1949), p. 402.

[2]Scott and French, op. cit., pp. 144-148.

initial test were significant, a t-test for uncorrelated groups was utilized. A t-test for correlated groups was utilized at the end of instruction to determine whether differences within the groups on the Lockhart-McPherson Badminton Volley Tests scores and the Scott Obstacle Race scores were significant. In order to compare the Badminton-Agility Group with the Badminton Group the data were analyzed by means of the analysis of covariance technique to take into account any initial differences between the means of the two samples.

Results of the investigation led the investigator to conclude that: (1) in the beginning the two groups were not significantly different either in badminton playing ability or in agility; (2) the scores in the test-retest of the Lockhart-McPherson Badminton Volley Test and the Scott Obstacle Race indicated that both groups improved significantly at the five per cent level of confidence; (3) after instruction the differences between the adjusted means on the tests were not significant at the five per cent level of confidence; (4) in comparing the two groups' improvement in agility as measured by the Scott Obstacle Race the differences were not significant at the five per cent level of confidence.

E. Carter[1] conducted an investigation which was designed to determine the relationship of participation in selected physical fitness activities and skill in archery and badminton in two classes of freshman college women during the fall semester of the academic year of 1965-1966 at Amarillo College in Amarillo, Texas. The investigator taught four classes of individual sports during the fall semester and two of these classes were arbitrarily chosen to be the subjects for the study. Forty-nine students of the fifty-one in these classes were used as the subjects. The students were divided into an experimental group consisting of twenty-six, and a control group consisting of twenty-five.

The control group received seven weeks of archery followed by seven weeks of badminton instruction for a forty-five minute period three times a week. The experimental group received seven weeks of archery followed by seven weeks of badminton instruction for thirty-five minutes plus ten minutes of specifically related progressive conditioning exercises three times a week.

The statistical procedures applied by the investigator were identical for the initial and final administrations of the

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[1]Ginger Kelley Carter, "A Study of the Relationship Between Specific Conditioning Exercises and Selected Skills in Badminton and Archery of Freshman Women Students Enrolled in Physical Education Classes at Amarillo College in Amarillo, Texas" (unpublished Master's thesis, College of Health, Physical Education, and Recreation, Texas Woman's University, Denton, Texas, 1966).

physical fitness tests and for the archery and badminton skill tests. Methods of treating the data included the determination of the significance of the difference between the means in each test between each group in order to compare the skill level and physical fitness gains among the groups. Initial and final tests comparisons were also made within the groups to help ascertain the feasibility of the basic hypotheses. Tables were constructed to aid in the presentation of the data.

Carter concluded that specific conditioning exercises designed to develop the fitness components necessary for archery and badminton skills did not significantly improve skill factors in these two sports.

Summary

In this chapter the investigator presented a brief review of the two principles of overlearning and overloading. The use of different conditioning programs for specific sports was also discussed. Circuit training, a method of conditioning, was discussed in detail and its many advantages were emphasized. A discussion concerning the need of strength and endurance in the sport of badminton was also included in this chapter.

Elements of the research design of this investigation were discussed under the headings: Statement of the Problem, Definitions and/or Explanations of Terms, Limitations of

the Study, Purposes of the Study, and Survey of Related Literature.

Chapter II will present an explanation of the procedures followed by the investigator in developing the present study.

CHAPTER II

PROCEDURES FOR THE DEVELOPMENT OF THE STUDY

The present study was developed to determine if a significant difference exists between a badminton class with a progressive circuit training program and a badminton class with no circuit training program after participation in fourteen weeks of prescribed physical education activities at Texas Woman's University, Denton, Texas, during the fall semester of the academic year of 1969-1970.

In this chapter the procedures followed in the development of the study are presented. The investigation reveals the methods of collecting data, criteria for the selection of skill tests, selection of circuit training items, selection of subjects, preparation for the administration of tests, development and presentation of the teaching units, and methods of treating data.

Methods of Collecting Data

The data upon which the present study was based were obtained through a thorough study of available documentary materials and through the administration of selected skill tests and circuit training exercises.

Criteria for Selection of Tests

The criteria used by the investigator for the selection of the tests employed in the present study were: validity, reliability, objectivity, administrative economy, and game-like situation. The definitions of these criteria are:

1. Validity--A test is said to be valid when it measures what it is supposed to measure.[1]
2. Reliability--Reliability is the extent to which a given test yields a constant and therefore dependable score for that which it measures. It pertains to the internal consistency of the test itself.[2]
3. Objectivity--Objectivity is the degree of uniformity with which different qualified individuals may score the same test.[3]
4. Administrative economy--The administrative economy of a test pertains to the factors of the required time for administration, the ease of administration, the cost of

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[1]M. Gladys Scott and Esther French, Evaluation in Physical Education (St. Louis: The C. V. Mosby Company, 1950), p. 35.

[2]Carl E. Willgoose, Evaluation in Health Education and Physical Education (New York: McGraw-Hill Book Company, Inc., 1961), p. 24.

[3]Ibid., p. 25.

administration, and the expense and availability of equipment.[1]

5. Game-like situation--A test should be as nearly like the game situation as possible.[2]

Selection of Skill Tests

Upon the basis of the foregoing criteria for a good test, the investigator selected two skill tests to measure the badminton skills of freshman college women who participated as subjects in the study. The two badminton skill tests employed by the investigator were Hicks' Clear and Smash tests.[3]

The reliability of the clear and smash tests was determined by the Pearson Product-Moment method of correlation, using the odd-even scores for twenty trials on each of these tests. The Spearman-Brown Prophecy formula also was used because the odd-even correlation represents only one-half of the entire test and a correlation for the full-length test was desired."[4]

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[1]John F. Bovard, Fredrick W. Cozens, and E. Patricia Hagman, Tests and Measurements in Physical Education (Philadelphia and London: W. B. Saunders Company, 1949), p. 327.

[2]M. Gladys Scott and Esther French, Better Teaching Through Testing (New York: A. S. Barnes and Company, 1945), p. 13.

[3]Joanna Virginia Hicks, "The Construction and Evaluation of a Battery of Five Badminton Skill Tests" (unpublished Doctor's Dissertation, College of Health, Physical Education, and Recreation, Texas Woman's University, Denton, Texas, 1967).

[4]Ibid.

Hicks[1] used both the clear and smash tests on beginning badminton players who were enrolled in a required physical education program at the Texas Woman's University, Denton, Texas. The clear and the smash tests were the most recent badminton tests available to the investigator. These tests also met the desirable criteria of resembling an actual game situation.

The validity for the clear (.605) and the smash (.545) as determined by the tournament scores plus the total judges' evaluation was considered to be moderate and fair respectively.[2] According to Koenker,[3] a highly dependable relationship is from .90 to 1.00. He felt that the reliability coefficient determined for the clear (.89) and smash tests (.83) is considered highly dependable. The explanation of both the clear and smash tests may be found in the Appendix.

Selection of Circuit Training Items

The fixed circuit to be used in the study consisted of the following exercises: wrist roll, agility run, overhead press, wall volley, overhead hit, and push-ups. Alternate exercises are as follows: curling sit-ups, shuttle run, jump rope, upright rowing, and bent rowing. All eleven of the

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[1] Ibid., pp. 63-64.

[2] Ibid., p. 127.

[2] Robert H. Koenker, Simplified Statistics (Bloomington, Indiana: McKnight and McKnight Publishing Company, 1961).

exercises were developed with emphasis on training or conditioning the body to be fit for an efficient performance in badminton. The primary development, equipment, and directions of each exercise may be found in the Appendix.

Selection of Subjects

Forty-six freshman college women, enrolled in the required physical education program for the general university student at the Texas Woman's University, Denton, Texas, served as the subjects in this study. They were enrolled in two beginning badminton classes, the experimental group containing twenty-six and the control group with twenty. These classes met regularly three times each week for fourteen weeks with each class period being forty minutes in length.

Preparation for Administration of the Tests

Preparation for the administration of the tests involved the following steps: (1) construction of score sheets, (2) organization of equipment, (3) orientation of students, and (4) selection and training of student assistants.

Score sheets were prepared by the investigator for recording the scores of both the initial and final test scores derived from the administration of the clear and smash badminton skill tests. The score sheets may be found in the Appendix.

All tests were administered in the gymnasium which was divided into two stations or testing areas for the administration of the tests. The subjects who were not taking the clear-smash tests, or helping with them, practiced in one half of the gymnasium.

Prior to the actual administration of the tests, three class periods in both of the physical education classes were devoted to the orientation of the subjects with respect to the purposes of the study, the content of the respective syllabi upon which subsequent instructional periods were to be based, the testing procedures to be followed, the required costume for class participation, and the basic badminton fundamentals.

Administration of Tests

The pre-tests were administered during the second and third weeks of the semester. The students were not deemed ready for skill testing until some knowledge of strokes had been gained. For this reason, therefore, the testing program did not begin until the second week of the semester.

Four assistants, all Texas Woman's University students highly interested in badminton and physical education, were selected to help in the testing procedure. The assistants were given background information on the nature and the purpose of the study and detailed instructions on the procedures for the administration of the tests. Their primary

function was to help watch the subject's starting position, the net, the target areas, the boundary lines, and to record the subject's score. The class instructor and the investigator administered the clear test the second week of the semester, and the smash test was administered the following week.

The skill tests were administered in two classes. Both classes were tested separately at their respective class time. The testing procedure followed by the investigator was the same as that used by Hicks[1] in her testing. Her explanation of the method for conducting the tests is as follows:

> The usual procedure was to assign one player to be a recorder and three players to retrieve shuttlecocks. One player had the responsibility for confirming the test administrator's judgment if the shuttlecock hit, went over, or went under the rope. Another player was assigned to observe the target area and confirm the score to be awarded each trial. The seventh player was "on deck" as the next person to take the test. When a subject completed her twenty trials of the test she took another subject's place. The relieved player became the "on deck" person.

This pattern was followed for the administration of both the clear and smash tests.

The same procedures were followed by the forty-six freshman college women after their participation in fourteen weeks of selected physical education activities. During the post-testing, both classes again took the clear and smash tests.

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[1] Ibid., p. 74.

Development and Presentation of Teaching Units

A syllabus was developed by the investigator for each of the two groups of freshman college women. This syllabus was comprised of forty-two teaching units. Each unit was planned for forty minute periods of actual instruction, during which time the classes met three times a week for fourteen weeks. Group I had a ten minute progressive circuit training program plus a thirty minute badminton activity class, while Group II had a forty minute badminton activity class minus the progressive circuit training program.

The content of the teaching units was developed from a variety of human and documentary sources of data. Because circuit training has not been greatly researched, particularly for women, the investigator thoroughly examined what has been done on this type of conditioning. Information from R. E. Morgan and G. T. Adamson,[1] Robert Sorani,[2] Bud Wilkinson,[3] Benjamin Ricci,[4] and Payton Jordan and Bud Spencer[5] proved helpful in the selection of specific progressive circuit training exercises which, along with instruction and practice with respect to badminton skills, were incorporated into the

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[1]Morgan and Adamson, op. cit., pp. 43-64.

[2]Sorani, op. cit., pp. 45-62.

[3]Wilkinson, op. cit., pp. 53-98.

[4]Ricci, op. cit., pp. 9-33.

[5]Jordan and Spencer, op. cit., pp. 245-272.

syllabus for Group I. The badminton coach at the Texas Woman's University, Virginia Hicks,[1] served as the major consultant with regard to much of the material used in teaching units pertaining to badminton. Some of the exercises used in the circuit were based upon information obtained from a workshop on Physical Fitness conducted at the Texas Woman's University during the summer session of 1968, under the instruction of Joan Sullivan,[2] and upon the personal knowledge and experience of the investigator.

Group I, which participated in the progressive circuit training program and badminton, met at eight o'clock in the morning on Tuesdays, Thursdays, and Saturdays. During the first ten minutes of the class period each student progressed through the different stations of circuit training exercises. The instructor was stationed in the center of the gymnasium to supervise the class, and the students worked in a clockwise direction while completing the circuit. Exercises used for the circuit training program were geared toward developing the specific muscle groups pertinent to badminton. Some of the exercises were designed to develop strength in the neck, chest, upper back, shoulders, upper arm, forearm, wrist,

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[1]Interview with Virginia Hicks, Badminton Coach, Texas Woman's University, Denton, Texas, July, 1969.

[2]Physical Fitness Workshop with Joan Sullivan, Physical Education Instructor, Portland Community College, Portland, Oregon, June 24 - July 12, 1968.

abdomen, and the hips. The other exercises in the circuit were intended to develop coordination, agility, timing, and better stroke technique. During the remainder of the class period students received instruction in badminton and practiced different badminton skills. An outline of the syllabus developed for Group I may be found in the Appendix. The description and analysis of each exercise used in the progressive circuit training program as well as the placement of the exercise stations around the gymnasium, may also be found in the Appendix.

Group II, which participated in badminton, met at nine o'clock in the morning on Tuesdays, Thursdays, and Saturdays. Instruction in badminton was given to Group II for the entire forty minutes of each class period. An outline of the syllabus developed for Group II may be found in the Appendix.

Methods of Treating Data

Identical statistical procedures were applied to the data obtained from the initial and final administrations of the badminton skill tests. Methods of treating the data included: the equation of the groups prior to conducting the study, the determination of the significance of gains within each group, and the comparison of the gains between the two groups.

Bartlett's test of homogeneity was used at the beginning of the study to determine if the two groups were equated

in badminton skill with respect to standard deviation or homogeneity. Group I, with a variance of 197.2253 and 25 degrees of freedom, when compared with Group II, with a variance of 165.1447 and 19 degrees of freedom on the clear test, yielded a Chi Square of 0.1202, which was not significant. Group I, with a variance of 243.1651 and 25 degrees of freedom, when compared with Group II, with a variance of 216.7868 and 19 degrees of freedom on the smash test, yielded a Chi Square of 0.0996, which was not significant.

The investigator's next step was to review the purposes of the study as set forth in the hypotheses. To test the difference between groups, a one-way analysis of variance was utilized. The .05 level of confidence was accepted by the investigator as requisite to the rejection of the null hypotheses. The Table of F was referred to for interpretations of ratios computed through the formula. The six hypotheses of the investigation were tested through the application of a test of significance--four analyses of variance for equal groups and two analyses of variance for unequal groups.

Summary

In Chapter II the investigator presented methods of collecting data, criteria for the selection of skill tests, selection of circuit training items, selection of subjects,

preparation for the administration of tests, administration of tests, development and presentation of the teaching units, and methods of treating data.

The findings and interpretation of the study are presented in Chapter III.

CHAPTER III

PRESENTATION OF THE FINDINGS

In the following chapter the investigator will submit an analysis of the data, interpret the findings, and test the hypotheses stated in Chapter I. A summary of the chapter will be presented. The formulas used in all computations are general and can be found in any book of statistics.[1]

Forty-six subjects enrolled in two required physical education classes of the Texas Woman's University were chosen to participate in the study. Group I was the experimental group which engaged in a progressive circuit training program preceding the badminton activity class. Group II was the control group which had no circuit training preceding their badminton class.

Comparisons of the Pre-Test and Post-Test Scores of the Control Group on the Clear Test

Table I represents the mean, number, variance, and the standard deviation for both the pre-test and post-test scores on the clear test of the control group. The mean for

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[1]James L. Bruning and B. L. Kintz, Computational Handbook of Statistics (Glenview, Illinois: Scott, Foresman and Company, 1968), pp. 109-114; James B. Williams, Statistical Analysis (New York: Olivetti Underwood Corporation, 1968), pp. 206-211.

the pre-test was 9.75 points, the number was 20, the variance was 165.14 points, and the standard deviation was 12.85 points. The mean for the post-test was 33.80 points, the number was 20, the variance was 534.06 points, and the standard deviation was 23.11 points.

TABLE 1

MEAN, NUMBER, VARIANCE, AND STANDARD DEVIATION ON PRE-TEST AND POST-TEST CLEAR SCORES OF THE CONTROL GROUP

Test	Mean	Number	Variance	Standard Deviation
Pre-test	9.7500	20	165.1447	12.8508
Post-test	33.8000	20	534.0631	23.1098

Pre-test scores and post-test scores of the clear test were compared through the application of a one-way analysis of variance for equal groups. Based on the data collected, at the assigned significance level of .05, an F ratio of 16.5445 indicates there was a significant difference between scores on the pre-test and the post-test for the control group with respect to scores on the clear test. Table 2 presents a summary of the one-way analysis of variance with respect to pre-test and post-test scores on the clear test for the control group.

TABLE 2

SUMMARY TABLE FOR ANALYSIS OF VARIANCE ON PRE-TEST AND POST-TEST CLEAR SCORES OF THE CONTROL GROUP

Source	SS	df	ms	F
Between Groups	5784.0250	1	5784.0250	16.5445**
Within Groups	13284.9500	38	349.6039	
Total	19068.9750	39		

$F_{(1, 38)}$ (.05) = 4.10

$F_{(1,38)}$ (.01) = 7.35**

Comparisons of the Pre-Test and Post-Test Scores of the Experimental Group on the Clear Test

Table 3 represents the mean, number, variance, and the standard deviation for both the pre-test and post-test scores on the clear test of the experimental group. The clear test yielded the following data for the experimental group: the mean of the pre-test scores was 10.93 points, the number was 26, the variance was 197.23 points, and the standard deviation was 14.04 points; the post-test scores had a mean of 17.26 points, the number was 26, the variance was 245.97 points, and the standard deviation was 15.68 points. Even though the mean of the subject's scores on the post-test was greater than the mean of the pre-test scores (17.2592 to 10.9259 points), the increase was not a significant one.

TABLE 3

MEAN, NUMBER, VARIANCE, AND STANDARD DEVIATION ON PRE-TEST AND POST-TEST CLEAR SCORES OF THE EXPERIMENTAL GROUP

Test	Mean	Number	Variance	Standard Deviation
Pre-test	10.9259	26	197.2253	14.0436
Post-test	17.2592	26	245.9697	15.6834

A one-way analysis of variance for equal groups was used to compare the scores of the experimental group on the pre-test and post-test of the clear test. Based on the data collected, at the assigned significance level of .05, an F ratio of 2.4436 indicates there was no significant difference between the scores of the subjects upon the pre-test and the scores of the subjects upon the post-test, although a learning period of fourteen weeks in duration had expired between testing periods. Table 4 presents a summary of the one-way analysis of variance with respect to the scores of the experimental group on the clear test.

Comparisons of the Pre-Test and Post-Test Scores of the Control Group on the Smash Test

Table 5 represents the mean, number, variance, and the standard deviation for both the pre-test and post-test scores on the smash test of the control group. The smash

TABLE 4

SUMMARY TABLE FOR ANALYSIS OF VARIANCE ON PRE-TEST AND POST-TEST CLEAR SCORES OF THE EXPERIMENTAL GROUP

Source	SS	df	ms	F
Between Groups	541.5000	1	541.5000	2.4436
Within Groups	11523.0371	50	221.5968	
Total	12064.5371	51		

$F_{(1, 50)}$ (.05) = 4.03

test yielded the following data from the control group: the mean of the pre-test was 11.45 points, the number was 20, the variance was 216.79 points, and the standard deviation was 14.72 points; the mean of the post-test was 46.35 points, the number was 20, the variance was 272.66 points, and the standard deviation was 16.51 points.

TABLE 5

MEAN, NUMBER, VARIANCE, AND STANDARD DEVIATION ON PRE-TEST AND POST-TEST SMASH SCORES OF THE CONTROL GROUP

Test	Mean	Number	Variance	Standard Deviation
Pre-test	11.4500	20	216.7868	14.7236
Post-test	46.3500	20	272.6605	16.5124

Pre-test scores and post-test scores on the smash test were compared among the control group by means of a one-way analysis of variance. Based on the data collected, at the assigned significance level of .05, an F ratio of 49.7708 indicates there was a significant difference between scores on the pre-test and scores on the post-test. Table 6 presents a summary of the one-way analysis of variance with respect to the pre-test and post-test scores of the control group on the smash test.

TABLE 6

SUMMARY TABLE FOR ANALYSIS OF VARIANCE ON PRE-TEST AND POST-TEST SMASH SCORES OF THE CONTROL GROUP

Source	SS	df	ms	F
Between Groups	12180.1000	1	12180.1000	49.7708**
Within Groups	9299.5000	38	244.7236	
Total	21479.6000	39		

$F_{(1, 38)}$ (.05) = 4.10

$F_{(1, 38)}$ (.01) = 7.35**

Comparisons of the Pre-Test and Post-Test Scores of the Experimental Group on the Smash Test

Table 7 represents the mean, number, variance, and the standard deviation for both the pre-test and post-test scores on the smash test of the experimental group. The

smash test yielded the following data with respect to the experimental group: the mean for the pre-test was 17.27 points, the number was 26, the variance was 243.17 points, and the standard deviation was 15.59 points; the mean for the post-test was 50.23 points, the number was 26, the variance was 371.47 points, and the standard deviation was 19.27 points.

TABLE 7

MEAN, NUMBER, VARIANCE, AND STANDARD DEVIATION ON PRE-TEST AND POST-TEST SMASH SCORES OF THE EXPERIMENTAL GROUP

Test	Mean	Number	Variance	Standard Deviation
Pre-test	17.2692	26	243.1651	15.5937
Post-test	50.2307	26	371.4682	19.2735

Scores of the pre-test and scores of the post-test on the smash test with respect to the experimental group were compared through the application of a one-way analysis of variance for equal groups. Based on the data collected, at the assigned significance level of .05, an F ratio of 45.9594 indicates there was a significant difference between the pre-test scores and the post-test scores. Table 8 presents a summary of the one-way analysis of variance on the scores of the experimental group on the smash test.

TABLE 8

SUMMARY TABLE FOR ANALYSIS OF VARIANCE ON PRE-TEST AND POST-TEST SMASH SCORES OF THE EXPERIMENTAL GROUP

Source	SS	df	ms	F
Between Groups	14124.0192	1	14124.0192	45.9594**
Within Groups	15365.7308	50	307.3146	
Total	29489.7500	51		

$F_{(1, 50)}$ (.05) = 4.03

$F_{(1, 50)}$ (.01) = 7.17**

Comparisons of the Differences Between Pre-Test and Post-Test Scores for the Experimental Group and the Control Group on the Clear Test

Table 9 represents the mean, number, variance, and the standard deviation for both the control group and the experimental group scores on the clear test. The mean difference for the control group was 24.05 points, the number was 20, the variance was 301.94 points, and the standard deviation was 17.38 points; the mean difference for the experimental group was 6.33 points, the number was 26, the variance was 91.08 points, and the standard deviation was 9.54 points.

The difference between the pre-test scores and the post-test scores on the clear test for the control group and

TABLE 9

MEAN, NUMBER, VARIANCE, AND STANDARD DEVIATION OF THE DIFFERENCES BETWEEN PRE-TEST SCORES AND POST-TEST SCORES FOR THE CONTROL GROUP AND THE EXPERIMENTAL GROUP ON THE CLEAR TEST

Group	Mean	Number	Variance	Standard Deviation
Control	24.0500	20	301.9447	17.3765
Experimental	6.3333	26	91.0771	9.5434

the experimental group were compared by means of a one-way analysis of variance for unequal groups. When these differences were subjected to a one-way analysis of variance, the control group, with a mean score of 24.05 points, scored significantly higher than the experimental group, with a mean score of 6.33 points. Therefore, there was a significant difference between the differences in pre-test scores and post-test scores between the control group and the experimental group, as evidenced by the F ratio of 20.02. Table 10 is a presentation of the summary for the one-way analysis of variance with respect to difference scores of the control group and the experimental group on the clear test.

Comparisons of the Differences Between Pre-Test and Post-Test Scores for the Experimental Group and the Control Group on the Smash Test

Table 11 represents the mean, number, variance, and the standard deviation for both the control group and the

TABLE 10

SUMMARY TABLE FOR ANALYSIS OF VARIANCE OF THE DIFFERENCES BETWEEN PRE-TEST SCORES AND POST-TEST SCORES FOR THE CONTROL GROUP AND THE EXPERIMENTAL GROUP ON THE CLEAR TEST

Source	SS	df	ms	F
Between Groups	3606.2841	1	3606.2841	20.0226**
Within Groups	8104.9500	44	184.2034	
Total	11711.2341	45		

$F_{(1, 44)}$ (.05) = 4.06

$F_{(1, 44)}$ (.01) = 7.24**

experimental group scores on the smash test. The mean difference for the control group was 34.90 points, the number was 20, the variance was 408.31 points, and the standard deviation was 20.21 points; the mean difference for the experimental group was 32.88 points, the number was 26, the variance was 363.71 points, and the standard deviation was 19.07 points.

Based on the data collected, at the assigned significance level of .05, an F ratio of 0.1198 indicates there was no significant difference between the scores of the control group and the scores of the experimental group on the Smash Test. Although the mean of the control group was slightly higher than the mean of the experimental group (34.90 points

TABLE 11

MEAN, NUMBER, VARIANCE, AND STANDARD DEVIATION OF THE DIFFERENCES BETWEEN PRE-TEST AND POST-TEST SCORES FOR THE CONTROL GROUP AND THE EXPERIMENTAL GROUP ON THE SMASH TEST

Group	Mean	Number	Variance	Standard Deviation
Control	34.9000	20	408.3052	20.2065
Experimental	32.8846	26	363.7066	19.0710

to 32.88 points), this difference was not a significant one. Table 12 presents a summary of the one-way analysis of variance between groups with respect to the Smash Test.

TABLE 12

SUMMARY TABLE FOR ANALYSIS OF VARIANCE OF THE DIFFERENCES BETWEEN PRE-TEST SCORES AND POST-TEST SCORES FOR THE CONTROL GROUP AND THE EXPERIMENTAL GROUP ON THE SMASH TEST

Source	SS	df	ms	F
Between Groups	45.9157	1	45.9157	0.1198
Within Groups	16850.4539	44	328.9648	
Total	16896.3696	45		

$F_{(1,\ 44)}(.05) = 4.06$

Tests of Hypotheses

Upon the basis of the results of the analysis of data through the application of the appropriate statistical test--one-way analysis of variance--the hypotheses stated in the first chapter were tested. The results of the applied tests are presented below.

Hypothesis I

> There is no significant difference between pre-test scores and post-test scores of the control group upon the Clear Test.

Based upon the data collected from the pre-test scores and the post-test scores of the control group upon the Clear Test, the investigator rejected the null hypothesis.

Hypothesis II

> There is no significant difference between pre-test scores and post-test scores of the experimental group upon the Clear Test.

Based upon the data collected for this study, the investigator failed to reject the null hypothesis.

Hypothesis III

> There is no significant difference between pre-test scores and post-test scores of the control group upon the Smash Test.

The data collected from the pre-test scores and the post-test scores caused the investigator to reject the null hypothesis.

Hypothesis IV

> There is no significant difference between pre-test scores and post-test scores of the experimental group upon the Smash Test.

The investigator rejected the null hypothesis after subjecting the data to a one-way analysis of variance.

Hypothesis V

> There is no significant difference between the difference scores from the pre-test scores and the post-test scores for the experimental group and the control group upon the Clear Test.

The data collected for this study provided sufficient information for the investigator to reject the hypothesis.

Hypothesis VI

> There is no significant difference between the difference scores from the pre-test scores and the post-test scores for the experimental group and the control group upon the Smash Test.

Based upon the data collected for this study, the investigator failed to reject the null hypothesis.

Summary

In this chapter the investigator submitted an analysis of the data and tested the hypotheses. Based upon the findings, the investigator rejected Hypotheses I, III, IV, and V: there was a significant difference between pre-test scores and post-test scores of the control group upon the Clear Test; there was a significant difference between pre-test scores and post-test scores of the control group upon the Smash Test; there was

a significant difference between pre-test scores and post-test scores of the experimental group on Smash Test; and there was a significant difference between the difference scores from the pre-test scores and the post-test scores for the experimental group and the control group upon the Clear Test. The investigator failed to reject Hypotheses II and VI: there was no significant difference between pre-test scores and post-test scores of the experimental group upon the Clear Test; and there was no significant difference between the difference scores from the pre-test scores and the post-test scores for the experimental group and the control group upon the Smash Test.

Chapter IV will present the summary, conclusion, a discussion of the findings, and recommendations for further studies.

CHAPTER IV

SUMMARY, CONCLUSION, DISCUSSION OF THE FINDINGS, AND RECOMMENDATICNS FOR FURTHER STUDIES

This chapter will include a summary of the present investigation, conclusion based on the findings, discussion of the findings, and recommendations for further studies.

Summary of the Investigation

It has been said by some authorities that the program of physical education should be supplemented with a program of weight training or some comparative conditioning exercises that overload all of the major muscle groups of the body and subject them to vigorous exercises. The use of weight lifting, isometrics, gymnastics, and calisthenics can enhance the strength, endurance, and flexibility requirements needed to perform a specific activity. How the individual utilizes these forms of conditioning is largely a matter of individual adjustment following the fundamental principle of analyzing the speed movements and muscular requirements demanded for a particular activity. In short, a badminton player would gain little benefit from certain forms of weight exercises practiced by swimmers or basketball players, and would be wasting time and energy that would prove more valuable if projected toward specific badminton skills.

A distinctive and desirable method of presenting exercises is found in a progressive circuit training program which allows the individual to always work at his present and progressive capacity and at his own work rate. As a method of training (under optimum conditions), circuit training utilizes three variables--load, repetitions, and time--which other methods of training do not provide.[1]

It is an accepted fact that weight exercises do build muscular strength, but the percentage that added muscular strength contributes to performance is not known at this time.[2]

The purpose of this investigation was to determine if a significant difference existed between a beginning badminton class which participated in a progressive circuit training program and a beginning badminton class which did not have a progressive circuit training program.

The research design involved a total of forty-six undergraduate students in two separate classes of badminton. Group I, the experimental class, had a progressive circuit training program preceding the badminton activity class. Group II, the control class, had no progressive circuit training program preceding the badminton activity class. The Clear and Smash Tests were administered to both groups during

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[1]Sorani, op. cit., p. 5.

[2]Jordan and Spencer, op. cit., p. 245.

the second week of the fall semester. The two tests were administered a second time during the last week of the semester. Statistical procedures were applied to the data obtained from the initial and final administrations of the badminton skill tests to determine the significances of gains within each group and the comparison of gains between the groups.

Findings of the Study

The six hypotheses which guided the development of this investigation were as follows:

(1) There is no significant difference between pre-test scores and post-test scores of the control group upon the Clear Test. At the assigned significance level of .05, this hypothesis was rejected.

(2) There is no significant difference between pre-test scores and post-test scores of the experimental group upon the Clear Test. This hypothesis was accepted at the assigned significance level of .05.

(3) There is no significant difference between pre-test scores and post-test scores of the control group upon the Smash Test. At the assigned significance level of .05, this hypothesis was rejected.

(4) There is no significant difference between pre-test scores and post-test scores of the experimental group upon the Smash Test. This hypothesis was rejected at the assigned significance level of .05.

(5) There is no significant difference between the difference scores from the pre-test scores and the post-test scores for the experimental group and the control group upon the Clear Test. At the assigned significance level of .05, this hypothesis was rejected.

(6) There is no significant difference between the difference scores from the pre-test scores and the post-test scores for the experimental group and the control group upon the Smash Test. This hypothesis was accepted at the assigned significance level of .05.

Conclusion of the Study

The statistical analysis of the data indicated that a progressive circuit training program, as conducted in this study, preceding a badminton class did not yield a significant positive influence upon the playing ability of those students enrolled in the class as compared with the playing ability of those students enrolled in a badminton class which was not preceded by a progressive circuit training program.

Discussion of the Findings

The investigator feels that the results of the study appear to have been influenced by the fact that the average student, enrolled in the required physical education class used in this study, may have been motivated more by the desire to play, make a good grade, and improve their skill than by an interest in conditioning. Due to this lack of motivation, the investigator feels that the potential of the circuit training program was not realized. The investigator also believes that the motivation of the students might have been enhanced by the use of more testing stations, as this would have perhaps stimulated and sustained the interest of the students. In addition, it is believed by the investigator that a complete change of exercises at each testing station every two or three weeks might have stimulated and motivated the students.

The investigator also believes that the progressive circuit training program could have been altered to include more overloading of the strength exercises. A greater amount of strength might have resulted if the subjects had attempted to progress to the next level on these exercises with just a few repetitions.

Recommendations for Further Studies

The following studies have been recommended for further investigation:

A. To determine the result of a progressive circuit training program on an individual sport at different skill levels.

B. To determine the result of a progressive circuit training program on a team sport at different skill levels.

C. To determine the result of a progressive circuit training program on any sport and skill level conducted for more than one semester.

D. To determine the result of a progressive circuit training program which would include the use of a greater number of testing stations, as well as a variety of exercises at each station, than the number used in this investigation.

E. To determine the result of a progressive circuit training program which would include more overloading of the strength exercises than was used in this investigation.

APPENDIX A

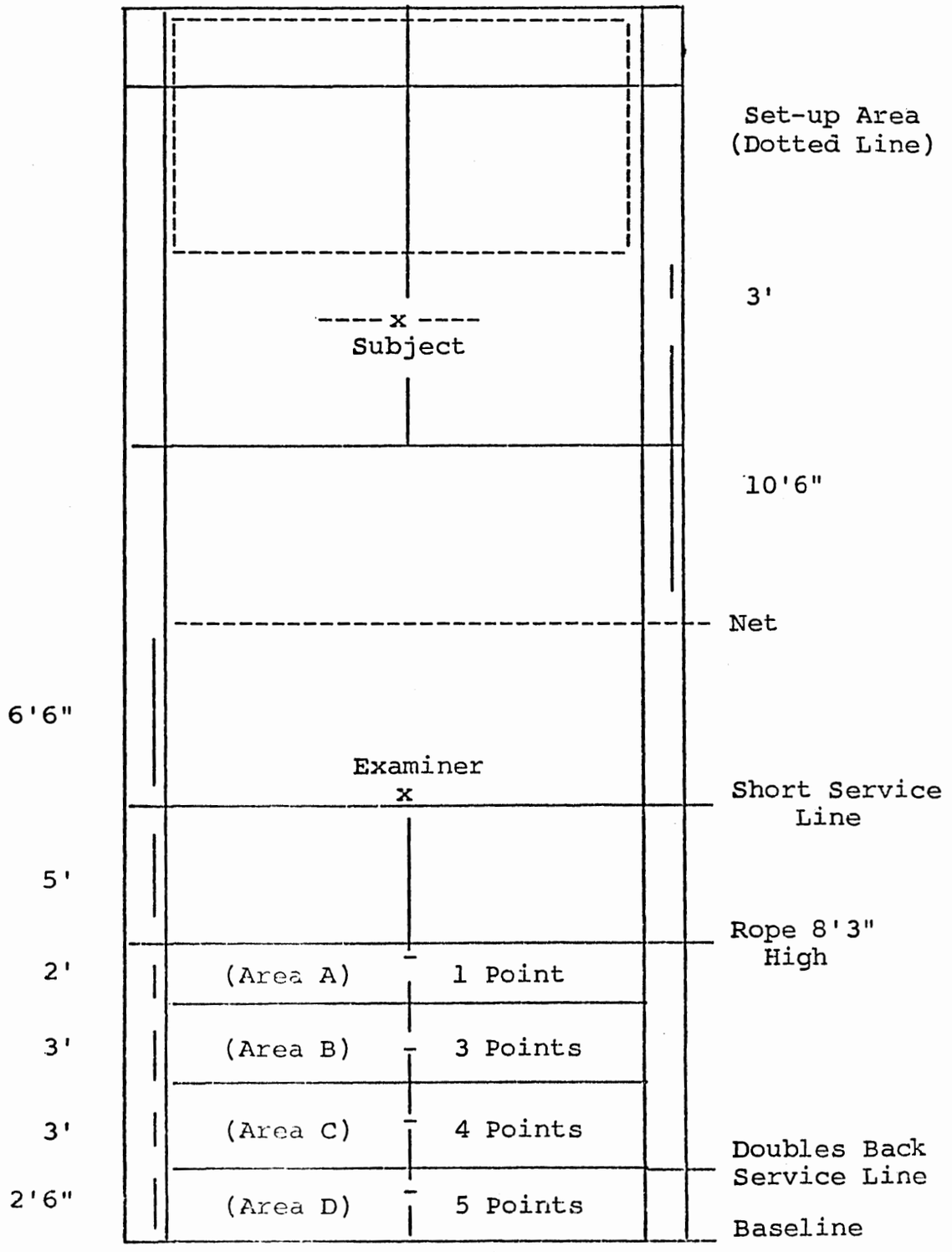
DESCRIPTION OF BADMINTON SKILL TESTS

Clear Test

1. Purpose
   To test a player's ability to move to the shuttlecock quickly and successfully execute a clear shot.
2. Equipment
   a. Ten new feathered, corktipped, indoor badminton shuttlecocks.
   b. A clothesline rope stretched across the court 11'6" from the net and parallel to it, at a height of 8'3" from the floor on the examiner's side of the net.
3. Floor Markings
   a. A mark on the center service line on the subject's side of the net, 10'6" from the net.
   b. A line drawn 13'6" from the net between the singles side boundary lines on the subject's side of the net.
   c. A line drawn 13'6" from the net and parallel to it on the examiner's side of the net.
   d. A line drawn 16'6" from the net and parallel to it on the examiner's side of the net.
4. Testing Procedure
   The player being tested stands in the court opposite the examiner on the center service line 10'6" from the net. The examiner stands on the intersection of the short service line and the center service line, on the same side of the net as the target areas. The set-up hit by the examiner must be high and go into an area beginning 13'6" from the net and extending to the baseline, between the singles side boundary lines. The examiner should hit to the left, the right or the middle of the court in a random order. The player attempts to send the shuttlecock by means of a clear stroke above the rope so that it lands in the target area. The examiner should call out the score to an assistant to record after each trial. This same assistant can determine if the shuttlecock goes over, under or hits the rope. Twenty trials are administered.
5. Scoring Rules
   a. A shuttlecock which hits the rope does not count, and another trial is allowed.
   b. A shuttlecock which lands on a line dividing two scoring areas receives the score of the higher area.
   c. A score of zero is given for any trial failing to go over the rope.
   d. A score of zero is given for attempting to hit the shuttlecock and missing it.

FIGURE I

DIMENSIONS AND POINT VALUES OF TARGET AREAS FOR THE CLEAR TEST



e. A score of zero is given if the shuttlecock does not land in the court in the space behind the rope and on the target.
f. A shuttlecock which lands in Area A, between the rope and 13'6" from the net, counts 1 point.
g. A shuttlecock which lands in area B, 13'6" to 16'6" from the net, counts 3 points.
h. A shuttlecock which lands in area C, 16'6" to 19'6" from the net, counts 4 points.
i. A shuttlecock which lands in area D, in the back alley, counts 5 points.
j. A score of zero is given for any shuttlecock landing in the side alleys.
k. If the examiner determines that a set-up is not adequate, it does not count as a trial.
l. A score of zero is given if no attempt is made by the player to hit a valid set-up.
m. A score of 100 is possible on this test.[1] (see Fig. 1)

Smash Test

1. Purpose
   To test a player's ability to move to the shuttlecock quickly and successfully execute a smash shot.
2. Equipment
   a. Ten new feathered, corktipped, indoor badminton shuttlecocks.
   b. A clothesline rope stretched 36" directly above and parallel to the top of the net.
3. Floor Markings
   a. A line drawn 10' from the net and parallel to it on the examiner's side of the net.
   b. A line drawn 13' from the net and parallel to it on the examiner's side of the net.
   c. A line drawn 16'6" from the net and parallel to it on the examiner's side of the net.
   d. A line 2' in from the left singles side boundary line and parallel to it and extended from the short service line to the doubles back service line on the subject's side of the net.
   e. A line 2' in from the right singles side boundary line and parallel to it and extended from the short service line to the doubles back service line on the subject's side of the net.

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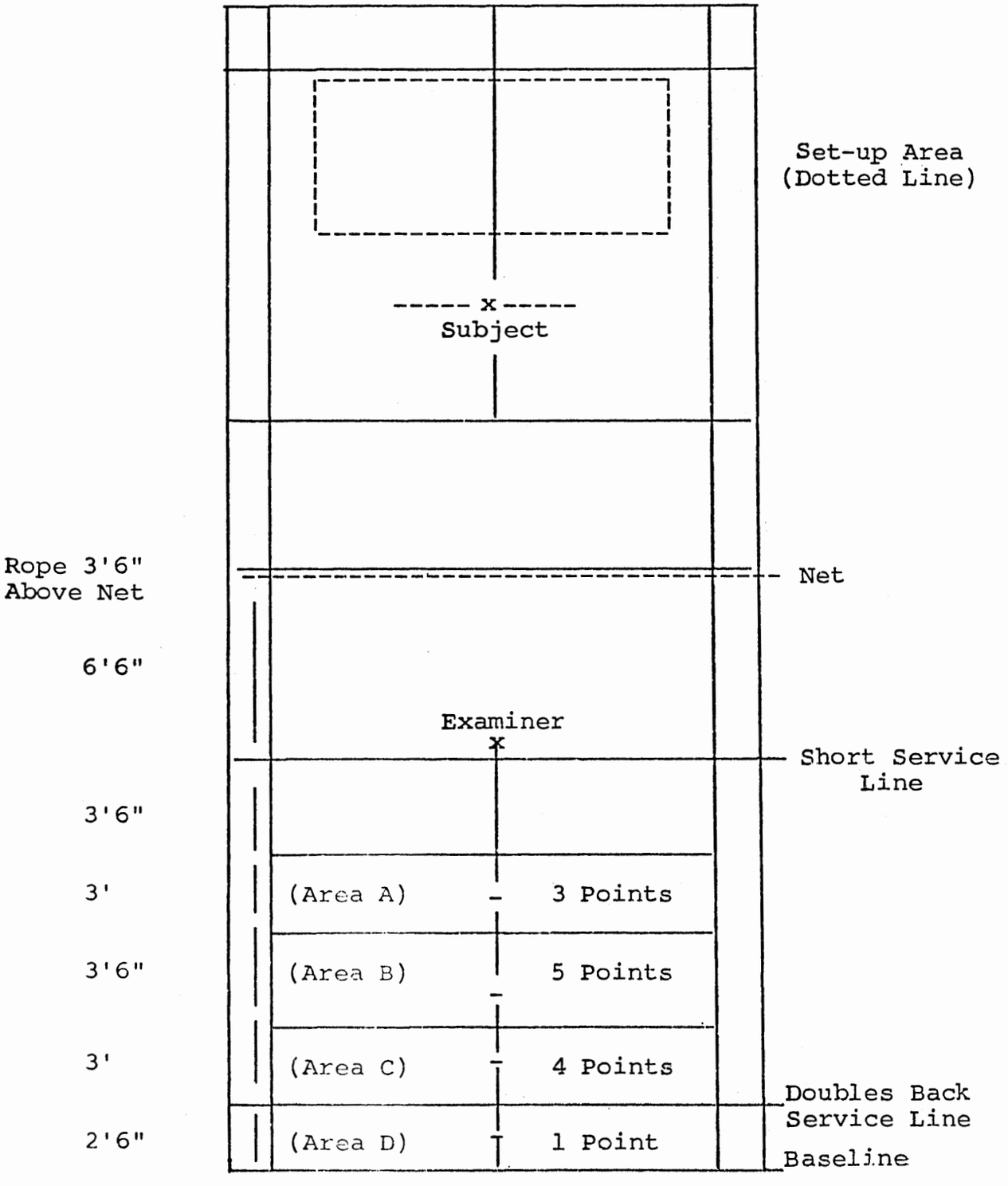
[1] Ibid., pp. 81-85.

FIGURE II

DIMENSIONS AND POINT VALUES OF TARGET AREAS FOR THE SMASH TEST



f. A mark on the center service line on the subject's side of the net, 10'6" from the net.

4. Testing Procedure
The player being tested stands on the center service line 10'6" from the net. The examiner stands on the intersection of the short service line and the center service line, on the same side of the net as the target areas. The set-up must be high and go into an area beginning 13'6" from the net and extending to the baseline, between the singles side boundary lines. The examiner should hit to the left, the right or middle of the court in a random order. The player should attempt to send the shuttlecock by means of a smash shot between the net and the rope stretched above the net so that it lands in the target area. The examiner should call out the score to an assistant to record after each trial. This same assistant can determine if the shuttlecock goes over the rope. Another assistant can determine if the shuttlecock goes between the net and the rope stretched 36" above it. Twenty trials are administered.

5. Scoring Rules
   a. A shuttlecock which hits the rope does not count and another trial is allowed.
   b. A shuttlecock which lands on a line dividing two scoring areas receives the score of the higher area.
   c. A score of zero is given for any trial failing to go between the net and the rope stretched 36" above the net.
   d. A score of zero is given for attempting to hit the shuttlecock and missing it.
   e. A score of zero is given for any shuttlecock landing in the side alleys.
   f. A shuttlecock which lands in area A, 10' to 13' from the net, counts 3 points.
   g. A shuttlecock which lands in area B, 13' to 16'6" from the net, counts 5 points.
   h. A shuttlecock which lands in area C, 16'6" to 19'6" from the net, counts 4 points.
   i. A shuttlecock which lands in area D, the back alley, counts 1 point.
   j. A score of zero is given if the shuttlecock is contacted below head level since a drive would result rather than a smash stroke.
   k. If the examiner determines that a set-up is not adequate, it does not count as a trial.
   l. A score of zero is given if no attempt is made by the player to hit a valid set-up.
   m. A score of 100 points is possible on this test.[1] (See Figure II)

---

[1] Ibid., pp. 89-93.

APPENDIX B

DESCRIPTION OF THE PROGRESSIVE

CIRCUIT TRAINING PROGRAM

Wrist Roll

I. Purpose
To develop the forearm muscles that flex and extend the wrist.

II. Equipment
- A. Twelve, eighteen inch broom handles.
- B. Twelve, twenty-four inch pieces of window cord.
- C. Four, two and a half pound weights.
- D. Four, five pound weights.
- E. Four, ten pound weights.

III. Directions
- A. Starting position and movement
  The student stands erect, arms outstretched forward, parallel to the floor, palms down. The student rolls the bar forward until the weight has been pulled up to the hands; and then lets it unwind rapidly to the floor. Then the bar is rolled backward until the weight is up; and finally lets it unwind rapidly.[1]
- B. Instruction Poster at Exercise Station
  1. Blue circuit level (low) requires two and a half pounds.
  2. Red circuit level (medium) requires five pounds.
  3. Gold circuit level (high) requires ten pounds.
- C. Rules
  1. Students must use the required weight for their level.
  2. The whistle must be blown before the exercise begins.
  3. The arms must be outstretched during the entire exercise time.
  4. There must be a continuous forward and backward rolling of the bar.
  5. The exercise lasts for thirty seconds.

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[1]Elaine Smith, "Circuit Training in Basketball," Basketball Guide, August 1968-August, 1969, Division for Girls and Women's Sports (Washington, D. C.: American Association for Health, Physical Education, and Recreation, 1968), p. 40.

Agility Run

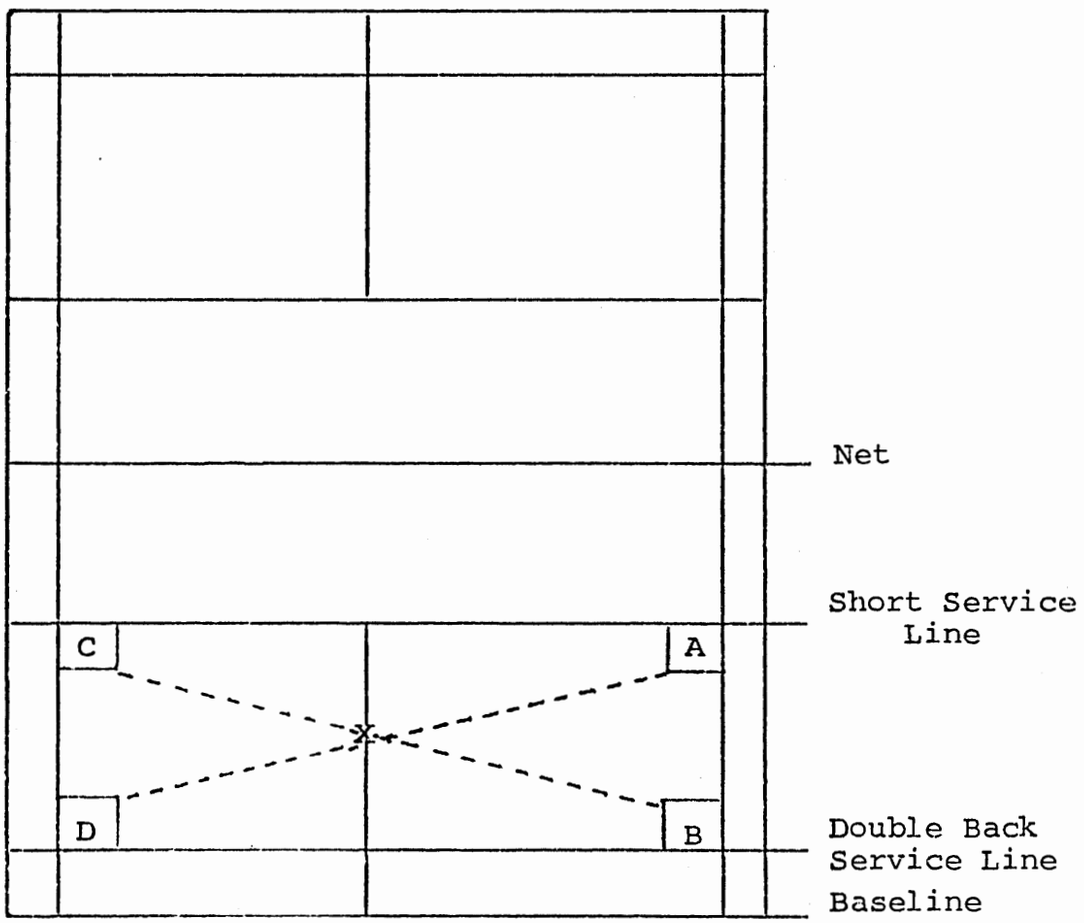
I. Purpose

To increase the student's ability to move more quickly and efficiently on the badminton court.

II. Equipment

The floor markings on a badminton court.

A. Dimensions of the target areas:



III. Directions

A. Starting position and movement

The student stands on the center service line at mark X (see the preceding figure). At a signal given by the instructor (running the stop watch), the student runs to mark A, back to X, to mark B, back to X, to mark D, back to X, and to mark C.

This pattern of running is repeated as many times as possible in a period of thirty seconds.[1]

B. Instruction Poster at Exercise Station
   1. Blue circuit level (low) requires ten to twenty points.
   2. Red circuit level (medium) requires twenty to thirty points.
   3. Gold circuit level (high) requires over thirty points.

C. Rules
   1. One point is scored each time the student being tested touches the A, B, C, D, and X marks. No score is given if the mark or box is not touched.
   2. The whistle must be blown before the exercise begins.
   3. There must be movement the whole time.
   4. The exercise lasts for thirty seconds.

---

[1]Joanna Virginia Hicks, "The Construction and Evaluation of a Battery of Five Badminton Skill Tests" (unpublished Doctor's dissertation, College of Health, Physical Education, and Recreation, Texas Woman's University, Denton, Texas, 1967).

Overhead Press

I. Purpose
To develop primarily the shoulders (deltoid), triceps, and the upper back and neck muscles (trapezius).

II. Equipment
Eight homemade barbell sets.

III. Directions
A. Starting position and movement
The feet should be comfortably spread about shoulder width apart. The weight should be supported just above the chest at shoulder height. Push the weight overhead, extending the arms completely. Lower the weight to the chest and repeat.[1]
B. Instruction poster at exercise station
1. Blue circuit level (low) requires ten to twenty pounds.
2. Red circuit level (medium) requires twenty-five to thirty pounds.
3. Gold circuit level (high) requires thirty-five to forty pounds.
C. Rules
1. Students must use the required weight for their level.
2. The whistle must be blown before the exercise begins.
3. Avoid arching the back during the exercise.
4. There must be a continuous pushing and lowering of the weight.
5. The exercise lasts for thirty seconds.

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[1]Robert P. Sorani, Circuit Training (Dubuque, Iowa: William C. Brown Company, 1966), p. 57.

Wall Volley

I. Purpose
To develop the proper stroke techniques on a moving shuttlecock and also develop wrist strength.

II. Equipment
Masking tape, tape measure, solid wall, badminton racket, and a shuttlecock are the items needed for this exercise.

III. Directions
- A. Starting position and movement
The shuttlecock is started with an underhand hit from behind the six footline and the student should move forward to the three-foot line to continue hitting it against the wall above the five-foot line. If a student fails to hit the shuttlecock, it is re-served from behind the six-foot line. The count is accumulative.[1]
- B. Instruction poster at exercise station
  1. Blue circuit level (low) requires ten to twenty hits.
  2. Red circuit level (medium) requires twenty to thirty hits.
  3. Gold circuit level (high) requires over thirty hits.
- C. Rules
  1. One hit is scored each time the student hits the shuttlecock against the wall, behind the three-foot line and above the five-foot line.
  2. The whistle must be blown before the exercise begins.
  3. The exercise lasts for thirty seconds.

---

[1]Valerie Colvin and Mignon Lester, "Badminton Skills Through Circuit Training," Tennis--Badminton Guide, June, 1968-June, 1970, Division for Girls and Women's Sports, (Washington, D. C.: American Association for Health, Physical Education, and Recreation, 1968), p. 123.

Overhead Hit

I. Purpose
To develop coordination and timing.

II. Equipment
Six cane poles, roll of white tape, six shuttlecocks, sixty inches of window cord, and six badminton rackets.

III. Directions
- A. Starting position and movement
  Shuttlecock is suspended from the cane pole and can be adjusted at various heights to take care of the individual. The bird should be hit away from the playing court. Stop the bird between each hit. Jog one lap around the area.[1]
- B. Instruction poster at exercise station
  1. Blue circuit level (low) requires five hits.
  2. Red circuit level (medium) requires five to ten hits.
  3. Gold circuit level (high) requires over ten hits.
- C. Rules
  1. One hit is scored each time the shuttlecock is hit, and a lap around the instructor is made.
  2. The whistle must be blown before the exercise begins.
  3. The exercise lasts for thirty seconds.

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[1] Ibid.

Push-Ups

I. Purpose
To develop primarily the triceps of the arms, anterior shoulder, and chest muscles.

II. Equipment
Stopwatch.

III. Directions
A. Starting position and movement
Start in the up position with the hands a little more than shoulder width apart. Keep the body straight throughout the exercise. Allow the chest to touch on each down stroke (do not reach with the chin).[1]

If the student is unable to do the push-up, a modified one is used:

Go down on hands and knees, with hands slightly more than shoulder-width apart. Keep body straight and bend the elbows, touching the chin to the floor in front of the hands. Straighten the elbows and return to the starting position.[2]

B. Instruction poster at exercise station
1. Blue circuit level (low) requires from two to ten modified push-ups.
2. Red circuit level (medium) requires from two to five real push-ups.
3. Gold circuit level (high) requires over five real push-ups.

C. Rules
1. The students must use their own circuit level until they meet the maximum of the circuit.
2. The whistle must be blown before the exercise begins.
3. The exercise lasts for thirty seconds.

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[1]Sorani, op. cit., p. 49.

[2]Patsy Neal, Basketball Techniques for Women (New York: The Ronald Press Company, 1966), pp. 28-29.

Curling Sit-Ups

I. Purpose
To develop primarily the abdominal muscles, hip flexors, and the anterior neck flexors.

II. Equipment
Stopwatch.

III. Directions
- A. Starting position and movement
Start in a lying position with the heels close to the buttocks and the hands clasped behind the head. If this is too difficult, start with the hands at the side. Tighten the abdominal muscles and curl-up, bringing the forehead near the knees, then uncurl back down.[1]
- B. Instruction poster at exercise station
  1. Blue circuit level (low) requires from two to ten sit-ups.
  2. Red circuit level (medium) requires from ten to fifteen sit-ups.
  3. Gold circuit level (high) requires over fifteen sit-ups.
- C. Rules
  1. Do not perform the exercise with an arched or straight back.
  2. The students must use their own circuit level until they meet the maximum of the circuit.
  3. The whistle must be blown before the exercise begins.
  4. The exercise lasts for thirty seconds.

---

[1]Sorani, op. cit., p. 49.

Shuttle Run

I. Purpose
To increase the student's ability to change directions.

II. Equipment
Masking tape, tape measure, and a stopwatch.

III. Directions
A. Starting position and movement
Lines are marked sixteen feet apart with masking tape. Start behind one line and shuttle back and forth, touching each line. Each line touched counts as one time.[1]

B. Instruction poster at exercise station
1. Blue circuit level (low) requires from five to ten times.
2. Red circuit level (medium) requires from ten to fifteen times.
3. Gold circuit level (high) requires over fifteen times.

C. Rules
1. Each line touched counts as one time.
2. The whistle must be blown before the exercise begins.
3. There must be movement the whole time.
4. The exercise lasts for thirty-seconds.

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[1]Colvin, op. cit., p. 125.

Jump Rope

I. Purpose
To develop coordination and strengthen the wrists.

II. Equipment
Eight different length jump ropes and a stopwatch.

III. Directions
- A. Starting position and movement
  Students keep elbows close to body using wrist to turn the rope. They may use a two-foot jump or alternate feet.[1]
- B. Instruction poster at exercise station
  1. Blue circuit level (low) requires from ten to fifteen jumps.
  2. Red circuit level (medium) requires from fifteen to twenty-five jumps.
  3. Gold circuit level (high) requires over twenty-five jumps.
- C. Rules
  1. Each complete jump and turn of the rope counts as one jump.
  2. The whistle must be blown before the exercise begins.
  3. The exercise lasts for thirty seconds.

---

[1]Smith, op. cit., p. 38.

Upright Rowing

I. Purpose
To develop primarily the deltoid muscle of the shoulders, the arm flexors (biceps), and some upper back development.

II. Equipment
Eight homemade barbell sets.

III. Directions
- A. Starting position and movement
  Standing erect, grasp the bar with the hands about six inches apart and let it rest against the top of the thighs. Pull the bar up near the chin, keeping the elbows above the hands at all times. Lower to the starting position and repeat.[1]
- B. Instruction poster at exercise station
  1. Blue circuit level (low) requires ten to twenty pounds.
  2. Red circuit level (medium) requires twenty-five to thirty pounds.
  3. Gold circuit level (high) requires thirty-five to forty pounds.
- C. Rules
  1. Students must use the required weight for their level.
  2. The whistle must be blown before the exercise begins.
  3. There must be a continuous pulling and lowering of the weight.
  4. The exercise lasts for thirty seconds.

---

[1]Sorani, op. cit., p. 57.

Bent Rowing

I. Purpose
To develop primarily the forearm flexors, extensors of the upper arm (triceps and latissimus dorsi), shoulder retractors, and the upper back muscles.

II. Equipment
Eight homemade barbell sets.

III. Directions
A. Starting position and movement
Stand with the feet comfortably apart and bend at the hips. Grasp the bar with an overhand grip slightly more than shoulder-width apart. Pull the bar to the body just below the chest. Return to a starting position and repeat. Bend the knees slightly during the exercise to reduce the stress on the lower back.[1]
B. Instruction poster at exercise station
1. Blue circuit level (low) requires ten to twenty pounds.
2. Red circuit level (medium) requires twenty-five to thirty pounds.
3. Gold circuit level (high) requires thirty-five to forty pounds.
C. Rules
1. Students must use the required weight for their level.
2. The whistle must be blown before the exercise begins.
3. There must be a continuous pulling and lowering of the weight.
4. The exercise lasts for thirty seconds.

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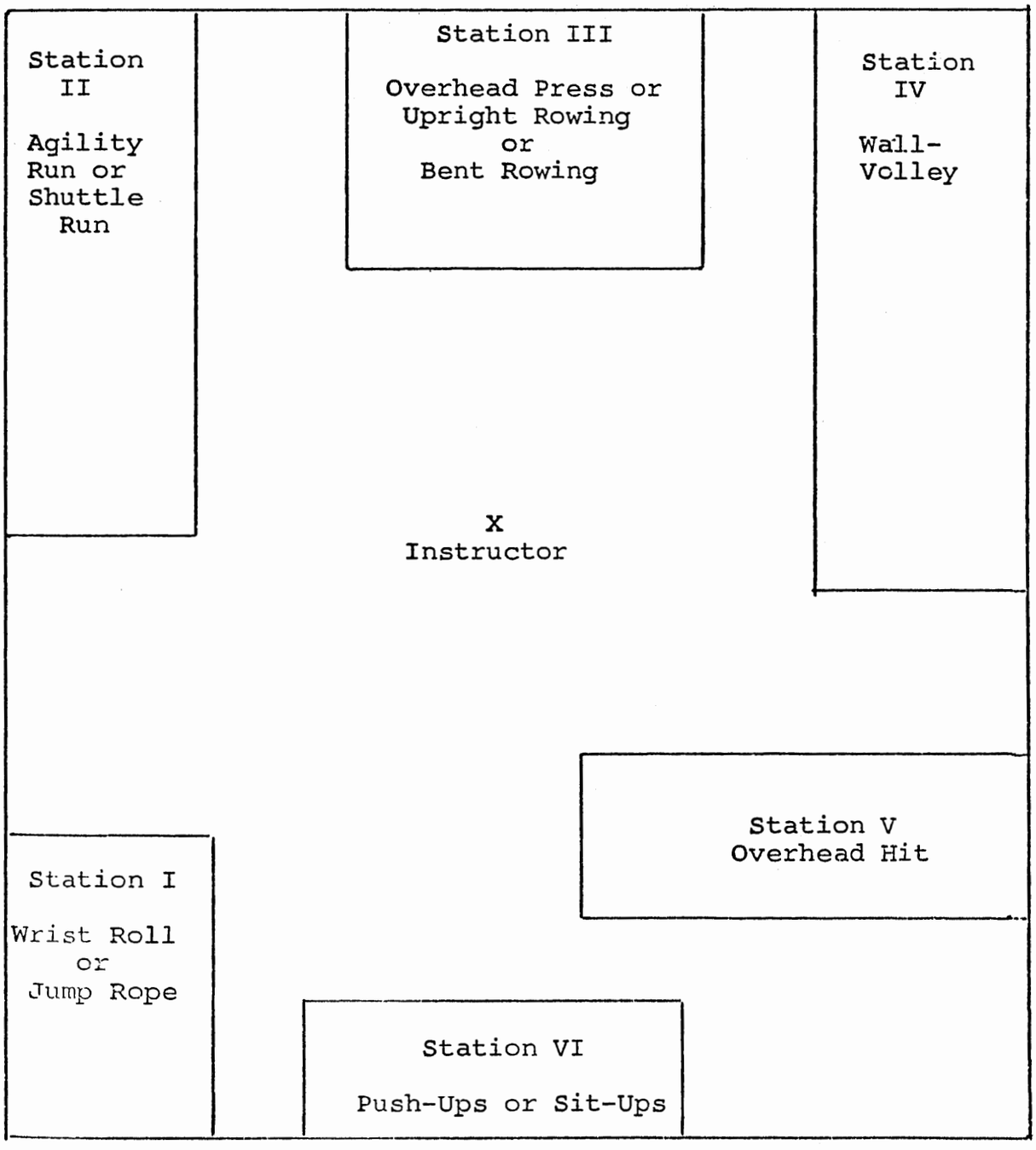
[1] Ibid., p. 56.

DIAGRAM OF THE EXERCISE STATIONS



APPENDIX C

DESCRIPTION OF HOMEMADE WEIGHTS

(Used for some of the exercises in the circuit)

I. Eight sets of barbell weights were made because of the expense of the store-bought weights.

II. Equipment
- A. Eight fairly strong pipes.
- B. Eight flower pots of three different sizes.
- C. Container of wax paper.
- D. Sack of cement mix.
- E. Sack of sand.
- F. Available water supply.
- G. Container to mix the ingredients in, and a spatula to mix with.
- H. Scale to weigh the ingredients.
- I. White tape to wrap around the pipes.
- J. Coarse and fine sand paper.
- K. Quart cans of blue, red, and gold paint.
- L. Several different size paint brushes.
- M. Can of paint remover.

III. Directions
- A. Mix the sand, cement, and water together in a large container, using the spatula. Through experimenting, one can learn to mix the right amounts of each.
- B. Line each flower pot with wax paper first. Pour the mixture into the eight flower pots. Weigh each one of the pots to make sure that there are four, twenty pound ones, two, thirty pound ones, and two, forty pound ones. One can either add or pour out the ingredients if the weight is not right.
- C. Stick the eight pipes down the center of each container, trying to keep it as straight as possible.
- D. After the cement dries repeat the same thing to the other side of the pipe, and then let this dry.
- E. Lift both sides of the weight out of the flower pots, careful not to shatter the cement.
- F. Let the weights sit for a day to completely dry out.
- G. Use first, coarse sand paper and then fine sand paper to smooth the edges and to add to their shapes.
- H. Paint the four twenty pound weights blue, the two thirty pound weights red, and the two forty pound weights gold. The weights need two coats of paint.

I. After the weights dry, put white tape all around the pipe itself to add to the looks of the weights.

IV. Women and girls are usually against weight training because of the masculine aspect of it. The colorful homemade weights will compel these women and girls to see weight training in a new light.

APPENDIX D

TABLE 13

DATA FROM TWENTY CONTROL GROUP SUBJECTS ON TWENTY TRIALS OF THE CLEAR PRE-TEST

Subjects	Trials																				Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	9
4	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	4	10
5	0	0	0	0	3	3	0	5	0	0	3	3	3	3	0	0	4	0	0	0	27
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	5	3	0	0	0	0	3	4	0	0	0	0	5	0	3	0	1	0	0	3	27
8	0	0	0	0	0	3	0	1	0	3	0	0	3	0	0	0	0	0	4	0	14
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	3	0	3	0	4	0	0	0	4	4	3	4	0	4	5	0	0	3	3	5	45
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	3	0	0	3	3	0	3	1	3	0	0	0	0	3	0	0	0	0	3	3	25
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	5	0	0	0	0	0	0	3	4	0	3	0	0	0	0	0	0	0	4	0	19
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	3	0	3	0	0	0	3	0	0	0	0	0	3	0	0	0	12
19	4	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	7
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 14

DATA FROM TWENTY CONTROL GROUP SUBJECTS ON TWENTY TRIALS OF THE CLEAR POST-TEST

Subjects	Trials																				Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
1	0	0	0	0	0	1	0	4	0	3	0	0	3	0	1	4	0	0	5	0	21
2	4	0	0	4	3	0	0	0	1	0	3	0	0	4	0	0	0	0	0	3	22
3	0	0	4	4	3	0	3	4	3	4	0	0	4	4	0	0	0	1	0	3	37
4	4	4	3	0	3	0	0	3	3	4	4	0	0	0	0	4	0	0	3	0	35
5	0	3	0	3	4	3	0	4	4	3	0	0	4	4	0	4	4	0	0	0	40
6	5	4	0	3	4	0	3	3	0	4	0	0	0	0	3	0	3	4	0	0	36
7	4	4	5	3	3	3	0	3	0	4	4	0	0	5	4	5	3	0	5	5	60
8	0	4	0	0	0	0	0	4	3	0	0	0	3	3	0	1	4	3	1	0	26
9	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	3	1	0	0	0	7
10	0	0	0	0	0	0	0	5	0	5	0	0	5	5	4	3	3	0	0	4	34
11	4	5	5	5	5	5	5	4	4	5	0	4	4	5	4	3	4	4	5	4	84
12	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
13	0	4	0	0	5	4	0	4	3	0	4	4	0	0	0	0	0	0	3	4	35
14	3	0	5	0	0	0	4	4	3	4	5	4	1	5	0	4	0	3	0	4	49
15	0	0	4	0	0	0	0	3	0	3	0	0	0	0	0	0	0	0	0	0	10
16	0	4	5	3	4	5	5	5	5	5	5	5	4	0	5	3	5	5	4	4	81
17	0	0	0	0	4	4	3	3	5	4	4	3	3	3	5	4	3	5	0	0	53
18	4	0	4	0	4	0	0	0	0	0	3	0	4	0	3	4	0	0	0	0	26
19	0	3	3	3	3	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	16
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 15

DATA FROM TWENTY CONTROL GROUP SUBJECTS ON TWENTY TRIALS OF THE SMASH PRE-TEST

Subjects	Trials																				Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	5	0	0	8
3	0	0	0	3	3	0	0	5	0	4	5	3	0	0	4	0	5	0	5	5	42
4	0	0	0	0	3	0	3	0	0	0	0	0	0	0	0	0	0	3	0	0	9
5	0	3	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	6
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	3	3	0	0	5	0	3	0	3	5	22
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	3	5	3	5	0	0	3	5	0	3	5	0	3	0	5	0	0	5	0	3	48
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	3	0	0	3	3	0	5	0	0	3	0	3	0	0	20
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	5	0	0	0	0	0	0	3	0	0	5	0	5	0	0	18
16	4	4	0	0	0	5	3	0	0	0	0	3	0	4	4	0	0	0	0	4	31
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	5
18	0	0	0	0	0	0	0	0	0	0	3	0	3	5	0	0	0	3	3	0	17
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3

TABLE 16

DATA FROM TWENTY CONTROL GROUP SUBJECTS ON TWENTY TRIALS OF THE SMASH POST-TEST

Subjects	Trials																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total
1	1	1	4	4	5	4	1	5	4	5	3	4	4	5	0	5	4	0	4	5	68
2	0	4	0	0	5	0	5	0	5	4	0	5	5	5	3	0	4	3	4	5	57
3	4	1	3	4	0	5	4	3	4	0	0	0	4	5	3	0	0	5	3	3	51
4	0	4	4	0	5	5	0	4	5	5	4	4	5	5	0	5	0	3	0	0	58
5	5	3	3	0	5	3	5	0	0	0	5	0	4	5	4	5	4	5	0	0	56
6	3	5	5	5	0	0	4	0	0	0	3	0	4	5	3	0	5	3	3	0	48
7	3	0	3	0	4	0	3	3	5	3	0	5	0	0	0	0	0	4	5	0	38
8	4	4	5	0	0	4	0	0	0	5	5	0	5	3	4	0	3	0	4	5	51
9	0	1	0	0	0	0	0	0	5	0	4	3	1	0	0	0	1	0	5	0	20
10	0	0	0	0	0	0	0	0	0	0	5	0	4	4	0	0	3	5	0	0	21
11	4	1	5	4	1	4	0	5	4	4	0	0	0	0	1	1	4	3	0	1	42
12	0	5	3	0	4	3	4	3	4	4	0	4	5	5	5	0	3	0	5	0	57
13	0	4	5	4	4	4	0	0	5	0	1	5	1	4	4	5	0	4	4	0	54
14	0	0	0	0	3	0	4	4	1	0	1	0	4	4	0	0	5	0	4	0	30
15	0	0	0	0	0	3	0	0	0	0	0	0	0	5	5	5	0	5	0	0	23
16	3	3	5	5	4	0	0	0	4	5	3	5	5	4	0	5	4	4	4	3	66
17	0	0	4	4	5	5	4	5	5	4	0	4	1	0	0	4	1	5	5	0	56
18	4	0	4	0	4	5	4	0	5	4	5	4	0	4	5	5	4	4	4	4	69
19	0	0	0	3	0	3	5	0	0	5	5	2	3	0	3	5	5	2	0	5	46
20	0	0	0	0	0	0	0	0	0	5	0	3	0	0	0	5	0	0	0	3	16

TABLE 17

DATA FROM TWENTY-SIX EXPERIMENTAL GROUP SUBJECTS
ON TWENTY TRIALS OF THE CLEAR PRE-TEST

Subjects	Trials																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total
1	0	4	0	0	0	0	0	0	3	3	0	0	0	0	0	0	0	0	0	0	10
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	4	0	0	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	10
4	0	0	0	3	0	0	5	4	3	4	3	5	5	3	4	1	0	0	4	4	48
5	0	0	0	4	5	3	3	4	4	3	3	0	0	4	5	0	0	0	0	0	38
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	3	0	0	0	3	0	0	0	0	0	0	0	0	0	0	6
10	4	1	0	0	0	3	3	0	0	0	0	0	0	3	0	3	4	0	0	3	24
11	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3
12	0	0	0	1	0	3	0	0	0	0	4	0	0	3	0	0	0	0	0	3	14
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	4	0	0	4	0	0	0	0	5	3	0	0	0	0	1	0	3	3	0	23
15	3	0	0	0	0	3	0	0	3	3	4	0	4	0	3	0	0	0	1	0	24
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	3	4	4	0	0	4	0	3	18
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3
19	0	4	0	0	0	0	0	0	5	0	0	4	4	0	0	0	0	0	0	0	17
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
23	0	3	0	0	0	0	0	0	0	0	0	0	3	4	0	0	3	0	0	0	13
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 18

DATA FROM TWENTY-SIX EXPERIMENTAL GROUP SUBJECTS
ON TWENTY TRIALS OF THE CLEAR POST-TEST

Subjects	Trials																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total
1	0	5	3	4	4	0	0	0	4	3	4	3	0	0	0	3	0	4	4	1	42
2	0	0	4	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	5
3	0	3	3	4	0	3	3	0	3	0	3	3	0	3	0	4	0	0	0	3	35
4	3	4	3	4	0	1	3	3	3	3	0	0	0	0	4	0	3	3	3	3	43
5	3	4	5	0	4	0	4	0	0	0	4	4	5	3	3	5	0	0	0	4	48
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	3	0	1	0	0	0	0	0	4
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	3	0	0	0	0	0	3	3	0	0	0	0	0	0	0	0	0	0	9
10	0	0	4	5	4	0	0	0	4	0	4	0	0	0	3	3	0	0	0	0	27
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3	0	0	0	6
12	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	3	0	3	0	0	0	0	4	0	0	0	0	4	0	4	18
15	0	0	4	1	0	0	4	3	1	0	0	0	4	4	0	0	3	0	1	0	25
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	3	5	3	4	4	0	0	3	4	0	0	3	0	0	0	0	1	5	0	0	35
18	0	0	0	0	0	3	3	0	0	0	0	3	3	3	1	0	0	0	0	0	16
19	0	0	0	4	0	3	0	0	4	0	3	0	0	0	4	0	4	0	0	0	22
20	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	4	0	0	0	7
21	0	0	0	0	3	0	0	0	0	0	4	0	0	1	0	0	0	0	0	0	8
22	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	3	0	0	0	0	6
23	0	0	0	0	0	3	1	0	3	0	0	0	0	0	1	0	0	0	0	0	8
24	3	0	0	4	0	3	0	0	4	3	0	0	0	3	3	0	4	0	3	0	30
25	3	0	0	0	0	0	0	0	0	0	0	0	0	4	3	0	0	0	3	3	16
26	0	0	0	0	0	0	3	3	0	3	0	0	0	0	0	0	0	0	0	1	10

TABLE 19

DATA FROM TWENTY-SIX EXPERIMENTAL GROUP SUBJECTS
ON TWENTY TRIALS OF THE SMASH PRE-TEST

Subjects	Trials																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total
1	0	0	3	0	0	0	0	0	0	0	0	0	3	0	5	0	0	0	0	5	16
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	3	6
3	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	5	0	0	5	0	15
4	5	5	5	0	0	0	5	0	0	4	0	0	5	5	4	5	1	5	0	4	53
5	0	0	0	0	0	0	5	0	0	0	5	0	3	3	0	0	5	5	0	5	31
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	5	0	3	0	0	0	0	0	0	0	0	0	3	0	0	0	0	3	14
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	3
10	0	0	0	0	0	0	5	0	0	5	3	5	3	0	0	5	0	0	0	0	26
11	0	0	0	5	0	0	0	0	0	5	3	0	0	0	0	0	0	0	5	3	21
12	0	0	0	0	3	0	4	0	5	0	3	0	0	3	0	0	5	3	0	3	29
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	5	0	5	0	5	5	4	0	3	3	3	3	4	5	5	5	3	0	58
15	0	0	0	0	0	0	0	5	5	0	0	3	5	0	0	5	0	0	5	3	31
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	3	0	0	3	3	5	0	5	0	0	0	0	3	0	0	0	22
18	3	0	0	0	0	0	0	0	0	0	5	0	0	4	5	0	0	0	3	0	20
19	0	0	0	0	0	0	0	0	5	3	0	3	0	5	0	5	0	0	3	3	27
20	0	3	0	0	0	0	3	0	3	0	0	0	0	5	0	0	0	0	0	0	14
21	5	0	0	3	0	0	0	0	3	0	0	0	0	0	0	0	0	0	3	0	14
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	3	0	0	5	0	3	0	0	5	0	0	5	0	0	0	5	0	0	26
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	5	0	0	0	3	3	0	0	3	0	0	0	0	0	0	0	5	0	0	0	19
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4

TABLE 20

DATA FROM TWENTY-SIX EXPERIMENTAL GROUP SUBJECTS
ON TWENTY TRIALS OF THE SMASH POST-TEST

Subjects	Trials																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total
1	4	5	4	0	5	5	5	3	5	5	0	5	5	3	3	0	0	3	4	5	69
2	0	0	3	0	5	0	3	4	0	5	0	0	5	0	5	1	5	0	1	3	40
3	3	0	0	5	4	2	5	0	5	5	3	4	0	0	0	5	5	3	5	5	59
4	5	0	0	5	5	0	5	5	1	5	0	4	0	0	5	3	1	5	0	0	49
5	4	5	3	5	5	5	5	2	3	5	5	0	5	5	5	5	3	5	5	5	85
6	4	1	5	0	0	4	5	5	0	5	4	5	5	4	3	0	0	5	0	3	58
7	0	0	0	0	4	4	5	4	5	3	4	4	3	3	4	4	0	0	5	3	55
8	0	0	0	0	0	0	3	0	0	0	0	3	0	0	3	0	0	0	3	0	12
9	4	0	0	5	4	0	4	5	0	4	0	4	4	5	5	5	3	5	0	4	61
10	5	0	5	3	5	3	5	0	5	5	4	3	4	5	1	0	0	0	0	3	56
11	0	0	0	0	4	5	0	5	4	5	5	5	0	0	5	5	3	3	0	3	52
12	0	3	5	3	3	5	3	3	5	5	5	4	3	5	4	5	3	3	0	0	67
13	5	0	0	0	3	0	5	4	0	0	3	4	3	0	0	5	0	1	4	0	37
14	3	4	0	5	4	0	4	4	5	5	0	5	0	5	4	0	3	5	0	5	61
15	0	0	4	0	5	4	3	5	0	4	5	5	0	5	5	5	5	3	3	0	61
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2
17	5	3	0	3	5	5	0	5	0	0	0	0	5	0	5	3	0	0	0	5	44
18	5	5	5	4	0	5	4	4	3	0	0	3	5	5	0	4	5	4	5	5	71
19	0	5	0	5	0	5	0	4	0	1	1	0	0	0	4	5	5	3	0	5	43
20	5	3	5	5	3	5	5	5	3	4	5	4	5	3	5	5	5	3	4	4	86
21	4	0	0	0	0	0	0	0	3	0	0	5	5	5	5	0	3	5	3	0	38
22	0	3	0	4	0	0	0	0	4	5	0	4	0	0	0	0	3	0	5	5	33
23	5	0	0	2	3	0	0	5	3	0	0	5	0	4	3	0	2	3	5	3	43
24	5	0	0	0	3	0	0	0	0	1	4	3	0	3	0	5	0	5	0	3	32
25	0	1	4	5	0	4	0	5	5	0	0	0	0	0	0	5	3	0	0	5	37
26	1	0	5	0	3	0	5	5	0	4	4	3	1	5	2	5	0	5	4	3	55

APPENDIX E

SYLLABUS FOR GROUP I PROGRESSIVE CIRCUIT

TRAINING AND BADMINTON

First Week

Tuesday	Drives; low serves.
Thursday	Clears; high serves.
Saturday	Review.

Second Week

Tuesday	Clear pre-test.
Thursday	Clear pre-test.
Saturday	Clear pre-test.

Third Week

Tuesday	Smash pre-test.
Thursday	Smash pre-test.
Saturday	Smash pre-test.

Fourth Week

Tuesday	Learn circuit training exercises.
Thursday	Determine student's level at each station.
Saturday	Review of circuit training exercises and review of badminton skills.

Fifth Week

Tuesday	Ten minutes of circuit training. Review of badminton doubles.
Thursday	Ten minutes of circuit training. Review of badminton doubles.
Saturday	Ten minutes of circuit training. Review of badminton doubles and partner assignments.

Sixth Week

Tuesday	Ten minutes of circuit training. Round Robin Tournament begins.
Thursday	Ten minutes of circuit training. Round Robin Tournament.
Saturday	Ten minutes of circuit training. Introduction of the smash shot. Round Robin Tournament.

Seventh Week

Tuesday	Ten minutes of circuit training. Round Robin Tournament.
Thursday	Ten minutes of circuit training. Round Robin Tournament.
Saturday	Review for mid-term.

Eighth Week

Tuesday	Change student's levels at the different stations if they have reached the maximum for that level
Thursday	Ten minutes of circuit training. Introduction of the backhand clear shot. Round Robin Tournament.
Saturday	Mid-term test.

Ninth Week

Tuesday	Ten minutes of circuit training. Introduction of the drop shot. Round Robin Tournament.
Thursday	Ten minutes of circuit training. Review drop shot. Round Robin Tournament.
Saturday	Ten minutes of circuit training. Round Robin Tournament.

Tenth Week

Tuesday	Ten minutes of circuit training. Round Robin Tournament.
Thursday	Ten minutes of circuit training. Round Robin Tournament.
Saturday	Ten minutes of circuit training. Round Robin Tournament.

Eleventh Week

Tuesday	Ten minutes of circuit training. Round Robin Tournament.
Thursday	Holiday.
Saturday	Holiday.

Twelfth Week

Tuesday	Ten minutes of circuit training. Review of singles strategy.
Thursday	Ten minutes of circuit training. Singles Round Robin Tournament.
Saturday	Ten minutes of circuit training. Singles Round Robin Tournament.

Thirteenth Week

Tuesday	Ten minutes of circuit training. Singles Round Robin Tournament.
Thursday	Ten minutes of circuit training. Singles Round Robin Tournament.
Saturday	Ten minutes of circuit training. Singles Round Robin Tournament.

Fourteenth Week

Tuesday	Ten minutes of circuit training. Singles Round Robin Tournament.
Thursday	Ten minutes of circuit training. Singles Round Robin Tournament.
Saturday	Ten minutes of circuit training. Singles Round Robin Tournament.

Final Exam Week

Saturday	Clear post-test. Smash post-test.

APPENDIX F

SYLLABUS FOR GROUP II BADMINTON

First Week

Tuesday	Drives; low serves.
Thursday	Clears: high serves.
Saturday	Review.

Second Week

Tuesday	Clear pre-test.
Thursday	Clear pre-test.
Saturday	Clear pre-test.

Third Week

Tuesday	Smash pre-test.
Thursday	Smash pre-test.
Saturday	Smash pre-test.

Fourth Week

Tuesday	Review drives and clears.
Thursday	Review of skills.
Saturday	Review of skills.

Fifth Week

Tuesday	Review of badminton doubles.
Thursday	Review of badminton doubles.
Saturday	Review of doubles and partner assignments.

Sixth Week

Tuesday	Round Robin Tournament begins.
Thursday	Round Robin Tournament.
Saturday	Introduction of the Smash Shot. Round Robin Tournament.

Seventh Week

Tuesday	Round Robin Tournament.
Thursday	Round Robin Tournament.
Saturday	Review for mid-term.

Eighth Week

Tuesday	Round Robin Tournament.
Thursday	Introduction of the backhand clear shot. Round Robin Tournament.
Saturday	Mid-term test.

Ninth Week

Tuesday	Introduction of the drop shot. Round Robin Tournament.
Thursday	Review drop shot. Round Robin Tournament.
Saturday	Round Robin Tournament.

Tenth Week

Tuesday	Round Robin Tournament.
Thursday	Round Robin Tournament.
Saturday	Round Robin Tournament.

Eleventh Week

Tuesday	Round Robin Tournament.
Thursday	Holiday.
Saturday	Holiday.

Twelfth Week

Tuesday	Review of singles strategy.
Thursday	Singles Round Robin Tournament.
Saturday	Singles Round Robin Tournament.

Thirteenth Week

Tuesday	Singles Round Robin Tournament.
Thursday	Singles Round Robin Tournament.
Saturday	Singles Round Robin Tournament.

Fourteenth Week

Tuesday	Singles Round Robin Tournament.
Thursday	Singles Round Robin Tournament.
Saturday	Singles Round Robin Tournament.

Final Exam Week

Saturday	Clear post-test.
	Smash post-test.

BIBLIOGRAPHY

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Books

American Association for Health, Physical Education, and Recreation. Physical Education for High School Students. Washington, D. C.: National Education Association, 1960.

Barrow, Harold M., and McGee, Rosemary. A Practical Approach to Measurement in Physical Education. Philadelphia: Lea and Febiger, 1964.

Bender, Jay, and Shea, Edward J. Physical Fitness: Tests and Exercises. New York: The Ronald Press Company, 1964.

Bernard, Harold W. Psychology of Learning and Teaching. New York: McGraw-Hill Book Company, Inc., 1965.

Bovard, John F.; Cozens, Frederick W.; and Hagman, E. Patricia. Tests and Measurements in Physical Education. Philadelphia and London: W. B. Saunders Company, 1949.

Brace, David K. Health and Physical Education for Junior Senior High Schools. New York: A. S. Barnes and Company, 1948.

Broer, Marian R. Efficiency of Human Movement. Philadelphia: W. B. Saunders Company, 1960.

Clarke, H. Harrison. Application of Measurement to Health and Physical Education. New Jersey: Prentice-Hall, Inc., 1959.

_____. Muscular Strength and Endurance in Man. New Jersey: Prentice-Hall, Inc., 1966.

Cooper, John M., and Glassow, Ruth B. Kinesiology. St. Louis: C. V. Mosby Company, 1968.

Cooper, Kenneth H. Aerobics. New York: M. Evans and Company, Inc., 1968.

Counsilman, James E. The Science of Swimming. New Jersey: Prentice-Hall, Inc., 1968.

Cratty, Bryant J. Psychology and Physical Activity. New Jersey: Prentice-Hall, Inc., 1968.

Cureton, Thomas Kirk. Improving the Physical Fitness of Youth. Illinois: The Dial Press, 1964.

_____. Physical Fitness and Dynamic Health. Illinois: The Dial Press, 1965.

_____. Physical Fitness Appraisal and Guidance. St. Louis: C. V. Mosby Company, 1947.

Dagraedt, Mary, and Fossum, Bruce. Golf. Boston, Massachusetts: Allyn and Bacon, Inc., 1969.

Davidson, Kenneth R., and Gustavson, Lealand R. Winning Badminton. New York: A. S. Barnes and Company, 1953.

Dayton, O. William. Athletic Training and Conditioning. New York: The Ronald Press Company, 1965.

Division for Girls and Women's Sports. Basketball Guide. American Association for Health, Physical Education, and Recreation. Washington, D. C., 1969-1970.

_____. Tennis-Badminton Guide. American Association for Health, Physical Education, and Recreation. Washington, D. C., 1969-1970.

Doherty, J. Kenneth. Modern Training for Running. New Jersey: Prentice-Hall, Inc., 1964.

Duggan, Anne Schley; Montague, Mary Ella; and Rutledge, Abbie. Conditioning Exercises for Girls and Women. New York: A. S. Barnes and Company, 1945.

Falls, Harold B. Exercise Physiology. New York and London: Academic Press, Inc., 1968.

Fitts, Paul M., and Posner, Michael I. Human Performance. Belmont, California: Brooks/Cole Publishing Company, Inc., 1969.

Foreman, Ken, and Husted, Virginia. Track and Field Techniques for Girls and Women. Dubuque, Iowa: William C. Brown Company, 1965.

Francis, Carl C. Introduction to Human Anatomy. St. Louis: C. V. Mosby Company, 1964.

Friedrich, John, and Rutledge, Abbie. Beginning Badminton. Belmont, California: Wadsworth Publishing Company, Inc., 1962.

Gary, Mitchell J.; Oermann, Karl C. H.; and Young, Carl Haven. Conditioning Exercises, Games, Tests. Annapolis, Maryland: United States Naval Institute, 1960.

Golding, Lawrence A., and Bos, Ronald R. Scientific Foundations of Physical Fitness Programs. Minneapolis, Minnesota: Burgess Publishing Company, 1967.

Guilford, J. P. Fundamental Statistics in Psychology and Education. New York and London: McGraw-Hill Book Company, 1942.

Hettinger, Theodor. Physiology of Strength. Springfield, Illinois: Charles C. Thomas, 1961.

Hooks, Gene. Application of Weight Training to Athletics. New Jersey: Prentice-Hall, Inc., 1962.

Instruction Manual for Exer-Genie Exerciser. Exer-Genie, Inc., P. O. Box 3237, Fullerton, California, 92634, 1967.

Jackson, Nell C. Track and Field for Girls and Women. Minneapolis, Minnesota: Burgess Publishing Company, 1968.

Johnson, Warren R. Science and Medicine of Exercise and Sports. New York: Harper and Brothers Publishers, 1960.

Jordan, Payton, and Spencer, Bud. Champions in the Making. New Jersey: Prentice-Hall, Inc., 1968.

Karpovich, Peter V. Physiology of Muscular Activity. Philadelphia: W. B. Saunders Company, 1965.

Klafs, Carl E., and Arnheim, Daniel D. Modern Principles of Athletic Training. St. Louis: C V. Mosby Company, 1963.

Koenker, Robert H. Simplified Statistics. Bloomington, Illinois: McKnight and McKnight Publishing Company, 1961.

Lawther, John D. The Learning of Physical Skills. New Jersey: Prentice-Hall, Inc., 1968.

Lockhart, Aileene S., and Slusher, Howard S. Anthology of Contemporary Readings: An Introduction to Physical Education. Dubuque, Iowa: William C. Brown Company, 1966.

McAleece, M. J. The Healthways System of Bar Bell and Dumbell Training. Chicago, Illinois, 1960.

McCurdy, James Huff. The Physiology of Exercise. Philadelphia: Lea and Febiger, 1928.

Mackenzie, Marlin M. Toward a New Curriculum in Physical Education. New York: McGraw-Hill Book Company, 1969.

McPartlin, G. A. Fitness for Sport. London: G. Bell and Sons, LTD, 1957.

Mathews, Donald R. Measurement in Physical Education. Philadelphia and London: W. B. Saunders Company, 1963.

Metheny, Eleanor. Connotations of Movement in Sport and Dance. Dubuque, Iowa: William C. Brown Company, 1965.

Miller, Kenneth D. Track and Field for Girls. New York: The Ronald Press Company, 1964.

Morgan, R. E., and Adamson, G. T. Circuit Training. London: G. Bell and Sons, 1961.

Mott, Jane A. Conditioning and Basic Movements Concepts. Dubuque, Iowa: William C. Brown Company, 1968.

Neal, Patsy. Coaching Methods for Women. Reading, Massachusetts: Addison-Wesley Publishing Company, 1969.

Oxendine, Joseph B. Psychology of Motor Learning. New York: Appleton-Century-Crofts, Inc., 1968.

Pease, Charles A. Body Building Group Method. New York: The Ronald Press Company, 1963.

Poindexter, Holly Beth, and Vannier, Maryhelen. Individual and Team Sports for Girls and Women. Philadelphia: W. B. Saunders Company, 1960.

Poole, James. Badminton. Pacific Palisades, California: Goodyear Publishing Company, 1969.

President's Council on Physical Fitness. Youth Physical Fitness. Parts one and two. National Education Association of the United States, 1967.

Rasch, Philip J., and Burke, Roger K. Kinesiology and Applied Anatomy. Philadelphia: Lea and Febiger, 1963.

Ricci, Benjamin. Physical and Physiological Conditioning for Men. Dubuque, Iowa: William C. Brown Company, 1966.

Scott, M. Gladys. Analysis of Human Motion. New York: Meredith Publishing Company, 1963.

_____, and French, Esther. Evaluation in Physical Education. St. Louis: C. V. Mosby Company, 1950.

_____, and French, Esther. Measurement and Evaluation in Physical Education. Dubuque, Iowa: William C. Brown Company, 1959.

Scott, Phebe M., and Crafts, Virginia R. Track and Field for Girls and Women. New York: Appleton-Century-Crofts, Inc., 1964.

Shephard, Roy J. Endurance Fitness. Canada: University of Toronto Press, 1969.

Singer, Robert N. Motor Learning and Human Performance: An Application to Physical Education Skills. New York: The Macmillan Company, 1968.

Sorani, Robert P. Circuit Training. Dubuque, Iowa: William C. Brown Company, 1966.

Varner, Margaret. Badminton. Dubuque, Iowa: William C. Brown Company, 1966.

Wilkinson, Bud. Modern Physical Fitness. New York: The Viking Press, 1967.

Willgoose, Carl E. Evaluation in Health Education and Physical Education. New York: McGraw-Hill Book Company, Inc., 1961.

Articles

Adamson, G. T. "Circuit Training." Ergonomics, II (February, 1959), 183-86.

_____. "Circuit Training." Scholastic Coach, XXXII (December, 1962), 16-17.

_____., and Morgan, R. E. "Circuit Training," Journal of the Physical Education Association, XLVI (March, 1954), 1.

Amerman, B. "Consider Circuit Training for Baseball Conditioning." Athletic Journal, IL (November, 1968), 62-3.

Anderson, Kenneth. "Special Exercises for the Outdoors." The Field and Stream Guide to Physical Fitness (1969), pp. 108-13.

Dobie, Dorothy Delores. "Effectiveness of a Conditioning Program on Selected Tennis Skills of Women." Research Quarterly, XL (March, 1969), 39-44.

Ellis, R. "Circuit Training for Basketball." Athletic Journal, XLVIII (October, 1967), 14.

Farrally, R. "Circuit Training for Soccer." Athletic Journal, IL (May, 1969), 61.

Gambelli, F. E. "Circuit Training in the Junior High School." Journal of Health, Physical Education, and Recreation, XXXVIII (March, 1967), 93-5.

Grieve, A. "Circuit Training for Fitness." Scholastic Coach, XXXVI (September, 1966), 44.

Hakes, R. R., and Sosemier, R. A. "Circuit Training Time Allotments in a Typical Physical Education Class Period." Research Quarterly, XXXVII (December, 1967), 576-84.

Hinson, M. M. "Electromyographic Study of the Push-up for Women." Research Quarterly, XL (May, 1969), 305-11.

Homola, S. "Building Endurance and Power with Circuit Training." Scholastic Coach, XXXVI (April, 1967), 60.

Howell, M. L.; Hodgson, J.; and Alexander, J. F. "Effects of Circuit Training on Strength and Muscular Endurance." The Australian Journal of Physical Education, XXVIII (July, 1963), 14.

_____. and Morford, W. R. "Circuit Training for a College Fitness Program." Journal of Health, Physical Education, and Recreation, XXXV (February, 1964), 30-1.

_____. "Circuit Training." Journal of Health, Physical Education, and Recreation, XXXII (November, 1961), 33-4.

_____. "Circuit Training for Secondary Schools." New Zealand Journal of Physical Education, XXII (November, 1960), 11-14.

Huss, Van. "Effect of Overload Warm-up on the Velocity and Accuracy of Throwing." Research Quarterly, XL (October, 1962), 472-75.

Judd, W. A., and Glaser, R. "Overlearning." Journal of Educational Psychology, LX (August, 1969), 1-30.

Kula, R. "Greeley High and Circuit Training." Athletic Journal, XLIII (May, 1963), 70-1.

Landiss, Carl W. "Influences of Physical Education Activity on Motor Ability and Physical Fitness of Male Freshmen." Research Quarterly, XXVI (October, 1955), 295-307.

Lewis, A. S. "Some Limitations of Circuit Training." New Zealand Journal of Physical Education, XVI (November, 1958), 10-13.

Lockhart, Ailene, and McPherson, Frances A. "Lockhart-McPherson Badminton Volley Test." Research Quarterly, XX (December, 1949), 402.

Miller, A. Frances. "A Badminton Wall Volley Test." Research Quarterly, XXII (May, 1951), 208-13.

Mohr, Dorothy R. "The Measurement of Certain Aspects of the Physical Fitness of College Women." Research Quarterly, XV (December, 1944), 340-49.

_____. "Recent Research by Women in the United States." Journal of Health, Physical Education, and Recreation, (November, 1961), pp. 61-2.

Neuberger, Tom. "What the Research Quarterly Says About Warm-up." Research Quarterly, XL (October, 1969), 75-7.

Nunney, Deret N. "Relation of Circuit Training to Swimming." Research Quarterly, XXXI (May, 1960), 188-99.

Petroskey, Helen M. "A Study of Improvement of Fitness of College Freshman Women." Research Quarterly, XVI (December, 1945), pp. 257-65.

Pyke, F. S. "Effect of Preliminary Activity on Maximal Motor Performance." Research Quarterly, XXXIX (December, 1968), 1069-76.

Rogin, Gilbert. "Get Strong Without Moving." Sports Illustrated, (October, 1961), pp. 18-20.

Stelmach, G. E. "Effect of Added Weight on the Learning of a Discrete Arm Movement." Research Quarterly, XL (May, 1969), 376-82.

Straub, W. F. "Overload Training on the Overarm Throw." Research Quarterly, XXXIX (May, 1968), 370-79.

Thompson, Hugh L. "Effect of Warm-Up Upon Physical Performance in Selected Activities." Research Quarterly, XXIX (May, 1958), 231-46.

Vanzeune, G. "Circuit Training Adapted to Sports." La Gymnastique Educative, III (July, 1961), 197-203.

Vrijens, Jacques. "The Influence of Interval Circuit Exercises on Physical Fitness of Adolescents." Research Quarterly, XL (October, 1969), 595-99.

Walters, C. Etta. "A Study of the Effects of Prescribed Strenuous Exercises on the Physical Efficiency of Women." Research Quarterly, XXIV (March, 1953), 101-11.

Whitlow, G. "Elementary Circuit Training." Journal of Health, Physical Education, and Recreation, XXXIX (May, 1968), 26-27.

Willgoose, Carl E. "Physical Fitness: Our Primary Objective." Journal of Health, Physical Education, and Recreation, XXX (November, 1959), 32-33.

Unpublished Material

Carr, Norma Jane. "The Effect of Isometric Contraction and Progressive Body Conditioning Exercises on Selected Aspects of Physical Fitness and Badminton Achievement of College Women." Unpublished Master's thesis, Department of Health, Physical Education, and Recreation, University of Washington, Seattle, Washington, 1962.

Carter, Ginger Kelley. "A Study of the Relationship Between Specific Conditioning Exercises and Selected Skills in Badminton and Archery of Freshman Women Students Enrolled in Physical Education Classes at Amarillo College in Amarillo, Texas." Unpublished Master's thesis, College of Health, Physical Education, and Recreation, Texas Woman's University, Denton, Texas, 1966.

Cylver, Elizabeth Jean. "The Effect of a Ten-Minute Period of Body Conditioning Exercises on Certain Elements of Physical Fitness and Basketball Skill of High School Girls." Unpublished Master's thesis, Department of Health, Physical Education, and Recreation, University of Washington, Seattle, Washington, 1958.

Donaghe, Shelia Janell. "The Effect of a Ten-Minute Period of Progressive Rope Jumping Exercises on Certain Elements of Physical Fitness and on Badminton Achievement of College Women." Unpublished Master's thesis, Department of Health, Physical Education, and Recreation, University of Washington, Seattle, Washington, 1963.

Harris, Dorian Elizabeth. "The Effect of Selected Agility Activities on Badminton Playing Ability of Women at the University of Oregon." Unpublished Master's thesis, Department of Health, Physical Education, and Recreation, University of Oregon, Eugene, Oregon, 1963.

Hicks, Joanna Virginia. "The Construction and Evaluation of a Battery of Five Badminton Skill Tests." Unpublished Ph.D. dissertation, College of Health, Physical Education, and Recreation, Texas Woman's University, Denton, Texas, 1967.

Rogers, Bettejoe. "A Study of the Relationships Between Selected Physical Fitness Skills and Selected Basketball Skills of Freshman Women Students Enrolled in Physical Education Classes at Tarleton State College, Stephenville, Texas, during the Spring Semester of the Academic Year 1961-1962." Unpublished Master's thesis, College of Health, Physical Education, and Recreation, Texas Woman's University, Denton, Texas, 1962.

Stehr, Emma Jean. "A Comparative Study of the Development of Certain Elements of Physical Fitness on the Part of College Women in a Basketball and in a Modern Dance Class at Southern Illinois Normal University." Unpublished Master's thesis, College of Health, Physical Education, and Recreation, Texas Woman's University, Denton, Texas, 1945.