

SPECIFIC CONDITIONING PROGRAMS AND
STRENGTH OF JUNIOR HIGH
SCHOOL GIRLS

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BY
SHARON HALE, B. S.

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Denton, Texas

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We hereby recommend that the thesis prepared under
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be accepted as fulfilling this part of the requirements for the Degree of
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Committee:

Joe Brenting
Chairman
Claudine Sherrill
Bert Lyle

Accepted: L. L. Morrison
Dean of Graduate Studies

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CHAPTER I

INTRODUCTION

Strength tests may be considered one of the most successful ways to evaluate the physical condition of youngsters in schools.¹ This statement appears valid for a number of reasons. Mathews points out that in addition to being a basic parameter for any definition of fitness, strength traditionally has been used to measure fitness in school-age children and that such testing has been emphasized as a reflector of total fitness for the following reasons:

(1) Strength is a highly objective measure; (2) strength is affected by disease processes such as infected tonsils, cancers, ulcers, abscesses, and colds; and (3) strength is affected by emotional problems.²

Strength is frequently considered the single most important factor in the performance of gross motor activities.³ The physical status of school age students can be determined by measuring their strength and teachers can thus

¹H. Harrison Clarke, Application of Measurement to Health and Physical Education (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1959, Third Edition), p. 183.

²Donald K. Mathews, Measurement in Physical Education (Philadelphia: W. B. Saunders Company, 1964), p. 55.

³Barry L. Johnson and Jack K. Nelson, Practical Measurements for Evaluation in Physical Education (Minneapolis: Burgess Publishing Company, 1969), p. 241.

be aided in the construction of a more effective program to meet pupil needs.¹ A lack of adequate strength typically results in rapid muscular fatigue and this may limit the amount of time available to learn skills. Because muscular strength has been used to determine physical fitness and to determine the placement of students in levels of skill learning, it is important to establish methods of exercising which will be conducive to the development of muscular strength.

Rationale of the Study

The value of the development of muscular strength is based upon four assumptions:

- (1) Strength is necessary for good appearance; (2) strength is basic to good performance in skills; (3) strength is valued highly as a measure of physical fitness; and (4) maintenance of strength may serve as a prophylaxis against certain orthopedic deficiencies.²

Based upon the above four assumptions, it is believed important to determine the appropriate way to develop muscular strength in the junior high school age girl. This particular age group and sex was selected to participate in this study because of their availability, because of the general lack of knowledge concerning training programs for the development of muscular strength for this particular group, and because at this age

¹Mathews, op. cit., p. 55.

²Ibid., p. 53.

girls begin to take a vital interest in their appearance.¹ It has also been noted that activities requiring extreme expenditures of energy places stress on the body frame and supporting systems of this age group and that such stress requires adaptive adjustments of the organism which are considered desirable.²

A student needs the strength necessary to perform normal daily activities in an efficient manner.³ An excess of minimal strength can be used for emergency situations where survival is a factor. A student also needs sufficient excess strength in order that he may live his life more fully and completely in leisure time pursuits.⁴ Boys are encouraged to participate in strenuous physical activities, while the same type of activity has been frowned upon for girls. Muscular strength has always been a masculine prestige factor which boys deliberately attempt to acquire. Girls, on the other hand, have been encouraged to be gentle and dainty and to leave the heavy work which requires muscular strength to

¹Cyrus Mayshark and Leslie W. Irwin, Health Education in Secondary Schools (St. Louis, Missouri: The C. V. Mosby Company, 1968, Second Edition), p. 105.

²Clarke, op. cit., pp. 201-202, 205.

³Harold M. Barrow and Rosemary McGee, A Practical Approach to Measurement in Physical Education (Philadelphia: Lea and Febiger, 1968), p. 115.

⁴Ibid.

the boys. Present cultural attitudes suggest providing appropriate strength activities for girls to inculcate a true sense of independence and equality is acceptable. If girls need to develop muscular strength to maintain a good appearance and to participate successfully in motor activities, then training programs should be designed for girls for the purpose of developing muscular strength.

Statement of the Problem

The proposed study entailed an investigation of 150 junior high school girls from the Morgan City Junior High School in Morgan City, Louisiana, during the academic year of 1970-1971, to determine if there was a significant difference in the development of muscular strength as a result of using three different conditioning programs. The experimental conditioning programs were conducted daily at the beginning of each class for ten minutes for a period of six weeks. The conditioning programs used were: (1) a progressive circuit training program, (2) a general calisthenic program, and (3) an instructional or structured play program (basketball) was used by a control group. Upon the basis of the findings, a conclusion was drawn with respect to which program, if any, was most effective for the development of muscular strength as measured by the Strength Index.¹

¹Frederick Rand Rogers, Fundamental Administrative Measures in Physical Education (Newton, Massachusetts: The Pleiades Co., 1932), pp. 109-103.

Definitions and/or Explanations of Terms

For the purpose of clarification, the following definitions and/or explanations of terms were established for use in the study:

Circuit Training: Circuit training was defined as a "method of fitness training which appealed to students and contributed to muscular and circulo-respiratory development."¹ Circuit training uses three variables--load, repetition and time. By utilizing a circuit training program, large numbers of performers are able to train at the same time by employing a circuit of consecutively numbered exercises around which each performer progressed, doing a prescribed allocation of work at each exercise, and then checking his progress against a clock. Circuit training was designed for this study as a method of developing muscular strength.

Circuit: A circuit was defined as "the area about which a number of carefully selected exercises, arranged and numbered consecutively, are set up."² The two circuits used in this study were: (1) Circuit program one, which consisted

¹R. E. Morgan and G. T. Adamson, Circuit Training (London: G. Bell and Sons, 1968), p. 14.

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

of the squat thrust, back shuffle, modified pull-up, wall push-up on the fingers, supine back-lift, bench stepping, sit-up, wrist roll, criss-cross run over a two inch line and the parallel bar hold, and (2) Circuit program two, which consisted of the treadmill, wrist roll, bouncing hips, push-up from the toes, sit-up, parallel bar travel through, turtle-walk, toe raise, modified pull-up and stair climbing. The circuits were alternated every five days.

General Calisthenics: Two sets of calisthenics were designed to be alternated every five days. The programs used were: (1) Calisthenics program one, which consisted of bouncing hips, pedaling, squat-thrust, trunk twist with knee touching, skipping forward and backward, deep knee bend, push-up from the knees, sit-up, and the swan to be performed to music and the modified pull-up to be performed on the bar without music, and (2) Calisthenic program two, which consisted of the treadmill, hip shifting, tip-toe heel and toe, spine extension with knee grasp, bicycling, turtle-walk, running in place for endurance, sit-up, modified push-up performed to music and the modified pull-up on the bar performed without music.

Structured Play: Structured play has been defined as "the practical application of an activity being learned

in class."¹ In this study, the control group performed structured play (basketball) in place of any type of conditioning program.

Strength Index: The Strength Index used in the study to test the muscular strength of the subjects was comprised of the right and left grip strength, the back and leg lift strength as well as the number of modified pull-ups and standard toe push-ups that could be performed.

Purpose of the Study

The purpose of the study was to determine if muscular strength could be developed more readily through a fixed circuit training program, a general calisthenic program or a structured play program (basketball). Specifically, the following null hypothesis was tested: There is no significant difference in the development of muscular strength of the subjects by using a fixed circuit training program, a general calisthenic program or a structured play program (basketball).

Delimitations of the Study

The study was subject to the following delimitations:

1. The 150 students selected from the Morgan City Junior High School, Morgan City, Louisiana,

¹R. Brian Staples, "The Effect of Circuit Training on Strength and Cardiovascular Endurance" (unpublished Master's thesis, University of Alberta, Edmonton, Alberta, 1967), p. 15.

during the academic year of 1970-1971 to participate in the study.

2. Active participation of the subjects in the experimental groups ten minutes a day, five days a week for six weeks.
3. The extent to which the selected instruments reliably and validly measured the muscular strength of the subjects.
4. The extent to which muscular strength was developed as the result of having used a fixed circuit training program, a general calisthenic program or a structured play (basketball) program of conditioning during the experimental period.

Summary

Strength has been cited as necessary for good appearance, as basic to good performance in skills, as valued highly as a measure of physical fitness and as necessary for efficient performance in normal daily activities. Because of the above factors, this study was conducted to determine whether or not there was a significant difference in the development of muscular strength as a result of having used a circuit training program, a general calisthenic program or a structured play program (basketball) for conditioning. The subjects who participated in the study were 150 junior high

school age girls who were enrolled in the Morgan City Junior High School, Morgan City, Louisiana, during the academic year of 1970-1971. Each subject completed the Strength Index test that was composed of the right and left grip strength, the back and leg lift strength as well as for the number of modified pull-ups and standard toe push-ups she could perform. A review of the related literature was made and has been presented in the following chapter.

CHAPTER II

A SURVEY OF SELECTED RELATED LITERATURE

Many investigators have attempted to determine the effects of different systematic training methods on the development of the basic components of physical fitness.¹ For the present study, two common methods were selected, progressive circuit training and general calisthenics, along with a structured play (basketball) program which was considered the control situation to determine which program, if any, was most conducive to the development of one of the most important components of physical fitness, muscular strength. Selected related literature concerning circuit training, calisthenics and structured play programs were reviewed and the most pertinent studies are presented in this chapter.

Calisthenics

Carr,² in 1962, completed an experimental study in which she analyzed the effect of a five minute period

¹Jacques Vrijens, "The Influence of Interval Circuit Exercises on Physical Fitness of Adolescents," Research Quarterly, IL (October, 1969), 595.

²Norma June 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).

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. The subjects were enrolled in three beginning badminton classes at the University of Washington in Seattle, Washington, during the fall semester of the academic year of 1962-1963.

One group consisted of twenty-one subjects who received a fifteen minute period of progressive body conditioning exercises. A second group 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 beginning badminton. The classes were held for thirty-nine minutes, meeting twice a week for five weeks.

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) the 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 as a measure of agility. The measures of badminton ability investigated by Carr were taken by the administration of the Miller Wall Volley Test,

the Scott and French Badminton Serve Test and the Fox Badminton Knowledge Test.

The effect of the instructional unit was ascertained by testing the differences between the pre-test results of each group. The use of a t-test of significance provided information as to the significance of the differences between groups in their physical fitness, badminton skill, and badminton knowledge before and after instruction. Carr concluded that the series of isometric and body conditioning exercises participated in by the subjects during the study for five and fifteen minutes, respectively, twice a week for five weeks, did not cause a significantly greater improvement in physical fitness among the students than did the groups having only badminton instruction. All groups improved significantly on the Miller Wall Volley Test, and the control group was the only group to improve significantly on the Scott and French Badminton Serve Test.

Fabriscius,¹ in 1962-1963, conducted an investigation to compare the development of physical fitness of fourth grade boys and girls who participated in a regular elementary school physical education program with those who participated in a physical education program that included the addition of calisthenics. The subjects were eighty boys and eighty-two

¹Helen Fabriscius, "Effect of Added Calisthenics on the Physical Fitness of Fourth Grade Boys and Girls," Research Quarterly, XXXVI (May, 1964), 135-140.

girls in the fourth grade in the Jefferson, Washington, and Mt. View schools of Corvallis, Oregon.

Physical fitness was measured by the Oregon Motor Fitness Test which considered muscular strength, muscular endurance, and, to a certain extent, coordination and power. Upon the basis of the pre-test scores, the classes were divided into a control and an experimental group, with the mean scores and the standard deviations approximately equal. In each class period, three minutes and nine seconds were spent on added calisthenics in the experimental classes. The classes met four times per week.

The calisthenics used were designed to exercise all parts of the body--arm and shoulder, trunk and abdomen, leg, foot and ankle, and general endurance. All classes ran three laps around the gymnasium, performed the "Airplane" twenty times, and the jumping jack twenty times. The experimental classes performed the following exercises: (1) arm circling (N=50), (2) burpee (N=10), (3) push-ups (N=10 to 15), (4) sit-ups (N=10 to 20), (5) squat bends (N=10), and (6) the heel-toe (N=10).

The mean differences were determined for each group from the pre-test to the post-test. A t-test of significance was computed. Fabriscius concluded that five or six calisthenics may be included in the lesson plan without gross loss of instructional time and with significant benefits.

Campney and Wehr,¹ in 1964, studied a calisthenic exercise program advocated for adults by the President's Council on Physical Fitness to decide its effect on selected components of physical fitness. Nine male and ten female undergraduate college students from the Florida State University, Tallahassee, Florida, volunteered for the study.

The training for physical fitness was preceded and followed by measurements relative to the Council's objectives for the program: strength, flexibility, improved general appearance, endurance, coordination and efficiency. Following the initial measurements, the subjects participated in the program of calisthenics recommended by the Council for ten weeks. Each day the subjects performed six warm-up calisthenics (bend and stretch, knee lift, wing stretcher, half knee bend, arm circles, and the body bender) followed by seven conditioning calisthenics (toe touch, sprinter, sitting stretch, knee push-ups, leg raiser, and flutter kick) followed by one of three circulatory activities (walk-jog-run, rope skipping, or run in place-straddle-hop).

The appraisal of an improved general appearance was approached through the measurement of segmental girths

¹Harry K. Campney and Richard W. Wehr, "Effects of Calisthenics on Selected Components of Physical Fitness," Research Quarterly, XXXVI (December, 1965), 394-402.

and total body weight. Cable tension strength was measured for ten movements (forearm flexion and extension, arm flexion and extension, trunk flexion and extension, thigh flexion and extension, and leg flexion and extension). Flexibility in four movements, trunk flexion and extension and arm flexion and extension, was measured with a goniometer. Circulorespiratory endurance improvement was not measured.

Pearson product-moment coefficients of correlation were used to correlate the test-retest values of all measurements for reliability purposes. Subject differences noted from pre-training to post-training with each test were transposed to T values, and male and female groups were separated as directed by the Wilcoxon matched-pairs signed-ranks test. Each T value was then compared to a critical value of T which for this study was set at the .95 level of confidence.

The results of the study indicated that it was unlikely that the calisthenic exercise program advocated by the Council could produce significant increases in strength for men and women during a ten week program except in isolated instances. While there was an increase in strength for the total group (male and female) for nine of the ten movements tested, only arm extension and thigh flexion were significant. Although the male subjects did not show a significant increase in either of the movements significant

for the total group, they did exhibit a significant increment with regard to the strength of the trunk extensors. The females followed the pattern of the total group with a significant strength increase in arm extension. The women did not show a significant increase in thigh flexion strength. Campney and Wher concluded that the Council's exercise program is not likely to produce significant improvements in general appearance for men and women when this objective is evaluated in terms of segmental girths and total body weight.

Taddonio,¹ in 1965, conducted a study to compare the physical fitness of children enrolled in two fifth grade self-contained classes--one with no physical education program and the other with a curriculum of fifteen minute daily periods of calisthenics. Subjects for the study were grade five boys (N=30) and girls (N=24) from the Washington School, Ferndale, Michigan. Physical fitness was determined by the AAHPER Youth Fitness Test which was administered before and after the experimental period which was four months in length. Application of the t-test of significance to the mean scores of the two groups on the pre-test indicated no statistically significant differences on any of the items in the test battery.

¹Dominick A. Taddonio, "Effect of Daily Fifteen-Minute Periods of Calisthenics Upon the Physical Fitness of Fifth-Grade Boys and Girls," Research Quarterly, XXXVII (May, 1966), 276-281.

The experimental group was subjected to a progressively graded calisthenic program for fifteen minutes daily for four months. A conscious effort was made to include exercises to strengthen the arms, shoulder-girdle, trunk and legs. The calisthenic exercises were selected from the bluebook printed by the President's Council on Youth Fitness and Titled "Youth Physical Fitness: Suggested Elements of a School-Centered Program."

Application of the t-test of significance to the post-test scores resulted in the following conclusions: (1) the boys in the control group improved significantly in the shuttle run; the girls in the control group improved significantly in pull-ups, sit-ups, the shuttle-run, the fifty-yard dash and the softball throw; (2) the boys in the experimental group improved significantly in the shuttle run, fifty-yard dash and the softball throw; the girls improved significantly in the shuttle run, fifty-yard dash and the 600-yard run-walk; (3) there was no significant difference between the groups or between the sexes on any of the test items; and (4) there was a significant difference between the mean changes of test scores between the control group and experimental group for boys only in the fifty-yard dash.

Hilsendager,¹ in 1966, made a comparison of a calisthenic and a non-calisthenic physical education program to determine whether ten minutes of calisthenics was more or less conducive to the development of fitness for participation in motor skill activities than classes without any calisthenic program. The subjects used for this study were thirty-seven male students in senior high school who were members of two physical education classes, one class with seventeen members and the other class with twenty members. Both classes met twice a week and three times a week on alternate weeks.

The two classes were initially tested on a battery of tests consisting of the standing broad jump, pull-ups, sit-ups, shuttle-run, and squat thrusts. For an interval of ten class periods, one group engaged in ten minutes of calisthenics before beginning the daily skill activity, while the other group did not engage in calisthenics but immediately began the skill activity. During the next phase of the program, a second ten class period interval, the two classes reversed procedures. This was continued until the class completed four, ten period intervals. The calisthenics to be used on odd numbered days consisted of: the jumping jack, squat jump, lame dog, frog jump, vertical

¹Donald Hilsendager, "Comparison of a Calisthenic and a Non-Calisthenic Physical Education Program," Research Quarterly, XXXVII (March, 1966), 148-150.

jump, push-up, holding sit-up, rocker, grass exercises and hip carry; and the calisthenics to be used on the even numbered days consisted of: the jumping jack, bouncing ball, crotch stretcher, the vertical jump, push-up, holding sit-up, rocker, grass exercises, and the hip carry. The non-calisthenic group participated in touch football, volleyball, basketball and handball, respectively, during the four different ten class periods.

To compensate for initial differences, the data were analyzed and interpreted by the analysis of covariance. Hilsendager concluded that calisthenics affected performance on the standing broad jump and squat thrust tests more than did touch football. Performance on the sit-up test was affected more by calisthenics than by either volleyball or basketball. There were no significant differences found among the performance on the test items when calisthenics was compared to handball.

Lewis,¹ in 1967, investigated the effectiveness of three methods of conditioning upon strength, speed, endurance and selected basketball skills. The subjects used in the study were ninety male subjects from freshman and sophomore physical education classes at Syracuse University in Syracuse,

¹Frederick B. Lewis, "A Comparison of Three Methods of Conditioning Upon Strength, Speed, Endurance, and Selected Basketball Skills" (unpublished Doctoral Dissertation, New York University, New York, 1967).

New York, who had at least one year of experience in interscholastic, intra-mural, church league, YMCA league or other types of organized basketball competition but who were not Syracuse University varsity players. The three methods of conditioning were the traditional techniques of conditioning usually characterized by exercise drills, the combined isometric-isotonic technique of resistive exercise, and the basketball play technique in which no formal conditioning took place; this was referred to as the control group. There were ten subjects in each treatment group, within each of the three classes. The groups were pre-tested and these scores were analyzed with the t-test of significance to determine the effectiveness of the sampling procedures. No significant differences were found between the groups.

The study ran for twelve weeks with the subjects participating three days a week for one hour each session. The training aspect of each one hour period consisted of fifty minutes of basketball instruction followed by a ten minute conditioning period.

The analyses of variance and covariance were used to compare the three groups at the end of the twelve week period. Lewis concluded that: (1) all three groups showed significant gains in speed, endurance, strength and basketball skills; and (2) the resistive exercise group was

superior on the four measures during the post-test when compared to the traditional group and control group, but not significantly so.

Guinther¹ reported, in 1966, a study that compared the overall physical fitness achievement gains of ninth grade girls who received instruction in three varied calisthenic programs: timed, flexible and no calisthenics (control). Guinther also compared the physical fitness achievement gains of the subjects when classified into subgroups according to the same average age, height and weight.

Two hundred seventy-three ninth grade girls enrolled in physical education at Arcadia High School of the Scottsdale School District, Phoenix, Arizona, during the 1965-1966 academic year were the subjects for this study. Classification of the subjects into age, height and weight categories was accomplished by using the Neilson-Cozens Classification Index. Each main treatment group, (A, times; B, flexible; C, control), was subdivided into four subgroups classified by age, height, and weight. A random sampling table was used to determine which treatment groups were to be timed, flexible or non-calisthenic.

¹Pauline Guinther, "The Effects of Timed and Flexible Calisthenics Instruction on Achievement in a Selected Physical Fitness Battery" (unpublished Doctoral Dissertation, University of Arkansas, Fayetteville, Arkansas, 1966).

The sit-up test, standing broad jump test and the push-up test were administered during the pre- and post-tests to obtain the data for the study. The experimental period lasted four weeks. The F test was used to compare the difference between the initial and final achievement gains in physical fitness. The analysis of variance with the multiple classification technique was used to make comparisons between the physical fitness achievement gains of the students in the three different programs as well as for comparisons between the four like subgroups.

Guinther found that the instruction from the timed calisthenic program significantly influenced the physical fitness achievement in the standing broad jump test. All three programs appeared to be equally effective for ninth grade girls' achievement in the sit-up test and the push-up test. The grouping of students into age, height and weight subgroups had a significant effect upon the standing broad jump test and the push-up test in all three groups. This grouping procedure had no significant effect upon achievement in the sit-up test for any of the three programs.

Stanley¹ studied the effects of calisthenics and game type programs on the physical fitness of elementary

¹William Jerre Stanley, "The Effects of Calisthenics and Game Type Programs on the Physical Fitness of Elementary School Children" (unpublished Doctoral Dissertation, University of Arkansas, Fayetteville, Arkansas, 1963).

school children. The results of this study were: (1) a program of exercises produced statistically significant results for both boys and girls on the sit-up test in the AAHPER Youth Fitness Test; (2) the exercise program caused an improved but not statistically significant performance of the boys in pull-ups; and (3) the exercise and game program resulted in a statistically significant increase in performance on the modified pull-up test for the girls.

Structured Play

Butts,¹ in 1966, investigated the contributions which ten physical education class activities--badminton, basketball, bowling, fencing, field hockey, folk dance, golf, tennis, tumbling-trampolining, and volleyball--made to the physical fitness and motor ability of college women. The subjects were 227 undergraduate women students at Central Methodist College in Fayette, Missouri, who participated in one of the ten activities for one semester, meeting two classes per week. The semester ran for four months.

Physical fitness was defined as the ability of a person to perform certain tasks requiring muscular activity. The Fleishman Basic Fitness Test was used to measure physical fitness. General motor ability was defined as the

¹Eunice Mignon Butts, "The Contribution of Ten Selected Physical Education Activities to Physical Fitness and Motor Ability" (unpublished Doctoral Dissertation, Syracuse University, Syracuse, New York, 1966).

ability to manipulate the body so as to permit an individual to learn motor skills easily and to become proficient in them. Motor ability was measured by the Scott Motor Ability Test for College Women.

Hypotheses were developed which predicted the relative ranking of the ten activities investigated as to their contribution to physical fitness and motor ability. The statistical analysis of the data involved testing the differences between group means, from pre-test to post-test. The Spearman Rank-Difference Correlation Coefficient was determined between the predicted and actual rank for each hypothesis. The Fisher Matched-t formula was applied to determine whether the differences were statistically significant.

Butts concluded that all of the ten groups improved their general motor ability scores as was measured by the Scott Motor Ability Test for College Women, but Basketball made the most statistically significant gains. Of the ten activities studied, Basketball, Field Hockey, and Tennis, respectively, made the greatest contribution to the improvement in physical fitness, as measured by the Fleishman Basic Fitness Test, and motor ability levels.

Calisthenics, Intensive Training, Isometric and Circuit Training

Westering,¹ in 1966, conducted an experiment to determine the effects of four physical conditioning programs and time variables upon selected measures of physical performance. One hundred-forty undergraduate college men who were enrolled in four tennis classes at the Colorado State College in Greeley, Colorado, were subjected to the following physical fitness test battery during the first week of class: (1) the Harvard Step Test, (2) fifty-yard dash, (3) two-minute sit-ups, (4) pull-ups, (5) standing broad jump, (6) bar-dips, (7) 600-yard run, (8) the shuttle run, and (9) the leg lift. (The results of the pull-up, bar-dip and leg lift tests were used to compute the simplified Physical Fitness Index for each student.)

The students were randomly divided into four experimental groups within each class. These four groups were: (1) isometric, (2) calisthenic, (3) intensive training, and (4) circuit training. For eight weeks, the groups participated in a regular tennis and physical conditioning program twice a week. The intensively trained group exercised for seven minutes each period, the isometric group exercised for four minutes each period, the circuit training group

¹Forrest Edward Westering, "The Effects of Various Programs of Physical Conditioning on Selected Measures of Physical Performance" (unpublished Doctoral Dissertation, Colorado State College, Greeley, Colorado, 1960).

exercised for thirteen minutes each period, and the calisthenic group exercised for fifteen minutes each period. After an eight week training period, the physical fitness test battery was re-administered to the subjects. The ~~t-test~~ of significance of the difference between the means was used to analyze the results of the pre-test scores within each group on each physical performance test to determine if there was an initial significant difference between the groups. The analysis of co-variance was used to adjust the post-test mean scores to compensate for the pre-test differences and to determine the significance of the various programs of physical conditioning on the selected measures of physical fitness.

Westering concluded that there was no significant improvement by the isometric group on any of the physical performance tests. The least amount of time was consumed by this program, but it was also the least effective program in the development of physical performance. (Of the ten items, the calisthenic group improved significantly on the simplified Physical Fitness Index, bar-dips, and sit-ups). The circuit training and intensive training groups improved significantly in seven of the ten physical performance tests: fifty-yard dash, the shuttle run, pull-ups, the broad jump, leg lift, 600-yard run, the Harvard step test, and the simplified Physical Fitness Index. The circuit trained group

was significantly superior to the other groups in pull-ups and bar-dips, leg lift and the simplified Physical Fitness Index.

A higher level of physical performance was developed in a shorter period of time through the use of a circuit training or intensity training program as compared to a conventional calisthenic program. Although the circuit training program consumed thirty-three per cent more time than the average of the four programs, it was significantly more effective than the other three programs in promoting overall improvement in physical performance. The intensity and circuit training groups improved their endurance significantly over the other groups as was measured by the Harvard step test and the 600-yard run. The intensively trained group improved significantly over the other groups in sit-ups.

Circuit Training

Nunney,¹ in 1960, 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 were comprised of two groups of twelve college men from an intermediate swimming class at the University

¹Derek N. Nunney, "Relation of Circuit Training to Swimming," Research Quarterly, XXXI (May, 1960), 188-199.

of California, Los Angeles, California. The subjects were equated on the basis of a fifteen-minute endurance swim test using the front crawl only. Both volunteer groups were tested for swimming speed over thirty-three and one-third yards and their ability to perform dips, chins, the vertical jump, and push-ups. Height and weight were also measured.

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

The significance of the difference between the means of the pre-test and post-test scores for all factors, and for both groups was calculated. The experimental group was then compared to the control group by using critical ratios. Nunnely concluded that the experimental group made significant gains in swimming endurance and speed, weight, chins, and push-ups, but did not improve significantly in swimming speed, chins, dips or the vertical jump, push-ups or body height. The control group had a tendency to lose strength as was measured by the ability to perform chins, the vertical jump, and push-ups. There were no significant differences between the groups in swimming endurance, dips, the vertical jump, or push-ups.

Brown,¹ in 1961, conducted a study to determine the effect of a circuit training program on the physical fitness of grade five girls. Two classes of grade five girls at Kerrisdale Elementary School in Vancouver, British Columbia, participated in this study. All students in these two classes were given the AAHPER Youth Fitness Test. One class was selected to be the experimental class, and the second class became the control class.

The experimental class participated in a ten minute daily circuit training program at the beginning of each lesson for eight weeks. The remainder of the lesson was devoted to the regular physical education program. The control class participated in the regular physical education program for eight weeks. At the end of eight weeks both groups were re-administered the AAHPER Youth Fitness Test.

Statistical treatment of the data involved finding the significant differences between the initial and final test scores and between the group scores. The mean, standard deviation, and standard error were found for the initial and final tests of each group, and the significance

¹Annie May Brown, "The Effect of Circuit Training on the Physical Fitness of Grade 5 (Five) Girls" (unpublished Master's thesis, Department of Physical Education and Recreation, University of British Columbia, British Columbia, 1961).

of the difference between the means of the two groups was calculated.

The experimental group showed significant gains in performance on the modified pull-up, sit-up, shuttle run, standing broad jump, softball throw and the 600-yard run-walk. The control group showed significant gains in performance on the sit-up, shuttle run, standing broad jump, softball throw and the 600-yard run-walk. The control group performed significantly better than the experimental group in the shuttle run. Both the experimental and control group improved significantly in total physical fitness. There was no statistical significant difference between the mean gains of the two groups.

Komornicki,¹ in 1964, conducted an investigation to ✓ determine the effects of a progressive circuit training exercise program on the physical fitness of elementary boys and girls. - One hundred and eighty subjects were randomly selected from three elementary schools in the city of Chester, Pennsylvania, for the experimental group and one hundred and and eighty for the control group (ninety boys and ninety girls in each group).

¹James Walter Komornicki, "The Effects of a Progressive Circuit Training Program on the Physical Fitness of Elementary School Boys and Girls" (unpublished Doctoral Dissertation, Temple University, Philadelphia, Pennsylvania, 1967).

All subjects were measured for the following factors:

(1) age, (2) height, (3) weight, (4) AAHPER Youth Fitness Tests, (5) the Rogers' Strength Index Battery, (6) the Rogers' Physical Fitness Index, (7) a bent-arm hang test, and (8) a push and a pull strength test. All subjects were given a pre-test and a post-test. The progressive circuit training program was performed by the subjects of the experimental group three times a week as a part of their thirty-minute physical education class period. The control group participated in a planned physical education curriculum for one-half hour three times per week. The study lasted twelve weeks. A computer program designed for analysis of covariance was used for the analysis of the data. Komornicki concluded that: (1) the experimental group performed significantly greater in the push strength than the control group; (2) the control group performed significantly greater than the experimental group in the shuttle run. No significant differences were found between the two groups.

Banister,¹ in 1965, conducted a study to investigate current methods of fitness training. The subjects were comprised of four groups of fourteen to ~~sixteen~~ sixteen year-old boys in a North Vancouver junior high school who were closely

¹E. W. Banister, "A Comparison of Fitness Training Methods in a School Program," Research Quarterly, XXXVI (December, 1965), 397-392.

matched upon the basis of their scores on McCloy's Classification Index, the Larson Strength Test, and the Harvard Step Test.

Banister hypothesized that advantages lie with a program aimed specifically and separately at strength and cardiovascular endurance development. Each group was randomly assigned to a training regimen. The groups followed their different training routines for one period each school week until eight training sessions were completed. The group activities consisted of: (1) an interval-circuit group which performed on a special circuit emphasizing maximum resistance and then ran two miles, and included the barbell press, barbell curl, barbell reverse curl, barbell tricep snatch, barbell rowing, dumbbell side bends, dumbbell straddle jumps, dumbbell lying lateral raise, bench press, chins, sit-ups, and trunk extensions; (2) a circuit-run group which used standard circuits of varying intensity with submaximal resistences and then ran two miles; (3) a circuit-activity group which performed on the same standard circuits as the preceding group, but they supervised the circuit run group during the first one-third of their time and then they joined the circuit run group in the exercises, thus approximately one-third of the circuit-activity group's time was inactive; and (4) a games group that played games during the whole of their training (basketball, soccer, volleyball, football and

softball). The standard circuits used by all circuit training groups except the interval-circuit group were: sit-ups, chins, the shuttle run, step-ups, straddle jumps, squat thrusts, trunk extensions, push-ups, barbell curls, and the barbell press with each group doing a different number of repetitions and using different target times. The ~~t-test~~ of significance was applied to the data to determine if there was a significant difference between the means of the pre- and post-tests and between the groups.

Banister concluded that the only significant change made was in the composite score of the interval-circuit group over the circuit-activity group. Although the gains on the composite score made by the circuit-run group, these gains did not reach a statistically significant level over the other groups. Comparison of the results of the four methods showed that the method of using progressive resistances organized so that maximum weights were always used, combined with endurance running, was the only method to show superiority over any other group on a composite fitness score.

Hakes and Rosemier,¹ in 1965, attempted to determine the relative effectiveness of three different time allotments

¹Richard R. Hakes and Robert A. Rosemier, "Circuit Training Time Allotments in a Typical Physical Education Class Period," Research Quarterly, XXXVIII (December, 1967), 576-584.

to circuit training and active games in a typical physical education class period, by assigning treatment to groups with either a five and twenty-five minute, a ten and twenty minute, or a fifteen and fifteen minute distribution of time. Seventy male volunteers from a college physical education program were assigned by the university registrar to one of the three morning class periods during the spring semester of 1965.

Pre- and post-measures were taken on six circuit exercises: leg-exchanges, squat thrusts, sit-ups, bench-steps, push-ups, and pull-ups. One class of twenty-four subjects was exposed to five minutes of circuit training followed by twenty-five minutes of active games (basketball, soccer, touch football, touch rugby or volleyball). A second class of twenty-five subjects undertook ten minutes of circuit training and twenty minutes of three active games, while a third class of twenty-one subjects was assigned fifteen minutes of circuit training and fifteen minutes of active games. The particular game was held constant for all three treatment groups each day.

The statistical treatment of the data involved computing the initial and final mean scores for each of the three time allotment groups and computing the standard deviation of each group's scores. Change in performance was determined by subtracting the initial score from the

final score for each individual within a group and then averaging. Simple t-tests for correlated samples were conducted to determine the statistical significance of this change. In order to determine the effectiveness of time allotments, an analysis of covariance was performed among the three groups on each of the six exercises.

Hakes and Rosemier concluded that significant improvement was observed for all three groups on all exercises. The fifteen minute allotment of time for circuit training resulted in significantly better performances on sit-ups and leg-exchanges than did the five minute allotment. The group assigned a ten and twenty minute allotment to circuit training and supplemental activity was observed to be significantly superior on the bench step exercise to the fifteen and fifteen minute allotment. There was no significant difference among the three groups on the pull-up exercise as based on the improvement scores.

Carter,¹ in 1966, conducted an investigation to determine the relationship of participation in selected physical fitness activities and skill in archery and

¹Ginger Kelly 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).

badminton on two classes of freshman college women during the fall semester of the academic year of 1965-1966, at Amarillo College, Amarillo, Texas. Two individual sport classes taught during the fall semester were arbitrarily chosen to be the subjects for the study. Forty-nine students were used as subjects. The students were divided into an experimental group consisting of twenty-six and a control group consisting of twenty-three.

The control group received seven weeks of archery followed by seven weeks of badminton instruction for a fifty-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 during each class period plus ten minutes of specifically related progressive conditioning exercises three times a week.

The t-test of significance was applied to the data of each test between each group in order to compare the skill level and fitness gains among the groups. Initial and final test comparisons were made within the groups to help ascertain the feasibility of the basic hypothesis. Carter concluded that specific conditioning exercises designed to develop the fitness components necessary for archery and badminton skills did not significantly improve the skill factors in these two sports. As for the fitness

components, Carter further concluded that the experimental group was significantly superior to the control group on the push-up test and in muscular arm and shoulder-girdle strength.

Staples,¹ in 1967, conducted an investigation to determine the effects of a program of circuit training on selected strength and cardiovascular endurance. The program was administered over a ten week period, five days a week for a duration of ten to twelve minutes per day in which from two to three circuits per individual were performed. The subjects were eighth and ninth grade boys (N=60) and girls (N=38) from the Devon High School in Devon, Alberta.

The boys and girls were treated separately on the cardiovascular endurance test and the muscular strength tests, and each sex had an experimental group, which performed circuit training and a control group which performed structured play in lieu of circuit training as a part of a daily physical education class. The regular circuit consisted of the following isotonic exercises: chins, knee bends, push-ups, bench jumps and skips with the "Matterhorn" peg board climbing as a supplemental activity for all circuits.

¹R. Brian Staples, "The Effect of Circuit Training on Strength and Cardiovascular Endurance" (unpublished Master's thesis, University of Alberta, Edmonton, Alberta, 1967).

The weight training circuit exercises consisted of: two arm curls, bench presses, squats or knee bends, bench jumps, two arm presses and dumbbell swings. The endurance circuit involved the running of laps around the perimeter of the gymnasium floor.

Because the present study was related to strength, this review of Staples' study was limited to its effect on strength development of girls alone. Staples measured grip strength with the Smedley Adjustable Grip Dynamometer. He measured leg lift and back lift with the cable tensiometer by following the instructions given by Clarke. He also tested knee extension, elbow flexion and extension with the cable tensiometer. After testing for strength, Staples added all of the scores and obtained a summed strength score.

Staples compared the circuit training group (N=18) and the structured play group (N=20) initially to see if these groups were significantly different in terms of summed strength values. Staples concluded that for the development of strength in girls the circuit training group improved significantly greater than the control group in summed strength values.

Vrijens,¹ in 1968, conducted a study to determine whether it was possible to improve physical fitness of

¹Vrijens, op. cit., pp. 595-599.

adolescents by inserting interval circuit exercises in a regular physical education program. Eleven volunteers were compared to nine students in a scheduled physical education class. The eleven adolescents in the experimental group had a mean age of 16.7 years, and the group on nine control subjects had a mean age of 17.1 years. The sex of the subjects was not identified in the study. The groups were considered equivalent as their initial means were not significantly different for either the anthropometrical or functional tests used by the investigator.

The experimental group participated in the following circuit training program three times a week for six weeks: (1) bench stepping, (2) pull-ups, (3) squat thrusts, (4) sit-ups, (5) squat jumps, (6) push-ups, (7) jump exercise at bar, (8) rope climbing, (9) endurance exercise with a bench, and (10) exercise for the back muscles. An endurance exercise was included to be alternated each time with a specific strength exercise. The circuit was performed according to the interval principle which involved strenuous activity for a given time which was fixed at ninety per cent of the individual's performance capacity. The control group merely participated in a regular physical education class. A pre- and post-test was administered to determine the physical fitness status of the subjects.

Height, weight and circumference of the thigh and arm were the anthropometrical measurements taken for the study. The Harpenden skinfold caliper was used according to the method of McCloy to measure subcutaneous fat. A precise idea of the muscular development and superficial fat layer of the thigh was determined by using soft tissue roentgenographic pictures of the thigh. The following criteria were used to determine the functional aspect of the subjects' physical fitness: (1) maximum oxygen uptake by a vita maxima test, (2) approach of heart and circulation function by determining the heart volume, (3) the working pulssum for a ten minute submaximal work load on a bicycle ergometer, and (4) maximum oxygen pulse. Vital capacity, maximal ventilatory capacity, and ventilation equivalent were measured.

Vrijens concluded that after six weeks, favorable effects on morphological measurements were observed. For the experimental group, he found that it had a marked gain (not significant) in weight which was due mainly to muscular development. This was determined by the skinfold measurements and the roentgenographic pictures. There was a non-significant decrease in the fat layer of the thigh. Thigh, arm and chest girth increased significantly in the experimental group, while the same changes for the control group were small and not significant.

Maximum work capacity and maximal oxygen intake were significantly increased in the experimental group. Also for this group, the pulse rate adaptation after six weeks of training was more efficient than before the program and the heart volume was significantly enlarged. A significant gain of fifty heart beats for the ten minute submaximal ergocycle work was observed for the experimental group. A significantly more efficient adaptation of circulation was also confirmed. A significantly higher oxygen pulse pointed to an increased stroke volume and a more efficient peripheral gas exchange for the experimental group. The control group made no significant gains in any of these tests.

Vrijens suggested that results obtained under strict experimental conditions demonstrate that the physical fitness of adolescents can be improved after only a few weeks by inserting intensive exercises of short duration in a regular physical education program. He stated further that emphasis should be given to the significant value of circuit training for the regular physical education program. The exercises should be sufficiently intensive with near maximal loads, but the intensity should be fixed individually in accordance with each pupil's physical capacities.

Summary

One of the principal objectives in physical education is the improvement of physical fitness of youth. Much work

has been done to determine the effects of different systematic training methods on the development of the basic components of physical fitness.

Taddonio in a comparison of physical fitness of two fifth-grade classes, one with no physical education program and the other with a fifteen minute daily calisthenic period, found that the girls in the control group improved significantly in pull-ups, sit-ups, the shuttle run, the fifty-yard dash and the softball throw. The girls in the experimental class improved significantly in the shuttle run, fifty-yard dash, and the 600-yard run-walk. Taddonio did not find any significant difference between the groups on any of the test items.

Hilsendager found that calisthenics affected performance on the standing broad jump and squat thrust tests more than did touch football. He also found that performance on the sit-up test was more affected by calisthenics than by either volleyball or basketball. Hilsendager did not find any significant differences among the test item performances when calisthenics was compared to handball.

Butts found in her study of ten physical education class activities that Basketball, Field Hockey, and Tennis, respectively, contributed more to the improvement of the physical fitness and motor ability levels of her subjects. This study ran for four months.

Westering found that circuit training was significantly more effective than calisthenics, isometrics or intensity training in promoting overall improvement in physical performance. Westering's study involved using ten physical performance tests.

Nunney investigated the relationship between circuit training and the improvement of endurance, speed, weight and strength of swimmers and found significant gains in swimming endurance and speed, body weight, chins, and push-ups, but did not find a significant improvement in the dips or the vertical jump. The control group he used had a marked tendency to lose strength as was measured by their ability to perform chins, the vertical jump and push-ups.

Brown studied the effects of a circuit training program on the physical fitness of grade five girls and found that a physical education program which included a ten minute circuit training program improved physical fitness as measured by the AAHPER Youth Fitness Test. Staples found that circuit training influenced girls in a significantly superior way in the experimental group as compared to those in the control group with respect to summed strength values.

Vrijens found that results obtained under strict experimental conditions demonstrate that the physical fitness of adolescents can be improved after only a few weeks by inserting intensive exercises of short duration in a regular

physical education program. Vrijens stressed that emphasis should be given to the significant value of circuit training for the regular physical education program.

The results of the related studies can be interpreted as either being inconclusive of any single method of developing fitness components or that each program is unique. It may be reasoned that further study in this area is needed. The present study compared a circuit training program, a general calisthenic program and a structured play (basketball) program to determine which, if any, was more conducive to the development of muscular strength in junior high school age girls. The procedures for the study are presented in Chapter III.

CHAPTER III

PROCEDURES OF THE STUDY

Introduction

The present investigation was a study of the development of muscular strength of junior high school age girls as a result of having participated in two different conditioning programs: circuit training and general calisthenics. The Strength Index, which was composed of the right and left grip strength, back lift strength, leg lift strength and the number of push-ups and modified pull-ups that a subject could perform, was administered to the subjects during the pre-test and the post-test periods. Between the pre-test and the post-test, a period of six weeks, one experimental group participated in a circuit training program while the other experimental group participated in a general calisthenic program. A control group participated in a structured play program (basketball). The total number of participants was 123. The subjects were tested during the fall semester of the academic year 1970-1971, during which time they were enrolled at the Morgan City Junior High School in Morgan City, Louisiana.

Preliminary Procedures

The literature related to circuit training, calisthenics and muscular strength testing was reviewed. A tentative outline was prepared and presented during a Graduate Seminar of the College of Health, Physical Education and Recreation at the Texas Woman's University in Denton, Texas, on the ninth of August, 1970. After the Graduate Seminar, a corrected prospectus of the study was filed with the Dean of Graduate Studies. Permission was secured from Mr. Cyrus Provost, Principal, to use all female students enrolled in the investigator's classes at the Morgan City Junior High School in Morgan City, Louisiana, for the study.

Criteria for Selected Instruments

The hand dynamometer and the back and leg dynamometer were used to measure grip strength and back and leg strength, respectively, for each subject. To compute the Strength Index requires data collected with the above named instruments, and both instruments were obtained from the College of Health, Physical Education and Recreation of the Texas Woman's University. The instructions for using both instruments were easily understood by the subjects, and only a few minutes were required to obtain the strength measurements with each instrument.

The pull-up apparatus used to test for the number of modified pull-ups each subject could perform was constructed so as to be adjustable to the height of each subject. Campos used the device in a comparison of arm and shoulder girdle strength of junior high school girls and a complete description of the device may be found in that study.¹

The Strength Index was selected for the measurement of muscular strength because of its high reliability and objectivity, and especially because it involved testing the arm, leg, back and grip strength of each subject which encompassed the major body parts. The Strength Index was originally found to have a reliability coefficient of .94.² The literature provides many examples for different age and sex groups where the reliability was found to be very high. The high reliability of strength test scores guarantees high objectivity as long as mechanical instruments of measurement are used which are susceptible of being read within narrowly defined units.³ The objectivity of the Strength Index was found to be .94.⁴ Face validity has been assumed for the Strength Index. Lung capacity

¹Sara Campos, "A Comparison of Arm and Shoulder Girdle Strength of Junior High School Girls" (unpublished Master's thesis, College of Health, Physical Education and Recreation, Texas Woman's University, Denton, Texas, 1970), p. 61.

²Rogers, op. cit., p. 149.

³Ibid.

⁴Mathews, op. cit., p. 77.

measurement was omitted from the test battery because it was not considered to be a measurement of muscular strength.¹

Procedures for the Administration of the Strength Tests

The instructions for measuring grip strength, back lift strength and leg lift strength used in the study were those stated by Mathews.²

Grip Strength

For measuring grip strength, Mathews recommended that:

(1) The subject's hands should be first chalked. Place the concave edge of the manuometer between the first and second joints of the fingers, with the dial toward the palm. (2) The subject is allowed any movement while squeezing the instrument, provided he does not hit any object with his fist. The most common movement is the upper cut. (3) The right grip is tested first.³

Back Lift Strength

For measuring the back lift strength, Mathews suggested that:

(1) The subject stands on the dynamometer base, with feet parallel and about 6 (sic) inches apart. The malleoli of the ankle joint should be as nearly opposite the attachment of the dynamometer to its base as possible. (2) The subject stands with head erect, back straight, and chalked fingers extending down the thighs. The examiner holds the bar at the tips of the subject's fingers to obtain proper adjustment. The bar is then connected to the chain. (3) The subject bends slightly forward, with knees straight, and grasps the bar near either end. (4) The subject is

¹Charles Harold McCloy, Tests and Measurements in Health and Physical Education (New York: F. S. Crofts and Company, 1939), p. 129.

²Mathews, op. cit., pp. 65-67.

³Ibid., p. 65.

asked to lift straight up while the examiner spots by placing his hands over the subject's to prevent the latter's hands from slipping.¹

Leg Strength

Mathews explained that for measuring the leg lift,

(1) The subject assumes the same position as in the back lift. A belt is used around the subject's hips to stabilize the bar, as the lifting force of the legs is much too great to be held by the hands. (2) The subject holds the center of the bar, palms down, at the level of the pubic bone. (3) As the tester faces the subject, the belt loop is attached to the left end of the bar. The belt is then brought around the lower portion of the sacrum to be attached to the right end of the handle (4) To make the attachment to the right side of the bar, proceed as follows: Form a loop in the belt by folding it back. The loop should be just opposite the end of the handle. Holding the loop in the left hand, reach down between the belt and subject to grasp the end of the belt in the right hand. Slide the loop over the bar and pull the end of the belt up against the subject's hip. With the belt in this position, the pulling force of the bar will hold the tail end of the belt against the subject's body, preventing the bar from sliding--similar to a timber hitch. (5) The subject, with head up and back straight, bends at the knees. The handle is hooked onto the chain so that the subject's knees are flexed between 115 and 125 degrees. (6) The bar will be on the subject's thighs during the lift. The subject may place his hands either in the middle or at the ends of the bar. (7) The subject is asked to lift straight up. At the completion of the lift the subject's knee joints should be almost completely extended to insure maximum effort.²

Arm Extension and Forearm Flexion Strength

The instructions that were used for the administration of the pull-ups were those provided by McCloy.³

These instructions were:

¹Ibid., pp. 65-66.

²Ibid., p. 67.

³McCloy, op. cit., p. 33.

The horizontal bar . . . should be adjusted to about the height of the bottom of the sternum. The girl grasps the bar . . . with palms upward in such a position that when she slides her feet under the bar with body straight, arms and body for approximately a right angle. The weight should rest on the heels, The girl should then pull up with a straight body as many times as possible.¹

No score was given for a performance during which the body sagged or the hips were raised.

Arm Flexion and Forearm Extension Strength

Hinson² suggested the full push-up to be used as a measure of shoulder girdle and upper arm strength because it required little more muscular activity than that required by the bench push-up which was recommended by Mathews,³ and does not depend upon the use of equipment. The suggestion of Hinson was followed and therefore the test required that the student assume a starting position lying prone upon the floor. After assuming this position, the legs were kept straight and the hands were placed on the floor directly beneath the shoulders with the weight of the body on the hands and the toes. The body was pushed up by means of straightening the arms while keeping the body in a straight trunk alignment. The body was lowered until the chest

¹Ibid.

²Marilyn M. Hinson, "An Electromyographic Study of the Push-up for Women," Research Quarterly, XII (May, 1969), p. 311.

³Mathews, op. cit., p. 72.

touched the floor when an immediate push-up was required. This cycle was repeated as many times as possible. No sagging or arching at the hips was permitted, and no rest was permitted between each push-up.

Instructions for the Performance of the Strength Tests

A specific set of instructions for performing each strength test was presented to the subjects before they were tested. The exact instructions may be found in the Appendix.

A complete demonstration was performed for each test for the students. The testing period lasted four days. The best score for each performance was recorded on the score sheet. A copy of the score sheet has also been presented in the appendix.

Criteria for Selection of Testing Assistants

Two assistants were selected from each class and given instructions for holding the scale used for measuring back and leg lift strength. A third student was shown how to record the scores on the score sheet. These students were selected because each had exhibited leadership ability, a sense of responsibility in class, and an eagerness to assist in the testing procedures.

Conditioning Programs Used by the Experimental Groups

The two conditioning programs used by the experimental groups were circuit training and calisthenics. The control group did not participate in a conditioning program during the experimental period. The exercises selected were based upon criteria established prior to any activity. The circuit training program was divided into two sets of exercises. The first set, which was performed during the first week and every other week thereafter, consisted of the following exercises: (1) squat thrust, (2) bouncing hip, (3) modified pull-up, (4) wall push-ups on the finger tips, (5) supine back-lift, (6) bench stepping, (7) sit-up, (8) wrist roll, (9) criss-cross run over a two inch line, and (10) parallel bar hold. The second set of circuit exercises which were performed during alternate weeks, consisted of the following exercises: (1) treadmill, (2) wrist roll, (3) bouncing hip, (4) push-ups on the hands and toes, (5) sit-up, (6) parallel bar travel through, (7) turtle walk, (8) toe raises, (9) modified pull-ups on the bar, and (10) bench stepping. Each exercise was performed for forty-five seconds with a fifteen second rest period between each exercise. The exercises were performed in the order listed above for each circuit. At the beginning of the study, each student was assigned to an exercise station

at which she was to start her exercises daily. The subjects went through the assigned circuit one time during each class period.

The calisthenic program used by one experimental group was also divided into two sets of exercises. Set one consisted of the following exercises: (1) bouncing hips (N=8 for ninety seconds), (2) pedaling (N=12 for sixty-three seconds), (3) squat-thrust (N=16 for thirty seconds), (4) trunk twist with knee touching (N=6 for thirty-three seconds), (5) skipping forward and backward (N=8 for sixty seconds), (6) deep knee bends (N=12 for thirty-six seconds), (7) toe push-up (N=5 for thirty-one seconds), (8) sit-up (N=12 for forty-eight seconds), (9) swan (N=8 for thirty-five seconds), and modified pull-ups (N=10 for twenty seconds). The second set of calisthenics consisted of the: (1) treadmill (N=16 for thirty seconds), (2) bouncing hips (N=8 for ninety seconds), (3) tip toe heel and toe (N=2 sets for thirty-five seconds), (4) spine extension with knee grasp (N=8 for twenty seconds), (5) bicycling (N=24 for thirty seconds), (6) turtle walk (N=64 for eighty seconds), (7) running in a stationary position (N=30 for thirty seconds), (8) sit-up (N=12 for forty-eight seconds), (9) modified push-up (N=20 for fifty seconds), and (10) modified pull-ups (N=10 for twenty seconds). The experimental group that used the calisthenic program performed the first set during the

first week and every other week thereafter, and the second set during the rest of the experimental period. The first set of calisthenics lasted 7.40 minutes and the second set lasted 7.55 minutes. The remainder of the ten minute exercise period was used to give all of the subjects in the calisthenic group an opportunity to complete the pull-ups. No rest period was provided for the calisthenic group except for the time that each subject had to wait for her turn to do the pull-ups. The progression of the exercise for the calisthenics was in the order mentioned previously in this paragraph.

The exercises used in both the circuit training program and the calisthenic program were selected because each subject, by performing the exercises in her program, was given an opportunity to develop hand and finger strength for her grip as well as arm, back and leg strength, all of which were measured by the Strength Index. The trunk twist exercise and the sit-up exercise were included to strengthen the abdominal muscles which were used as antagonistic muscles to the back muscles during the back lift test for back lift strength. The description of each exercise which has been included in the Appendix supports the criteria for the selection of each exercise for the study.

Selection of Subjects

The subjects selected for the study were 123 junior high school girls. The group comprised all students taught by the investigator during the fall semester of 1970-1971. Only those students who attended class and who participated during the entire experimental period were selected as subjects for the study. The five classes that were available for use in the study were randomly assigned to either the calisthenic, circuit training or structured play programs (basketball) used in the study.

Procedures for Analysis of Data

The statistical procedure used in the study was primarily the analysis of variance.¹ The analysis of variance technique was applied to the data yielded by the pre-test to determine whether or not there was a significant difference between the groups. It was also applied to the difference occurring between the pre-test and the post-test score to determine if a significant difference between the two scores for each group on each test was a result of the programs. A final comparison was made between the three groups to determine which, if any, was most conducive to the development of muscular strength in the subjects. The results

¹Allen L. Edwards, Statistical Methods, Second Edition (Dallas, Texas: Holt, Rinehart and Winston, Inc.), p. 257.

from the statistical computations are found in Chapter Four. The final procedures for the study included summarizing the data, the formulation of a conclusion of the problem based upon the findings of the study, making recommendations for further studies, compilation of a bibliography, and the preparation of a written report.

Summary

The present investigation was designed to determine whether a circuit training conditioning program, a calisthenic conditioning program or a structured play program (basketball) was most conducive to the development of muscular strength in junior high school girls. The related literature was reviewed and criteria were established for the selection of the test used, testing instruments, administration of the tests, selection of the exercises, administration of the exercise sessions, selection of the subjects, and the analysis of the data.

Female students from the Morgan City Junior High School (N=122) participated in the study during the fall semester of the 1970-1971 school year. Each subject was administered six strength tests at the beginning and again at the end of the study. After the pre-test, the subjects participated in assigned conditioning programs for ten minutes a day, five days a week for six weeks. The

calisthenic program consisted of sixteen different exercises which were divided into two different sets. The circuit training program used was also divided into two different sets of exercises with a total of seventeen different exercises. The control group participated in a basketball program during the entire experimental period. The data were analyzed by a one way analysis of variance technique. Chapter Four presents and interprets the data for the study.

CHAPTER IV

PRESENTATION AND ANALYSIS OF THE DATA

The purpose of the present study was to compare the effectiveness of a calisthenic, a circuit training and a structured play program on the development of muscular strength of junior high school girls. Muscular strength was measured by the Strength Index which included the following test items: right and left grip strength, back and leg lift strength, and the maximum number of modified pull-ups and standard push-ups that could be performed by each subject.

Performance of the Calisthenic, Circuit Training and Structured Play Groups on the Pre- and Post-Test Scores for Each Item

The mean, standard deviation, standard error of the pre- and post-test for each item for each group and the difference between the pre-test and post-test means were computed and are presented in Table 1. The summed strength score was obtained by adding the right grip strength, left grip strength, back lift strength, leg lift

strength and arm strength scores together.¹ Arm strength was determined by the formula:²

$$\text{Arm strength} = (\text{pull-ups} + \text{push-ups}) \times \left(\frac{W}{10} + H - 60 \right)$$

in which W equals the weight of the subject in pounds, and H equals the height of the subject in inches. It should be noted that each group improved from the pre-test to the post-test period with the exceptions of the calisthenic group in the back lift and the structured play group in the right hand grip test. The calisthenic group achieved the highest scores in four of the items initially but did not retain that position in the back lift at the end of the experimental period. The calisthenic group was not best in the summed strength score initially but in the final test produced the highest mean score for the summed strength score. The circuit training group, similarly, achieved the highest scores in four items of the pre-test but at the post-test, this group performed better than the other two groups in only three items. The structured play group did not perform better in any of the initial test items, but during the post-test recorded the highest mean score on the back lift.

¹Clarke, op. cit., p. 150.

TABLE 1

PRE- AND POST-TEST SCORES FOR EACH ITEM AND THE DIFFERENCE
BETWEEN THE MEANS FOR THE CALISTHENIC, CIRCUIT
TRAINING AND STRUCTURED PLAY GROUPS*

Item	Calisthenic		Circuit Training		Structured Play	
	Pre	Post	Pre	Post	Pre	Post
Right Grip						
\bar{X}	57.327	62.086	52.473	56.657	53.592	52.148
SD	1.327	1.999	1.778	1.672	2.229	1.773
SE	0.232	0.262	0.288	0.271	0.429	0.341
\bar{X} Diff	4.759		4.184		-1.444	
Left Grip						
\bar{X}	52.448	55.879	45.947	49.736	47.814	47.888
SD	1.624	1.885	1.900	1.887	2.020	2.180
SE	0.213	0.247	0.308	0.306	0.388	0.419
\bar{X} Diff	3.431		3.789		0.074	
Back Lift						
\bar{X}	252.241	248.362	239.605	251.315	235.740	253.518
SD	6.982	9.117	9.094	8.234	11.775	14.245
SE	0.916	1.197	1.475	1.335	2.266	2.741
\bar{X} Diff	-3.879		11.710		17.778	
Leg Lift						
\bar{X}	671.982	833.448	655.526	762.105	622.222	718.703
SD	24.981	31.350	31.362	26.938	24.933	37.573
SE	3.280	4.116	5.087	4.369	4.798	7.231
\bar{X} Diff	161.446		106.579		96.481	

*All data presented in pounds.

TABLE 1--Continued

Item	Calisthenic		Circuit Training		Structured Play	
	Pre	Post	Pre	Post	Pre	Post
Pull-Up						
\bar{X}	19.706	28.275	24.157	33.421	23.111	24.037
SD	1.195	1.442	1.484	1.763	2.099	2.458
SE	0.156	0.189	0.240	0.285	0.404	0.473
\bar{X} Diff	8.569		9.264		0.926	
Push-Up						
\bar{X}	5.327	7.155	7.578	10.078	4.518	5.740
SD	0.798	0.925	1.136	1.358	0.889	1.083
SE	0.104	0.121	0.184	0.220	0.171	0.280
\bar{X} Diff	1.828		2.500		1.222	
Arm Strength						
\bar{X}	293.493	425.612	339.562	494.188	336.748	349.446
SD	21.673	27.191	26.913	33.013	36.948	40.616
SE	2.845	3.570	4.366	5.355	7.110	7.786
\bar{X} Diff	132.109		154.626		12.698	
Summed Strength						
\bar{X}	1324.085	1619.612	1371.851	1613.977	1293.599	1421.705
SD	42.473	61.475	67.479	59.320	57.137	69.733
SE	5.577	8.072	10.949	9.623	10.996	13.420
\bar{X} Diff	295.527		242.126		128.106	

Analysis of Variance of Pre-Test Summed
Strength Scores for Determining
Initial Equivalency of the
Experimental and
Control Groups

An analysis of variance was computed for the pre-test summed strength scores for the calisthenic, circuit training and structured play groups to determine if the groups were initially equal. The summed strength scores were derived for each group by adding the right grip strength, left grip strength, back lift strength, leg lift strength and arm strength scores together. A summary for the analysis of variance of the pre-test summed strength scores for the calisthenic, circuit training and structured play groups is presented in Table 2.

TABLE 2

SUMMARY TABLE OF THE ANALYSIS OF VARIANCE OF
PRE-TEST SUMMED STRENGTH SCORES FOR THE
THREE GROUPS: CALISTHENIC, CIRCUIT
TRAINING AND STRUCTURED PLAY

Source	DF	SS	MS	F*
Between Groups	2	103793.125	51896.562	0.43
Within Groups	120	14305160.761	119209.673	
Total	122	14408953.887		

*F (2, 120) = 3.09 at the .05 level of confidence.

The analysis of variance for determining if the calisthenic, circuit training and structured play groups were initially equal in the performance of summed strength scores for the groups produced an F value of 0.43 which failed to meet the designated ($P=.05$) level of significance. This F value indicates that there was no initial significant difference between the three groups on the pre-test summed strength scores as was measured by the Strength Index. It would thus appear that the three groups were relatively homogeneous on the variable strength as measured in the study prior to the experimental period.

Analysis of Variance of Post-Test Summed
Strength Scores for Determining
Significant Difference Between
Groups at the Conclusion
of the Study

An analysis of variance was computed for the post-test summed strength scores of the calisthenic, circuit training and structured play groups as was measured by the Strength Index to determine if one group scored significantly greater than another group on the post-test and, therefore, to determine if one program appeared more conducive to the development of muscular strength in junior high school girls. A summary of the analysis of variance for the post-test summed strength scores for the calisthenic, circuit training and structured play groups may be found in Table 3.

TABLE 3

SUMMARY TABLE OF THE ANALYSIS OF VARIANCE
OF POST-TEST SUMMED STRENGTH SCORES
FOR THE THREE GROUPS: CALISTHENIC,
CIRCUIT TRAINING AND
STRUCTURED PLAY

Source	DF	SS	MS	F*
Between Groups	2	807603.500	403801.750	2.37
Within Groups	120	20383623.523	169863.529	
Total	122	21191227.023		

*F (2, 120) = 3.09 at the .05 level of confidence.

An F value of 2.37, which failed to meet the assigned level of significance, was the result of an analysis of variance for the post-test summed strength scores for the three groups. The data indicate that no single conditioning program, as provided in this study, was more conducive than the others in the development of muscular strength as measured by the Strength Index.

Analysis of the Difference Between the Pre-
and Post-Test Scores for the Three
Groups on the Individual Items

Although there was no significant difference between the programs in terms of the development of muscular strength, further analyses were made with the data to determine if

there were any significant changes on the difference score for any of the individual test items. An analysis of variance was computed on the difference between the pre-test and post-test scores for the three groups on all of the individual items. The difference score was determined by subtracting the pre-test score from the post-test score for each item.

The first mean difference score that was analyzed was for the right grip strength of the three groups. A summary for the analysis of variance for the mean difference between the pre- and post-tests for the right grip strength of the calisthenic, circuit training and structured play groups may be found in Table 4.

TABLE 4

SUMMARY TABLE FOR THE ANALYSIS OF VARIANCE
FOR THE DIFFERENCE BETWEEN THE PRE- AND
POST-TESTS FOR THE RIGHT GRIP
STRENGTH OF THE CALISTHENIC,
CIRCUIT TRAINING AND
STRUCTURED PLAY
GROUPS

Source	DF	SS	MS	F*
Between Groups	2	760.075	380.037	7.14
Within Groups	120	6382.997	53.191	
Total	122	7143.073		

*F (2, 120) = 3.09 at the .05 level of confidence.

F (2, 125) = 4.78 at the .01 level of confidence.

The analysis of variance for the mean difference scores in the right grip strength score for the calisthenic, circuit training and structured play groups produced an F value of 7.14, which was significant at the .01 level of confidence. To determine where the significant difference was between the means of the three groups, a Duncan's Multiple-Range Test was used. The results of the test may be found in Table 5.

TABLE 5

DUNCAN'S MULTIPLE-RANGE TEST FOR THE MEAN
DIFFERENCES FOR THE RIGHT GRIP STRENGTH
DIFFERENCE SCORE FOR THREE GROUPS

	Structured Play	Circuit Training	Calisthenic	K	R
Mean	-1.444	4.184	4.758		
Structured Play -1.444	—	5.628*	6.202*	3	3.532
Circuit Training 4.184		—	0.574	2	3.336

*Significant at the .05 level of confidence.

Duncan's Multiple-Range Test indicated a significant difference occurred between the means of the structured play group and the other two groups, the circuit training group and the calisthenic training group. The significant value

indicates that the programs used by the circuit training group and the calisthenic training group were significantly more conducive to the development of right grip strength than was the program designed for the structured play group at the .05 level of confidence. The exercises that were performed by the circuit training and calisthenic groups that had been designed to develop grip strength were the cause of this significant difference in right grip strength. The non-significant mean difference of .574 between the circuit training group and the calisthenic group on the right grip strength difference scores indicates that neither program used by these two groups was more conducive than the other to the development of right grip strength.

The second mean difference score analyzed was for the left grip strength of the three groups. Graphic representation for the analysis of variance of the left grip mean difference scores for the calisthenic, circuit training and structured play groups may be found in Table 6.

An analysis of variance of the left grip strength mean difference score for the calisthenic, circuit training and structured play groups produced an F value of 2.94 which was not significant. The non-significant value indicates that no program was more conducive to the development of left grip strength than any other program.

TABLE 6

SUMMARY TABLE FOR THE ANALYSIS OF VARIANCE FOR
THE DIFFERENCE BETWEEN THE PRE- AND
POST-TESTS FOR THE LEFT GRIP
STRENGTH OF THE CALISTHENIC,
CIRCUIT TRAINING AND
STRUCTURED PLAY
GROUPS

Source	DF	SS	MS	F*
Between Groups	2	260.925	130.462	2.94
Within Groups	120	5310.391	44.253	
Total	122	5571.317		

*F (2, 120) = 3.09 at the .05 level of confidence.

The third mean difference score that was compared by the analysis of variance was for the back lift strength of the three groups. The summary for the analysis of variance is presented in Table 7.

TABLE 7

SUMMARY TABLE FOR THE ANALYSIS OF VARIANCE FOR
THE DIFFERENCE BETWEEN THE PRE-TEST AND
POST-TEST FOR THE BACK LIFT STRENGTH
OF THE CALISTHENIC, CIRCUIT TRAINING
AND STRUCTURED PLAY GROUPS

Source	DF	SS	MS	F*
Between Groups	2	10633.622	5316.811	2.18
Within Groups	120	291882.638	2432.355	
Total	122	302516.260		

*F (2, 120) = 3.09 at the .05 level of confidence.

An analysis of variance of the mean difference score for the back lift for the calisthenic, circuit training and structured play groups produced an F value of 2.18 which was not significant. The F value indicates that no program was more conducive than any other program to the development of back lift strength.

A fourth analysis of variance was computed on the mean difference score for leg lift strength for the three groups. A summary for the analysis of variance for the leg lift strength difference score for the three groups may be found in Table 8.

TABLE 8

SUMMARY TABLE FOR THE ANALYSIS OF VARIANCE FOR
THE DIFFERENCE BETWEEN THE PRE- AND POST-TESTS
FOR THE LEG LIFT STRENGTH OF THE
CALISTHENIC, CIRCUIT TRAINING
AND STRUCTURED PLAY GROUPS

Source	DF	SS	MS	F*
Between Groups	2	108596.248	54298.124	1.72
Within Groups	120	3771346.437	31427.886	
Total	122	3879942.685		

*F (2, 120) = 3.09 at the .05 level of confidence.

The analysis of variance for the leg lift mean difference score as determined by pre- and post-test scores for the calisthenic, circuit training and structured play groups

produced an F value of 1.72 which was not significant. The F value indicates that no program was more conducive than any other program to the development of leg lift strength.

An analysis of variance of the mean difference score for the number of pull-ups performed by the three groups was completed. A summary for the analysis of variance for the pull-up difference scores may be found in Table 9.

TABLE 9

SUMMARY TABLE FOR THE ANALYSIS OF VARIANCE
FOR THE DIFFERENCE BETWEEN THE PRE- AND
POST-TESTS FOR THE PULL-UP SCORE FOR
THE CALISTHENIC, CIRCUIT TRAINING
AND STRUCTURED PLAY GROUPS

Source	DF	SS	MS	F*
Between Groups	2	1332.181	666.090	12.18
Within Groups	120	6559.444	54.662	
Total	122	7891.626		

* $F(2, 120) = 3.09$ at the .05 level of confidence.

$F(2, 125) = 4.78$ at the .01 level of confidence.

An analysis of variance of the mean difference for the pull-up test for the calisthenic, circuit training and structured play groups resulted in a highly significant F value of 12.18 at the .01 level of confidence. Duncan's Multiple-Range Test was then applied to the data to determine where the significant difference between the means for

these three groups lay. The results of the test may be found in Table 10.

TABLE 10

DUNCAN'S MULTIPLE-RANGE TEST FOR THE MEAN
DIFFERENCES FOR THE PULL-UP DIFFERENCE
SCORES FOR THREE GROUPS

	Structured Play	Calisthenic	Circuit Training	K	R
Mean	0.925	8.568	9.263		
Structured Play 0.925	—	7.643*	8.338*	3	3.569
Calisthenic 8.568		—	0.695	2	3.391

*Significant at the .05 level of confidence.

Duncan's Multiple-Range test indicated a significant difference between the means of the structured play group and the calisthenic and circuit training groups. The significant F value indicates that the programs designed for the calisthenic and circuit training groups were more conducive to improvement in the number of pull-ups that could be performed by the subjects than was the program designed for the structured play group. The exercises designed for the circuit training and calisthenic groups for the specific development of the strength of the arm and shoulder girdle

muscles were the cause for the significant difference found between these two groups and the structured play group which did not perform any exercises specifically designed to develop the strength of the arm and shoulder girdle muscles.

An analysis of variance was also computed on the mean difference for push-ups between the three groups. The mean difference for the calisthenic group was 1.827 push-ups, the standard deviation was 0.378 push-ups and the standard error was 0.049 push-ups. The circuit training group had a mean difference of 2.500 push-ups, a standard deviation of 0.670 push-ups and a standard error of 0.108 push-ups. The structured play group had a mean difference of 1.222 push-ups, a standard deviation of 0.902 push-ups and a standard error of 0.173 push-ups. Graphic representation for the analysis of variance for the push-up mean difference scores may be found in Table 11.

TABLE 11

SUMMARY TABLE FOR THE ANALYSIS OF VARIANCE
FOR THE DIFFERENCE BETWEEN THE PRE- AND
POST-TESTS FOR THE PUSH-UP SCORE FOR
THE CALISTHENIC, CIRCUIT TRAINING
AND STRUCTURED PLAY GROUPS

Source	DF	SS	MS	F*
Between Groups	2	26.386	13.193	0.97
Within Groups	120	1630.442	13.587	
Total	122	1656.829		

*F (2, 120) = 3.09 at the .05 level of confidence.

A non-significant F value was found when an analysis of variance was computed for the mean difference for the push-up test for the calisthenic, circuit training and structured play groups. The non-significant F value indicates that neither program was more conducive than the others to the improvement in the number of push-ups that any of the groups could perform.

An analysis of variance was run on the mean difference for the arm strength of the calisthenic, circuit training and structured play groups. The calisthenic group had a mean difference of 132.118 pounds, a standard deviation of 12.953 pounds and a standard error of 1.700 pounds. The circuit training group had a mean difference of 154.626 pounds, a standard deviation of 15.477 pounds and a standard error of 2.510 pounds. The structured play group had a mean difference of 12.698 pounds, a standard deviation of 24.214 pounds and a standard error of 4.660 pounds. A summary for the analysis of variance for the difference between the pre- and post-tests for the arm strength scores for the calisthenic, circuit training and structured play groups may be found in Table 12.

The analysis of variance of the mean difference in arm strength for the calisthenic, circuit training and structured play groups produced a very significant F value of 16.95. The highly significant F value indicates that at

TABLE 12

SUMMARY TABLE FOR THE ANALYSIS OF VARIANCE
FOR THE DIFFERENCE BETWEEN THE PRE- AND
POST-TESTS FOR THE ARM STRENGTH
SCORES FOR THE CALISTHENIC,
CIRCUIT TRAINING AND
STRUCTURED PLAY
GROUPS

Source	DF	SS	MS	F*
Between Groups	2	358672.748	179336.374	16.95
Within Groups	120	1269466.569	10578.888	
Total	122	1628139.317		

*F (2, 120) = 3.09 at the .05 level of confidence.

F (2, 125) = 4.78 at the .01 level of confidence.

least one group improved remarkably on the mean difference score as a result of the program designed for that group, therefore, a Duncan's Multiple-Range test was further applied to the data. The results of the test may be found in Table 13.

The Duncan's Multiple-Range test provided a significant difference between the means of the structured play and calisthenic groups. The significant mean difference indicates that the program designed for the calisthenic group was more conducive to the development of arm strength than was the program designed for the structured play group. The significant score found between the structured play

TABLE 13

DUNCAN'S MULTIPLE-RANGE TEST FOR THE MEAN
DIFFERENCES FOR THE ARM STRENGTH
DIFFERENCE SCORES FOR
THREE GROUPS

	Structured Play	Calisthenic	Circuit Training	K	R
Mean	12.698	132.118	154.626		
Structured Play 12.698	_____	119.420*	141.928*	3	69.945
Calisthenic 132.118		_____	22.508	2	47.244

*Significant at the .05 level of confidence.

group and the circuit training group indicates that the program designed for the circuit training group was also more conducive to the development of arm strength than was the program designed for the structured play group. The significant difference found between the calisthenic and structured play groups, and the circuit training and structured play groups indicates that the exercises designed for developing the strength of the shoulder girdle and arm muscles of the subjects in the calisthenic and circuit training groups contributed to the significant difference that was found. Since the structured play group did not improve significantly greater over any other group on arm

strength, this fact indicates that a program designed for the development of specific muscle areas of the body should have precedence over any program that does not make allowances for this development when different types of conditioning programs are being considered. The non-significant difference between the calisthenic group and the circuit training group indicates that neither program used by these groups was more conducive than the other to the development of arm strength.

An analysis of variance was run on the mean difference for the summed strength score for the calisthenic group, the circuit training group and the structured play group. The calisthenic group had a mean difference of 295.526 pounds for the summed strength score, a standard deviation of 38.988 pounds and a standard error of 5.119 pounds. The circuit training group had a mean difference of 242.126 pounds, a standard deviation of 60.281 pounds and a standard error of 9.778 pounds. The structured play group had a mean difference of 128.105 pounds, a standard deviation of 38.181 pounds and a standard error of 7.348 pounds. A summary for the analysis of variance of the summed strength difference score for the three groups may be found in Table 14.

The analysis of variance of the summed strength difference score for the calisthenic, circuit training and

TABLE 14

SUMMARY TABLE FOR THE ANALYSIS OF VARIANCE
FOR THE DIFFERENCE BETWEEN THE PRE- AND
POST-TESTS FOR THE SUMMED STRENGTH
SCORES FOR THE CALISTHENIC,
CIRCUIT TRAINING AND
STRUCTURED PLAY
GROUPS

Source	DF	SS	MS	F*
Between Groups	2	516409.992	258204.996	2.84
Within Groups	120	10899180.503	90826.504	
Total	122	11415590.492		

*F (2, 120) = 3.09 at the .05 level of confidence.

structured play groups produced a non-significant F value of 2.84 that indicates no program was more conducive to the improvement of the summed strength score than any other.

Analysis of the Improvement Within Groups From the Pre- to Post-Test for Each Item

The pre- and post-tests were analyzed by the analysis of variance for each test item for each group to determine if the post-test score for each item was significantly greater than the pre-test score for the same item. The presentation of the results of these analyses is presented in Table 15. Only the F value is presented for each item in the table. All pertinent raw data may be found in Table 1, pages sixty and sixty-one of this chapter.

TABLE 15

TABLE OF F VALUES OF THE ANALYSES OF VARIANCE
OF THE PRE- AND POST-TESTS FOR EACH
ITEM WITHIN EACH GROUP

Item	Calisthenic F	Circuit Training F	Structured Play F
Right Grip	3.23	3.01	0.26
Left Grip	1.93	2.05	0.00
Back Lift	0.11	0.93	0.96
Leg Lift	16.50**	6.82*	4.75*
Pull-Up	21.28**	16.58**	0.08
Push-Up	2.27	2.04	0.78
Arm Strength	14.68**	13.53**	0.05
Summed Strength	15.91**	7.45**	2.09

Calisthenic Group F (1, 57) = 4.02 at the .05
level of confidence.
**F (1, 57) = 7.12 at the .01
level of confidence.

Circuit Training Group F (1, 37) = 4.11 at the .05
level of confidence.
**F (1, 37) = 7.39 at the .01
level of confidence

Structured Play Group *F (1, 26) = 4.22 at the .05
level of confidence.
F (1, 26) = 7.72 at the .01
level of confidence.

The analyses of the items for the calisthenic group yielded significant F values at the .01 level of confidence for leg lift strength, for pull-ups, for arm strength and for summed strength. These significant F values indicate that the program designed for the calisthenic group was conducive to the significant improvement in specific strength areas on the post-test scores for the group. The non-significant F value for right grip strength, back lift strength, left grip strength and push-ups found through the analyses indicates that the program designed for the calisthenic group had little effect on the improvement of the post-test scores for these individual items.

The analyses of the items for the circuit training group yielded four significant F values for the following strength test items: the leg lift, pull-ups, arm strength and summed strength. These significant F values indicate that the program designed for the circuit training group was conducive to the improvement on the post-test scores for these items. The non-significant F values for right grip strength, back lift strength and for push-ups indicates that the program designed for the circuit training group had little effect on the improvement of the post-test scores for these individual items. Significant improvements were made by the calisthenic and circuit training groups on the same four items.

The analyses of variance for the pre- and post-test scores on the individual items for the structured play group yielded only one significant improvement which was noted for the leg lift strength test. The significant F value indicates that the program designed for the structured play group aided the group in improving its post-test score significantly over its pre-test score for the leg lift test. The fact that the structured play group participated in a basketball unit which required a lot of running and use of the leg muscles, could be considered as the contributory cause for this significant increase in the leg lift strength for the structured play group. Seven non-significant F values for the eight items indicate that the program designed for the structured play group did little to aid the group in developing muscular strength.

Summary

This chapter presented and analyzed the data. The mean, standard deviation, standard error and mean difference from pre-test to post-test were computed for all of the data. An analysis of variance was computed for the summed strength scores of the calisthenic, circuit training and structured play groups to determine if an initial significant difference was present between the three groups. No initial significant difference was found. At the conclusion of the study, an

analysis of variance was computed for the post-test summed strength scores to determine if one program was more conducive than another program to the development of muscular strength of junior high school girls. The analysis resulted in establishing the fact that no single conditioning program, as provided in the study, was more conducive than any other to the development of muscular strength as measured by the Strength Index.

Further analysis of the data involved computing an analysis of variance and where appropriate the Duncan's Multiple Range Test on the difference between the pre-test and post-test scores for each item to determine if any group improved significantly over another group on the individual items. The analysis resulted in the following findings. For right grip strength, a significant difference was found between the calisthenic group and the structured play group, favoring the calisthenic group. A significant difference was also found on right grip strength between the circuit training and structured play group, favoring the circuit training group. A significant difference was found between the three groups on the pull-up mean difference score with the calisthenic group being favored over the structured play group, and with the circuit training group being favored over the structured play group. A very significant difference was found between the three groups on the arm strength

mean difference score. Although no significant difference was found between the calisthenic and circuit training groups on the arm strength mean difference score, both of the groups were significantly superior to the structured play group for the arm strength mean difference score.

An analysis of variance was also computed for each group's pre-test and post-test scores to determine if each group had any improvements within itself as a result of the conditioning program that was designed for it in the study. The analyses of the improvement within the three groups on each item resulted in the following findings. For the calisthenic group, significant improvement was found for leg lift strength, pull-ups, arm strength and summed strength. No significant differences were found for the calisthenic group for right grip strength, back lift strength, right grip strength and push-ups. The analyses for the improvement within the circuit training group resulted in significant improvement on the leg lift test, pull-ups, arm strength and summed strength. Non-significant differences were found for the circuit training group on right grip strength, left grip strength, back lift strength and push-ups. The analyses for the improvement within the structured play group yielded only one significant improvement which was on the leg lift test. No significant improvement was noted by the structured play group on right grip strength, left grip strength, back

lift strength, pull-ups, push-ups, arm strength and summed strength. The summary of the study and conclusion to the investigation will be presented along with the limitations and suggestions for further studies in Chapter V.

CHAPTER V

CONCLUSION TO THE STUDY

Summary

Authorities in physical education have proposed that strength is necessary for good appearance, that it is basic to superior performance in skilled motor activities, that it is valued highly as a measure of physical fitness and that it is necessary for efficient performance in normal daily activities. The present investigation attempted to determine if a specific calisthenic program, a specific circuit training program or a specific structured play program (basketball) of conditioning was most conducive to the development of muscular strength.

The literature reveals that the influence of training programs on the development of muscular strength has been subjected to much study. Specific calisthenic programs have been compared to specific structured play programs, while specific circuit training programs have been compared with specific structured play programs. No known study, however, compared a calisthenic program, a circuit training program and a structured play program and it is certain that no previous study utilized the specific programs developed for this investigation.

One hundred and twenty-two junior high school girls from the Morgan City Junior High School in Morgan City, Louisiana, were administered the Strength Index during the 1970-1971 school year. The Strength Index included the measurement of right grip strength, left grip strength, back lift strength, leg lift strength and the maximum number of push-ups and modified pull-ups each subject could perform. Each subject participated in an assigned conditioning program five days a week, ten minutes a day for six weeks.

An analysis of variance was computed to determine the F ratio for each of the following:

1. The pre-test summed strength scores to determine if the groups were equal at the beginning of the study.
2. The post-test summed strength scores to determine if there was a significant difference between the three groups at the end of the study as a result of having used a calisthenic, a circuit training or a structured play program (basketball) of conditioning for the development of muscular strength.
3. The difference scores for each item which were obtained by subtracting the pre-test scores from the post-test scores to determine if either group improved significantly greater than another on any of the test items.

4. To determine if the post-test scores for each item were significantly greater than the pre-test scores for each item for the three groups.

The summed strength score was obtained for each subject by adding the right grip strength, left grip strength, back lift strength, leg lift strength and arm strength scores together. Arm strength was computed by the formula:

$$\text{Arm strength} = (\text{pull-ups} + \text{push-ups}) \times \left(\frac{W}{10} + H - 60 \right)$$

in which W equals the weight of the subject in pounds, and H equals the height of the subject in inches.

The findings of the study indicated that there was no significant difference between the calisthenic, circuit training and structured play program (basketball) used in this study with respect to the development of total muscular strength. This was determined by applying an analysis of variance to the summed strength scores of the three groups.

A significant difference was found between the calisthenic and structured play programs with the calisthenic program being superior on right grip strength, number of pull-ups performed and arm strength for the difference scores. This indicated that the calisthenic program was more conducive to the development of the specific aspects of muscular strength named. Similar results were observed between the circuit training program and the structured play program (basketball) with the circuit training program being significantly superior.

Because there was no significant difference between the calisthenic and circuit training programs on any measure taken it would appear that neither of these two programs were superior to the other in the development of muscular strength.

The results of the analysis of variance on the pre-test and post-test scores for each group on each strength measure indicated that the calisthenic group performed significantly greater on the post-test scores for leg lift, pull-ups, arm strength and summed strength scores as a result of having used the specific calisthenic program for conditioning. The circuit training group performed significantly greater on the post-test scores for leg lift strength, pull-ups, arm strength and summed strength scores as a result of having used the specific circuit training program. The structured play group (basketball) performed significantly greater on the post-test leg lift strength score as a result of having played basketball for six weeks. These results further indicate that although there was not a significant difference between the three groups on summed strength scores on the post-test, the programs did contribute to some significant increases in strength within each group.

The null hypothesis tested in the study was: There is no significant difference in the development of muscular strength of the subjects by using a fixed circuit training

~~program~~, a general calisthenic program or a structured play program (basketball). The hypothesis failed to be rejected. However, specific strength increases did occur and some were significant.

Conclusion to the Study

It may be concluded that different types of training programs designed to increase muscular strength contribute to this objective in varying amounts. No single method of training appears to be preferable as long as specific muscular strength activities are engaged in.

Limitations to the Study

One limitation to the study was the lack of weight lifting equipment available for use in the development of the circuit training program. Had such equipment been available, a more strenuous program could have been designed. A more strenuous program might have produced different results and it would have been more in line with the philosophy of the investigator. A second limitation was that the circuit training program had a built-in motivational system not evident to the other programs. This occurred through having the subjects of this group work with partners which seemed to help this group work harder than might otherwise be expected during their exercise program.

Suggestions for Further Studies

The following suggestions were made for further studies:

1. Replicate the study but design exercises for weight training for the circuit training groups.
2. Replicate the study but use a longer experimental period.
3. Replicate the study but use boys as subjects.
4. Replicate the study using the same exercises for the calisthenic and circuit training groups.
5. Conduct a study of a similar nature to the present one but use different age subjects, both younger and older.

APPENDIX A

INSTRUCTIONS FOR THE PERFORMANCE OF THE STRENGTH TESTS

INSTRUCTIONS FOR THE PERFORMANCE
OF THE STRENGTH TESTS

A specific set of instructions for performing each strength test was presented to the subjects before they were tested.¹ The instructions for performing the grip strength test were: (1) put chalk on your right hand; (2) hold the grip dynamometer in your right hand by placing the curved or rounded edge between the first and second joints of your fingers; (3) place the dial so that it will be facing toward your palm; (4) when you perform the test, you are to squeeze the instrument as much as possible without touching anything with your right hand; (5) take a practice trial without squeezing as much as possible; (6) take a real trial by squeezing as much as possible; (7) let me record your score; (8) take one more trial; (9) let me record your score; repeat the above steps while using the left hand. The highest score made was recorded on the score sheet.

The instructions for performing the back lift were: (1) stand with your feet on the places marked on the base of the dynamometer; (2) keep your head up and your back straight throughout the whole performance; (3) extend your fingers down to your thighs until your arms are straight; (4) grasp

¹Clarke, op. cit., pp. 65-67.

the bar near the ends with the palm of one hand facing the wall and the other palm facing your body; (5) when you perform the lift, you must lift the bar straight up and lift as much as possible; (6) take a practice lift by lifting until you get the feel of the execution of the performance; (7) lift for a maximum effort; (8) let me record your score; (9) lift again; (10) let me record your score. The highest score was recorded on the score sheet.

For the performance of the leg lift, the students were instructed to: (1) assume the same position you were in for the back lift; (2) grasp the bar near the center with your palms facing your body; (3) keep your head up and your back straight; (4) bend your knees until you are told to stop; (5) when you lift, you must lift straight up with the bar while keeping the bar supported on your thighs; (6) take a practice lift; (7) do not lift as much as possible; (8) take a real trial by lifting as much as possible; (9) let me record your score; (10) take another real trial; (11) let me record your score. The highest score was recorded on the score sheet.

The following instructions were given for performance on the pull-up bar: (1) stand on the platform and grasp the bar with your palms facing downward, and your hands about shoulder width apart; (2) place the heels of your feet at the base of the footboard and let the soles of your feet rest on

the footboard; (3) when you perform the pull-up, your body must be kept straight; (4) no sagging of the body or raising of the hips will be permitted; (5) if sagging of the body or raising of the hips occur, that performance will not be counted; (6) the body is pulled up to the bar by pulling with the arms and then flexing the elbows while the chest touches the bar; (7) then, the body is allowed to go back down by straightening the arms; (8) take one practice trial; (9) do as many pull-ups as possible. The maximum number of pull-ups performed was recorded as the score.

For performing the push-up, each student was instructed to: (1) assume a starting position by lying face down upon the floor; (2) keep your legs straight and place your hands upon the floor directly beneath your shoulders; (3) while performing the push-up, the weight of the body is on the hands and the posterior part of the toes; (4) push your body up by straightening your arms and keep your body straight; (5) then you lower your body to the floor until you touch your chest to the floor by bending your elbows; (6) repeat this procedure as many times as possible after you take one practice trial; (7) no rest is permitted between each push-up, and sagging or arching at the hips will not be permitted; (8) if you do so, that push-up will not be counted. The maximum number of pull-ups performed was recorded as the score.

APPENDIX B

SYLLABI FOR GROUPS

SYLLABUS FOR GROUP I CALISTHENICS

AND BASKETBALL

First Week

Monday	Ten minutes of calisthenics set one. History of basketball. Safety in basketball. Sportsmanship in basketball. Chest pass and catching.
Tuesday	Ten minutes of calisthenics set one. Review chest pass, and introduce and practice the chest bounce pass, right and left side arm pass.
Wednesday	Ten minutes of calisthenics set one. Review chest pass, chest bounce pass, right and left side arm pass.
Thursday	Ten minutes of calisthenics set one. Introduce and practice dribbling both right handed and left handed.
Friday	Ten minutes of calisthenics set one. Dribbling with alternate hands. Review dribbling and passing.

Second Week

Monday	Ten minutes of calisthenics set two. Introduce guarding techniques. Jumping for the net.
Tuesday	Ten minutes of calisthenics set two. Review passing, dribbling and guarding.
Wednesday	Ten minutes of calisthenics set two. Introduce one-hand set shot and two hand set shot. Play Around-the-World.
Thursday	Ten minutes of calisthenics set two. Introduce the figure eight drill. Review dribbling, guarding, passing and shooting.
Friday	Ten minutes of calisthenics set two. Introduce the foul shot and explain rules concerning the foul shot. Play Around-the-World.

Third Week

Monday	Ten minutes of calisthenics set one. Introduce the drive, one-hand shot and the drive, and rebounding. Jump for the net.
Tuesday	Ten minutes of calisthenics set one. Introduce rules of basketball taken from <u>Basketball for Women</u> written by Frances Schaafsma and published by William C. Brown Company, Dubuque, Iowa, 1966, pages fifty-two through fifty-five. Offensive and defensive strategy. Practice shooting.
Wednesday	Ten minutes of calisthenics set one. View film, "Strategy for Girls' Basketball." Review figure-eight drill and relate to offensive and defensive strategy.
Thursday	Ten minutes of calisthenics set one. Review rules and play a half-court game.
Friday	Ten minutes of calisthenics set one. Practice dribbling and passing. Full court game.

Fourth Week

Monday	Ten minutes of calisthenics set two. Review guarding techniques, dribbling, shooting (play Hearts). Full court game.
Tuesday	Ten minutes of calisthenics set two. Game.
Wednesday	Ten minutes of calisthenics set two. Dribbling and shooting drills. Game.
Thursday	Ten minutes of calisthenics set two. Warm-up drills. Game. Review guarding techniques, offensive and defensive strategy.
Friday	Ten minutes of calisthenics set two. Team selection. Games and Around-the-World.

Fifth Week

Monday	Ten minutes of calisthenics set one. Assign and review for skill tests on the chest pass, chest bounce pass and the side arm passes. Game.
Tuesday	Ten minutes of calisthenics set one. Skill tests. Game.
Wednesday	Ten minutes of calisthenics set one. Assign and review for skill test on dribbling right handed, left handed and alternating hands. Game.
Thursday	Ten minutes of calisthenics set one. Skill tests for dribbling. Game.
Friday	Ten minutes of calisthenics set one. Assign written test and review. Game.

Sixth Week

Monday	Ten minutes of calisthenics set two. Review for written test. Game.
Tuesday	Ten minutes of calisthenics set two. Assign skill test for shooting. Game.
Wednesday	Ten minutes of calisthenics set two. Administer written test. Practice shooting. Game.
Thursday	Ten minutes of calisthenics set two. Return written test. Skill test on shooting.
Friday	Ten minutes of calisthenics set two. Game.

SYLLABUS FOR GROUP II CIRCUIT TRAINING

AND BASKETBALL

First Week

Monday	Ten minutes of circuit training set one. History of basketball. Safety in basketball. Sportsmanship in basketball. Chest pass and catching.
Tuesday	Ten minutes of circuit training set one. Review chest pass, and introduce and practice the chest bounce pass, right and left side arm pass.
Wednesday	Ten minutes of circuit training set one. Review chest pass, chest bounce pass, right and left side arm pass.
Thursday	Ten minutes of circuit training set one. Introduce and practice dribbling both right handed and left handed.
Friday	Ten minutes of circuit training set one. Dribbling with alternate hands. Review dribbling and passing.

Second Week

Monday	Ten minutes of circuit training set two. Introduce guarding techniques. Jumping for the net.
Tuesday	Ten minutes of circuit training set two. Review passing, dribbling and guarding.
Wednesday	Ten minutes of circuit training set two. Introduce one-hand set shot and two hand set shot. Play Around-the-World.
Thursday	Ten minutes of circuit training set two. Introduce the figure-eight drill. Review dribbling, guarding, passing and shooting.
Friday	Ten minutes of circuit training set two. Introduce the foul shot and explain rules concerning the foul shot. Play Around-the-World.

Third Week

- Monday Ten minutes of circuit training set one. Introduce the drive, one-hand shot and the drive, and rebounding. Jump for the net.
- Tuesday Ten minutes of circuit training set one. Introduce rules of basketball taken from Basketball for Women written by Frances Schaafsma and published by William C. Brown Company, Dubuque, Iowa, 1966, pages fifty-two through fifty-five. Offensive and defensive strategy. Practice shooting.
- Wednesday Ten minutes of circuit training set one. View film, "Strategy for Girls' Basketball." Review figure-eight drill and relate to offensive and defensive strategy.
- Thursday Ten minutes of circuit training set one. Review rules and play a half court game.
- Friday Ten minutes of circuit training set one. Practice dribbling and passing. Full court game.

.. Fourth Week

- Monday Ten minutes of circuit training set two. Review guarding techniques, dribbling and shooting (play Hearts). Full court game.
- Tuesday Ten minutes of circuit training set two. Game.
- Wednesday Ten minutes of circuit training set two. Dribbling and shooting drills. Game.
- Thursday Ten minutes of circuit training set two. Warm-up drills. Game. Review guarding techniques, offensive and defensive strategy.
- Friday Ten minutes of circuit training set two. Team selection. Games and Around-the-World.

Fifth Week

Monday	Ten minutes of circuit training set one. Assign and review for skill tests on the chest pass, chest bounce pass and the side arm passes. Game.
Tuesday	Ten minutes of circuit training set one. Skill tests. Game.
Wednesday	Ten minutes of circuit training set one. Assign and review for skill test on dribbling right handed, left handed and alternating hands. Game.
Thursday	Ten minutes of circuit training set one. Skill tests for dribbling. Game.
Friday	Ten minutes of circuit training set one. Assign written test and review. Game.

Sixth Week

Monday	Ten minutes of circuit training set two. Review for written test. Game.
Tuesday	Ten minutes of circuit training set two. Assign skill test for shooting. Game.
Wednesday	Ten minutes of circuit training set two. Administer written test. Practice shooting. Game.
Thursday	Ten minutes of circuit training set two. Return written test. Skill test on shooting.
Friday	Ten minutes of calisthenics set two. Game.

SYLLABUS FOR GROUP III

STRUCTURED PLAY

(BASKETBALL)

First Week

Monday	History of basketball. Safety in basketball. Sportsmanship in basketball. Chest pass and catching.
Tuesday	Review chest pass, and introduce and practice the chest bounce pass, right and left side arm pass.
Wednesday	Review chest pass, chest bounce pass, right and left side arm pass.
Thursday	Introduce and practice dribbling both right handed and left handed.
Friday	Dribbling with alternate hands. Review dribbling and passing.

Second Week

Monday	<u>Introduce</u> guarding techniques. Jumping for the net.
Tuesday	Review passing dribbling and guarding.
Wednesday	Introduce one-hand set shot and two hand set shot. Play Around-the-World.
Thursday	Introduce the figure-eight drill. Review dribbling, guarding, passing and shooting.
Friday	Introduce the foul shot and explain rules concerning the foul shot. Play Around-the-World.

Third Week

Monday	Introduce the drive, one-hand shot and the drive, and rebounding. Jump for the net.
Tuesday	Introduce rules of basketball taken from <u>Basketball for Women</u> written by Frances Schaafsma and published by William C. Brown Company, Dubuque, Iowa, 1966, pages fifty-two through fifty-five. Offensive and defensive strategy. Practice shooting.
Wednesday	View film, "Strategy for Girls' Basketball." Review figure-eight drill and relate to offensive and defensive strategy.
Thursday	Review rules and play a half court game.
Friday	Practice dribbling and passing. Full court game.

Fourth Week

Monday	Review guarding techniques, dribbling, shooting (play Hearts). Full court game.
Tuesday	Game.
Wednesday	Dribbling and shooting drills. Game.
Thursday	Warm-up drills. Game. Review guarding techniques, offensive and defensive strategy.
Friday	Team selection. Games and Around-the-World.

Fifth Week

Monday	Assign and review for skill tests on the chest pass, chest bounce pass and the side arm passes. Game.
Tuesday	Skill tests. Game.
Wednesday	Assign and review for skill test on dribbling right handed, left handed and alternating hands. Game.
Thursday	Skill tests for dribbling. Game.
Friday	Assign written test and review. Game.

Sixth Week

Monday	Review for written test. Game.
Tuesday	Assign skill test for shooting. Game.
Wednesday	Administer written test. Practice shooting. Game.
Thursday	Return written test. Skill test on shooting.
Friday	Game.

APPENDIX C

EXERCISE PROGRAMS DESIGNED FOR THE STUDY

EXERCISE PROGRAMS DESIGNED FOR THE STUDY

I. Calisthenic Exercises

A. Calisthenic Program One

1. Bouncing Hips

a) Purpose

To develop strength in the arms, back, shoulder and leg muscles.

b) Directions

- (1) On count "One" move from a starting position with seat on floor, legs extended, hands on floor and fingers pointed forward, lift and twist torso to the left and bounce left hip lightly to the floor. Repeat bounce on "Two," "Three" and "Four." Then, on "One," lift and twist torso to the right and bounce right hip lightly to floor. Repeat on counts "Two," "Three" and "Four." After doing four bounces on each hip, alternate bounces on the left and right hip for eight counts.¹

- (2) Repeat eight times for ninety seconds.

2. Pedaling

a) Purpose

To develop strength in the leg muscles.

b) Directions

- (1) On count "One," move from a tip-toe position with arms bent forward, shoulder high, fingers touching, body erect, lower left ankle, knee and hip, taking weight of body on left foot. Right ankle and toes are fully extended with toes pointing down. On "And," return left foot to

¹Ed Durlacher, "Physical Fitness Instructions for Use With Honor Your Partner, Album 16, L. P. 16A" (Educational Activities, Inc., Queens Village, New York, 1964).

starting position. Do the same with right foot lowering it on "One" and rising on it on "And." Do the same with both feet.¹

- (2) Alternate left and right eight times, both eight times and repeat twelve times for sixty-three seconds.

3. Squat-Thrust

a) Purpose

To develop strength in the spine, hips, knees and ankles as well as in the arm and shoulder muscles.

b) Directions

- (1) Start in an erect position. On count "One," squat down, on "Two," extend the legs into a push-up position. On "Three," bring the legs back to a squatting position and on "Four," stand erect again.^{2,3}
- (2) Repeat sixteen times for thirty seconds.

4. Trunk-Twist with Knee Touching

a) Purpose

To develop strength in the neck, back and abdomen.

b) Directions

- (1) On count "One" and "Two," from a position of lying flat on back with legs fully extended, arms extended side-outwards from shoulders, with palms down, bring knees to chest. On "Three" and "Four," keeping head, shoulders and arms on floor, twist torso, thighs, legs, and feet to left touching thigh, leg and side of foot to floor. On "Five" and "Six," do the same to the right. On "Seven" and "Eight," return to starting position lowering legs to floor.⁴

¹Ibid.

²Robert Sorani, Circuit Training (Dubuque, Iowa: William C. Brown Company, 1966), p. 47.

³Durlacher, op. cit.

⁴Ibid.

(2) Repeat six times for thirty-three seconds.

5. Skipping Forward and Backward

a) Purpose

To develop strength in the feet, ankles and legs

b) Directions

- (1) On counts "One" through "Eight," start in an erect, relaxed position with left arm back and right arm forward, skip forward eight skips starting on the left foot and changing positions of arms with each skip. On the next eight counts, skip backward.¹
- (2) Repeat eight times for sixty seconds.

6. Deep Knee Bends

a) Purpose

To develop strength in the legs.

b) Directions

- (1) Start in an erect position with hands at sides. On count "One," go to a deep knee bend with hands on floor forward of body. - Keep knees together. On count "Two," while keeping hands down and heels on floor, straighten knees as much as possible. On count "Three," lower to knee bend, and on count "Four," return to starting position.²
- (2) Repeat twelve times for thirty-six seconds.

7. Toe Push-Up

a) Purpose

To develop strength in the arms, chest, shoulder girdle and abdomen.

b) Directions

- (1) Starting in a prone position with body straight, arms straight with hands resting on the floor just beneath the shoulders and fingers pointed forward with the weight of the body resting on the hands and toes, slowly lower body to floor until the chest touches the floor on counts "Down," "Two," "Three" and "Four." On counts "Up," "Two,"

¹Ibid.

²Ibid.

"Three" and "Four," raise body slowly to starting position. Body is kept straight at all times. At no time does the body rest on the floor.¹

8. Sit-Up with Knees Bent

a) Purpose

To develop strength in the abdominal muscles, hip flexors and anterior neck flexors.

b) Directions

(1) Start in a supine lying position with the heels close to the buttocks and the hands clasped behind the head. On count "One," tighten the abdominal muscles and curl up, bringing right elbow to left knee, on "Two," go down again, on "Three," curl up and touch left elbow to right knee and on "Four," return to starting position.²

(2) Repeat twelve times for forty-eight seconds.

9. Swan

a) Purpose

To develop strength in the chest, shoulder girdle, neck and back.

b) Directions

(1) Start in a prone position, face down, arms sideward from shoulders, palms down, knees bent with legs straight up, slowly arch the back and at the same time raise head, chest, arms and thighs as high as possible on counts "Up," "Two" and "Three." On counts "Down," "Two" and "Three," gradually lower the body to starting position.³

(2) Repeat eight times for thirty-five seconds.

10. Modified Pull-Up

a) Purpose

To develop strength of the arms and shoulder girdle.

b) Directions

(1) Stand at the pull-up bar and grasp it with palms facing downward with hands about

¹Ibid. ²Sorani, op. cit., p. 49.

³Durlacher, op. cit.

shoulder width apart. Place the heels of the feet at the base of the footboard and let the soles of the feet rest on the footboard. The weight of the body rests on the heels. Pull the body up until the chest touches the bar by flexing the arms at the elbow. Allow the body to go down to the starting position by strzightening the arms. Keep the body straight at all times,^{1,2}

(2) Repeat ten times for twenty seconds.

B. Calisthenic Program Two

1. Treadmill

a) Purpose

To develop strength in the arms, shoulder girdle and leg muscles.

b) Directions

(1) Start by getting down on the hands, arms straight, left leg extended straight back, right knee drawn under the chest. On "One," draw left leg under chest and thrust right leg back. On "Two," draw right leg under chest and thrust left leg back. Alternate right and left leg in rapid sequence.³

(2) Repeat sixteen times for thirty seconds.

2. Bouncing Hips

a) Purpose

To develop strength in the arms, back, shoulder and leg muscles.

b) Directions

See I. Calisthenic Exercises, A. Calisthenic Program One, exercise one, page one.

3. Tip-Toe Heel and Toe

a) Purpose

To develop strength in the toes, ankles, feet and legs.

b) Directions

(1) Start on tip-toe, body erect, ankles and knees fully extended. Step forward on

¹Clarke, op. cit., p. 147. ²Sorani, op. cit., p. 52.

³Charles A. Bucher, "Physical Fitness Exercises for Girls" (United States of America: Kimbo Music Publishing Company, 1965), exercises 19, 20 and 21.

the left foot landing on the ball of the foot on count "One." On count "Two," do the same with the right foot. Keep alternating through counts "Three" through "Six" and "Heel and Toe." On next six counts and "Now on Toes," take eight light walking steps forward. This is followed by four tip-toe steps, four walking steps, four tip-toe and four walking steps.¹

(2) Repeat for two complete sets for thirty-five seconds.

4. Spine Extension with Ankle Grasp

a) Purpose

To develop strength in the neck and back.

b) Directions

(1) Start in a prone lying position, flex knees and grasp ankles firmly with hands. On count "One," extend the head and stretch the spine strongly, lifting chest and thighs off floor. "Relax" tension while keeping a grasp on ankles.²

(2) Repeat eight times for twenty seconds.

5. Bicycling

a) Purpose

To develop strength in the abdomen and legs.

b) Directions

(1) Start lying supine with arms to sides, bend ankles back and raise left leg to chest. Return left leg to starting position slightly above floor and at the same time raise right knee to chest. Keep heels off of floor at all times.³

(2) Repeat twenty-four times for thirty seconds.

6. Turtle Walk

a) Purpose

To develop strength in all leg muscles.

¹Durlacher, op. cit.

²Ibid.

³Ibid.

b) Directions

- (1) Start in a squat position, trunk erect, head up, back straight, hands grasp knees. On count "One," walk forward starting on left foot and on "Two," walk forward on right foot. Continue procedure by alternating feet. Knees are bent at all times.¹
- (2) Repeat sixty-four times for eighty seconds.

7. Running In a Stationary Position

a) Purpose

To develop strength in the leg muscles.

b) Directions

- (1) Start in erect position with head slightly forward, shoulders straight, elbows bent, hands partially closed, left arm back, right arm slightly forward. Change arm positions with each running step. On counts "One" through "Eight," first start running in place by lifting up first the left foot and then right foot by raising the feet slightly from floor at a slow pace. On next eight counts, repeat but lift legs thigh high and at a rapid pace.²
- (2) Repeat thirty times for thirty seconds.

8. Sit-Up with Knees Bent

a) Purpose

To develop strength in the abdominal muscles, hip flexors and anterior neck flexors.

b) Directions

See I. Calisthenic Exercises, A. Calisthenic Program One, exercise eight, page three. Repeat twelve times for forty-eight seconds.

¹Robert Kiphuth, How To Be Fit (New Haven: Yale University Press, 1942), p. 81.

²Theodore G. Nicholas, Philip Lubarsky and John D. Del Vecchio, "Rhythms for Physical Fitness, 27 (Twenty-Seven) Intermediate Grades" (Bridgeport, Connecticut: Educational Recordings of America, Inc., 1962).

9. Modified Push-Up

- a) Purpose
To develop strength in the arms, chest and shoulder girdle.
- b) Directions
 - (1) With knees bent at right angles and the hands on the floor directly under the shoulders, lower the body to the floor until chest touches floor, then push back to starting position.¹
 - (2) Repeat twenty times for fifty seconds going down on four counts and coming up on four counts. The body must not sag, and a straight line from head to knees must be maintained.

10. Modified Pull-Up

- a) Purpose
To develop strength of the arms and shoulder girdle.
- b) Directions
See I. Calisthenic Exercises, A. Calisthenic Program one, exercise ten, page four.

II. Circuit Training Exercises

A. Circuit Training Program One

1. Squat-Thrust

- a) Purpose
To develop strength in the spine, hips, knees and ankles as well as in the arms and shoulder muscles.
- b) Directions
 - (1) See I. Calisthenic Exercises, A. Calisthenic program one, exercise three, page two.
 - (2) Repeat as many times as possible in forty-five seconds.

2. Bouncing Hips

- a) Purpose
To develop strength in the arms, back, shoulder and leg muscles.

b) Directions

- (1) See I. Calisthenic Exercises, A. Calisthenic Program One, exercise number one, page one.
- (2) Repeat as many times as possible in forty-five seconds.

3. Modified Pull-Ups

a) Purpose

To develop strength in the arms and shoulder girdle.

b) Directions

- (1) See I. Calisthenic Exercises, A. Calisthenic Program One, exercise ten, page four.
- (2) Repeat as many times as possible in forty-five seconds.

4. Wall Push-Ups

a) Purpose

To develop strength in the arms, shoulder girdle, wrists and fingers.

b) Directions

- (1) Stand erect about two feet from the wall. Place the first pads of the fingers against the wall, keep palms of hands away from wall. From this leaning position, lower the body to the wall by bending the elbows and allowing the chest to touch the wall. Maintain balance by rising up onto the balls of the feet each time the body is lowered to the wall. Then, push the body back into the starting position by straightening the arms completely.
- (2) Repeat as many times as possible in forty-five seconds.

5. Supine Back Lift

a) Purpose

To develop strength in the erector muscles of the back and extensors of the hips.

b) Directions

- (1) Start in a support position with the buttocks resting on the floor, heels close to the buttocks and hands resting on the floor beneath the shoulders with arms straight. Elevate the hips as high as possible. Contract the abdominal muscles as you move into this position. Then lower the body into starting position.¹
- (2) Repeat as many times as possible in forty-five seconds.

6. Bench Stepping

a) Purpose

To develop the anterior thigh muscles that extend the knee, and the extensor muscles of the hips.

b) Directions

- (1) Stand beside a bench thirteen inches high. Place right foot on the bench and step up placing the left foot beside the right foot on the top of the bench. Lower the right foot to the floor, then the left foot and repeat. Be sure to extend each leg completely on top of the bench.^{2,3}
- (2) Repeat as many times as possible in forty-five seconds.

7. Sit-Up with Knees Bent

a) Purpose

To develop strength in the abdominal muscles, hip flexors and anterior neck flexors.

b) Directions

- (1) See I. Calisthenic Exercises, A. Calisthenic Program One, exercise number eight, page 3.
- (2) Repeat as many times as possible in forty-five seconds.

¹Sorani, op. cit., p. 48.

²Ibid., p. 50.

³Morgan and Adamson, op. cit., p. 56.

8. Wrist Roll

- a) Purpose
To develop the forearm muscles and strengthen the hands.
- b) Directions
 - (1) Stand erect and hold the bar with a five pound weight attached in both hands with the hands a comfortable distance apart and palms facing down. Roll the bar forward (away from the performer) until the weight has been pulled up to the hands, and then unwind it.¹
 - (2) Repeat as many times as possible in forty-five seconds.

9. Criss-Cross Run

- a) Purpose
To develop strength in the muscles of the legs.
- b) Directions
 - (1) Stand erect and run down the sideline of half of a basketball court first stepping over the line with the right foot by bringing it across in front of the body and then stepping across the line with the left foot in the same fashion, thus making a cross over the line while making each running step. When the end of the line is reached, turn around and run in the opposite direction until the starting point is reached.
 - (2) Repeat as many times as possible in forty-five seconds.

10. Parallel Bar Hold

- a) Purpose
To develop the muscles of the hands, arms and shoulder girdle.

¹Sorani, op. cit., p. 54.

b) Directions

- (1) Stand erect between the bars of a parallel bar apparatus. Jump to a support position in such a position that the arms are straight and the elbows are locked and all body weight is placed on the hands.
- (2) Maintain this position as long as possible up to a maximum of forty-five seconds.

B. Circuit Training Program Two

1. Treadmill

a) Purpose

To develop strength in the arms, shoulder girdle and leg muscles.

b) Directions

- (1) See I. Calisthenic Exercises, B. Calisthenic Program Two, exercise one, page four.
- (2) Repeat as many times as possible in forty-five seconds.

2. Wrist Roll

a) Purpose

To develop the forearm muscles and strengthen the hands.

b) Directions

- (1) See II. Circuit Training Exercises, A. Circuit Training Program One, exercise eight, page nine. Use seven pounds of weight.
- (2) Repeat as many times as possible in forty-five seconds.

3. Bouncing Hips

a) Purpose

To develop strength in the arms, back, shoulder and leg muscles.

Directions

- (1) See I. Calisthenic Exercises, A. Calisthenic Program One, exercise one, page one.
- (2) Repeat as many times as possible in forty-five seconds.

4. Toe Push-Up

- a) Purpose
To develop strength in the arms, chest, shoulder girdle and abdomen.
- b) Directions
 - (1) See I. Calisthenic Exercises, A. Calisthenic Program One, exercise seven, page three.
 - (2) Repeat as many times as possible in forty-five seconds.

5. Sit-Up with Knees Bent

- a) Purpose
To develop strength in the abdominal muscles, hip flexors and anterior neck flexors.
- b) Directions
 - (1) See I. Calisthenic Exercises, A. Calisthenic Program One, exercise eight, page three.

6. Parallel Travel

- a) Purpose
To develop the upper body, including arms, shoulders, upper back and chest.
- b) Directions
 - (1) Stand between the bars of a parallel bar apparatus with the right hand gripping the bar on the right side and the left hand gripping the bar on the left side. Jump to a support position in which the arms are straight, elbows locked and the weight of the body rests on the hands. By moving the arms alternately, travel through the bars to the opposite end, keeping the body as straight as possible. Advance forward short distances at a time. Upon reaching the end, drop to the floor, turn and face the opposite direction, jump back into position between the bars and return to starting position. Score a complete travel through or a half travel through.¹

¹Ibid., p. 53.

- (2) Repeat as many times as possible in forty-five seconds.

7. Turtle Walk

- a) Purpose
To develop strength in all leg muscles.
- b) Directions
 - (1) See I. Calisthenic Exercises, A. Calisthenic Program Two, exercise six, page six.
 - (2) Repeat as many times as possible in forty-five seconds.

8. Toe Raises

- a) Purpose
To develop strength in the muscles of the feet and legs.
- b) Directions
 - (1) Stand in an erect position, feet flat on the floor and about four inches apart. On "Up," rise upon the balls of the feet, on "Down," resume starting position.¹
 - (2) Repeat as many times as possible in forty-five seconds.

9. Modified Pull-Ups

- a) Purpose
To develop strength in the arms and shoulder girdle.
- b) Directions
 - (1) See I. Calisthenic Exercises, A. Calisthenic Program One, exercise ten, page four.
 - (2) Repeat as many times as possible in forty-five seconds.

¹Durlacher, op. cit.

10. Bench Stepping

- a) Purpose
To develop the anterior thigh muscles that extend the knees, and the extensor muscles of the hips.
- b) Directions
 - (1) See II. Circuit Training Exercises, A. Circuit Training Program One, exercise six, page nine.
 - (2) Repeat as many times as possible in forty-five seconds.

APPENDIX D

RAW DATA SHEET

RAW DATA SHEET

Name _____ Class _____

Height Pre-test _____ Post-test _____

Weight Pre-test _____ Post-test _____

Strength Test Scores

	Pre-Test	Post-Test
1. Right Grip	_____	_____
2. Left Grip	_____	_____
3. Back Lift	_____	_____
4. Leg Lift	_____	_____
5. Pull-Ups	_____	_____
6. Push-Ups	_____	_____

APPENDIX E

RAW DATA CODE

RAW DATA CODE

S	Subject
RGS	Right Grip Strength (pounds)
LGS	Left Grip Strength (pounds)
BLS	Back Lift Strength (pounds)
LLS	Leg Lift Strength (pounds)
MPU	Modified Pull-Ups
PU	Push-Ups
AS	Arm Strength (pounds)
SS	Summed Strength (pounds)
Ht	Height (feet and inches)
Wt	Weight (pounds)

PRE-TEST SCORES

RAW DATA

Calisthenics Group I

S	RGS	LGS	BLS	LLS	MPU	PU	AS	SS	Ht	Wt
1	50.0	40.0	225.0	575.0	13.0	0.0	183.3	1073.3	62.5	116.0
2	40.0	26.0	175.0	525.0	12.0	0.0	102.0	863.0	56.5	85.0
3	40.0	39.0	225.0	450.0	14.0	2.0	133.6	887.6	59.0	83.5
4	54.0	50.0	280.0	310.0	23.0	12.0	343.0	1037.0	59.5	98.0
5	70.0	57.0	230.0	600.0	13.0	0.0	179.4	1136.4	61.0	128.0
6	50.0	45.0	275.0	425.0	21.0	5.0	213.2	1107.2	57.0	82.0
7	55.0	48.0	275.0	800.0	9.0	0.0	127.9	1305.8	62.0	121.0
8	45.0	47.0	170.0	720.0	42.0	12.0	464.4	1446.4	59.5	86.0
9	54.0	45.0	275.0	475.0	21.0	9.0	381.0	1230.0	62.5	102.0
10	50.0	48.0	175.0	585.0	18.0	9.0	261.9	1119.9	59.0	97.0
11	48.0	49.0	330.0	575.0	23.0	3.0	270.4	1272.4	61.0	94.0
12	54.0	56.0	250.0	695.0	21.0	3.0	355.2	1410.2	66.0	88.0

S	RGS	LGS	BLS	LLS	MPU	PU	AS	SS	Ht	Wt
13	60.0	50.0	275.0	950.0	19.0	8.0	324.0	1659.0	62.0	100.0
14	59.0	40.0	275.0	745.0	12.0	1.0	167.05	1286.05	61.0	118.5
15	50.0	31.0	250.0	475.0	30.0	8.0	266.0	1072.0	55.0	70.0
16	40.0	45.0	195.0	550.0	28.0	2.0	270.0	1100.0	59.5	90.0
17	60.0	50.0	275.0	445.0	3.0	0.0	38.1	868.1	61.0	117.0
18	39.0	40.0	250.0	675.0	27.0	0.0	191.7	1195.7	57.0	71.0
19	48.0	38.0	175.0	340.0	14.0	1.0	132.0	733.0	51.0	88.0
20	50.0	50.0	235.0	845.0	25.0	9.0	317.9	1497.9	58.0	93.5
21	40.0	40.0	200.0	1075.0	26.0	4.0	300.0	1655.0	61.0	90.0
22	62.0	60.0	265.0	975.0	17.0	7.0	247.2	1609.2	61.0	93.0
23	63.0	70.0	275.0	720.0	23.0	5.0	425.6	1533.6	64.0	112.0
24	60.0	60.0	260.0	545.0	17.0	0.0	210.8	1135.8	62.0	104.0
25	32.0	40.0	160.0	495.0	12.0	0.0	110.0	698.3	55.5	92.5
26	60.0	64.0	275.0	875.0	21.0	5.0	317.2	1591.2	62.0	102.0
27	58.0	49.0	250.0	500.0	15.0	2.0	192.9	1049.9	62.0	93.0
28	54.0	44.0	175.0	485.0	9.0	1.0	105.0	863.0	61.0	95.0

S	RGS	LGS	BLS	LLS	MPU	PU	AS	SS	Ht	Wt
29	50.0	50.0	200.0	520.0	11.0	0.0	143.0	963.0	63.0	100.0
30	68.0	60.0	350.0	1020.0	46.0	18.0	556.8	2054.8	60.0	87.0
31	77.0	62.0	320.0	985.0	20.0	4.0	427.2	1871.2	66.0	118.0
32	58.0	50.0	195.0	775.0	25.0	15.0	392.0	1470.0	61.0	88.0
33	48.0	39.0	185.0	650.0	14.0	0.0	138.6	1060.0	59.0	99.0
34	50.0	50.0	220.0	435.0	11.0	4.0	222.0	777.0	64.0	108.0
35	40.0	45.0	200.0	425.0	25.0	20.0	517.0	1227.5	62.0	95.0
36	55.0	50.0	300.0	775.0	10.0	1.0	173.8	1353.8	65.0	108.0
37	50.0	40.0	170.0	450.0	22.0	10.0	227.2	937.2	57.0	71.0
38	45.0	39.0	175.0	750.0	20.0	5.0	200.0	1209.0	56.0	80.0
39	70.0	56.0	250.0	920.0	12.0	0.0	144.0	1440.0	60.0	120.0
40	74.0	80.0	315.0	655.0	15.0	4.0	226.1	1350.1	60.0	119.0
41	50.0	53.0	250.0	725.0	36.0	23.0	483.8	1561.8	57.0	82.0
42	64.0	62.0	325.0	795.0	10.0	0.0	220.0	1466.0	66.0	160.0
43	60.0	70.0	250.0	500.0	20.0	0.0	320.0	1200.0	66.0	100.0
44	49.0	45.0	200.0	650.0	32.0	10.0	306.6	1250.6	56.0	73.0

S	RGS	LGS	BLS	LLS	MPU	PU	AS	SS	Ht	Wt
45	90.0	86.0	325.0	775.0	11.0	0.0	214.5	1490.0	63.0	165.0
46	82.0	68.0	260.0	500.0	30.0	22.0	698.8	1608.8	62.0	114.0
47	80.0	72.0	325.0	950.0	10.0	2.0	176.4	1603.4	63.0	117.0
48	80.0	72.0	350.0	695.0	40.0	14.0	712.8	1909.8	63.0	102.0
49	58.0	50.0	220.0	730.0	37.0	10.0	709.7	1767.7	65.0	101.0
50	100.0	74.0	350.0	775.0	22.0	10.0	586.0	1885.0	65.0	130.0
51	66.0	59.0	300.0	700.0	15.0	2.0	338.3	1463.3	67.0	129.0
52	70.0	48.0	275.0	595.0	20.0	0.0	395.0	1383.0	66.5	132.5
53	67.0	64.0	255.0	1050.0	7.0	0.0	121.8	1557.8	65.0	124.0
54	44.0	44.0	260.0	750.0	10.0	0.0	110.5	1280.5	61.0	100.5
55	69.0	62.0	300.0	910.0	18.0	12.0	262.5	1603.5	60.0	87.5
56	50.0	45.0	220.0	525.0	19.0	4.0	278.3	1118.3	61.0	111.0
57	62.0	70.0	335.0	810.0	22.0	9.0	635.5	1912.5	66.5	140.0
58	54.0	56.0	275.0	750.0	25.0	2.0	453.6	1588.6	66.0	108.0

Circuit Training Group II

1	27.0	26.0	125.0	650.0	41.0	20.0	379.2	1207.2	51.0	62.0
2	46.0	44.0	175.0	425.0	19.0	1.0	14.4	704.4	60.0	72.0

S	RGS	LGS	BLS	LLS	MPU	PU	AS	SS	Ht	Wt
3	50.0	48.0	260.0	650.0	22.0	1.0	302.46	1310.46	61.0	121.5
4	50.0	42.0	220.0	625.0	30.0	0.0	330.0	1267.0	61.5	95.0
5	61.0	59.0	250.0	900.0	30.0	10.0	536.0	1806.0	64.0	94.0
6	54.0	34.0	200.0	525.0	15.0	0.0	222.75	2837.75	64.0	108.5
7	60.0	55.0	270.0	950.0	13.0	7.0	250.0	1585.0	61.0	116.0
8	60.0	40.0	225.0	900.0	14.0	4.0	217.8	1442.80	62.5	96.0
9	59.0	59.0	350.0	835.0	20.0	7.0	427.95	1730.95	62.0	138.5
10	57.0	59.0	300.0	350.0	35.0	10.0	564.00	1330.0	63.0	111.0
11	56.0	30.0	225.0	715.0	24.0	3.0	297.00	1026.0	60.0	110.0
12	48.0	40.0	205.0	335.0	22.0	12.0	355.3	983.3	60.0	104.5
13	59.0	30.0	250.0	775.0	25.0	0.0	200.0	1314.0	59.0	80.0
14	60.0	60.0	275.0	925.0	30.0	14.0	598.4	1918.4	62.5	111.0
15	55.0	47.0	250.0	825.0	35.0	8.0	339.7	1516.7	57.5	79.0
16	79.0	62.0	345.0	800.0	30.0	9.0	559.65	1845.65	64.0	103.5
17	70.0	54.0	310.0	895.0	12.0	1.0	149.9	1475.9	60.0	113.0
18	51.0	41.0	270.0	500.0	26.0	7.0	152.1	1014.1	62.0	97.0

S	RGS	LGS	BLS	LLS	MPU	PU	AS	SS	Ht	Wt
19	40.0	35.0	200.0	580.0	23.0	12.0	420.0	1275.0	62.5	95.0
20	70.0	69.0	290.0	385.0	12.0	9.0	311.85	1125.85	63.0	118.5
21	48.0	54.0	250.0	650.0	11.0	0.0	127.6	1129.6	60.0	116.0
22	44.0	35.0	125.0	525.0	18.0	27.0	443.25	1172.25	55.0	98.5
23	40.0	40.0	175.0	650.0	31.0	0.0	480.3	1385.3	64.0	115.0
24	35.0	30.0	100.0	375.0	20.0	6.0	166.6	706.6	57.5	71.0
25	45.0	39.0	225.0	450.0	20.0	4.0	241.2	1000.2	61.0	90.5
26	50.0	41.0	250.0	595.0	16.0	2.0	195.4	1130.4	59.5	108.0
27	31.0	42.0	250.0	450.0	15.0	1.0	168.8	941.8	57.0	105.5
28	60.0	62.0	295.0	755.0	23.0	2.0	380.0	1552.0	63.0	122.0
29	65.0	60.0	275.0	975.0	31.0	15.0	478.4	1853.4	59.0	104.5
30	61.0	58.0	300.0	850.0	37.0	20.0	820.8	2089.8	63.0	114.0
31	56.0	59.0	265.0	730.0	27.0	12.0	483.6	1593.6	52.0	104.0
32	57.0	49.0	250.0	650.0	40.0	20.0	480.0	1486.0	57.0	80.0
33	59.0	45.0	245.0	330.0	5.0	0.0	94.0	773.0	61.0	178.0
34	48.0	30.0	175.0	830.0	28.0	0.0	242.2	1325.2	57.5	86.5
35	44.0	38.0	225.0	505.0	42.0	12.0	410.4	1222.4	58.0	76.0

S	RGS	LGS	BLS	LLS	MPU	PU	AS	SS	Ht	Wt
36	44.0	34.0	270.0	720.0	24.0	12.0	345.6	1413.6	59.0	96.0
37	55.0	58.0	210.0	525.0	20.0	7.0	344.25	1192.25	60.5	122.5
38	40.0	38.0	225.0	800.0	32.0	13.0	373.5	1476.5	58.5	83.0

Structured Play (Basketball) Group III

1	50.0	34.0	220.0	625.0	30.0	1.0	443.3	1372.30	64.0	103.0
2	50.0	50.0	265.0	850.0	32.0	4.0	406.8	1621.8	61.5	98.0
3	45.0	40.0	225.0	635.0	24.0	3.0	259.2	1204.2	55.0	96.0
4	51.0	57.0	225.0	620.0	15.0	0.0	195.0	1148.0	62.0	110.0
5	55.0	55.0	220.0	675.0	25.0	2.0	415.8	1222.8	64.5	109.0
6	52.0	39.0	275.0	760.0	30.0	9.0	261.3	1387.3	56.0	67.0
7	49.0	35.0	215.0	710.0	40.0	4.0	470.8	1479.8	62.0	87.0
8	68.0	68.0	290.0	825.0	18.0	3.0	375.9	1626.9	62.0	117.0
9	60.0	42.0	230.0	550.0	15.0	0.0	225.0	1107.0	63.0	120.0
10	39.0	55.0	255.0	375.0	15.0	1.0	208.0	932.0	62.0	110.0
11	64.0	50.0	260.0	500.0	13.0	4.0	205.7	1079.7	60.0	121.0
12	50.0	48.0	270.0	700.0	31.0	2.0	587.4	1655.4	65.0	128.0

S	RGS	LGS	BLS	LLS	MPU	PU	AS	SS	Ht	Wt
13	64.0	52.0	275.0	630.0	32.0	2.0	340.0	1361.0	59.0	100.0
14	78.0	70.0	250.0	520.0	39.0	13.0	696.8	1714.8	63.0	104.0
15	55.0	45.0	300.0	775.0	20.0	2.0	211.2	1386.2	59.0	96.0
16	40.0	40.0	135.0	510.0	20.0	6.0	195.0	920.0	57.0	75.0
17	64.0	64.0	325.0	630.0	26.0	10.0	523.6	1606.6	64.0	106.0
18	51.0	51.0	205.0	505.0	50.0	3.0	890.4	1702.4	64.5	123.0
19	35.0	39.0	100.0	475.0	20.0	4.0	134.4	783.4	52.0	56.0
20	60.0	45.0	220.0	775.0	15.0	2.0	311.1	1412.1	68.0	113.0
21	37.0	42.0	230.0	580.0	16.0	0.0	172.8	1061.8	60.0	108.0
22	80.0	62.0	350.0	700.0	32.0	6.0	562.4	1754.4	63.5	113.0
23	46.0	39.0	270.0	625.0	22.0	5.0	243.0	1253.0	58.6	90.0
24	40.0	40.0	135.0	400.0	17.0	1.0	142.2	757.2	55.0	79.0
25	56.0	54.0	295.0	795.0	7.0	20.0	105.35	1305.35	63.5	115.5
26	50.0	42.0	125.0	525.0	0.0	5.0	248.75	990.75	59.0	99.5
27	58.0	32.0	200.0	530.0	20.0	10.0	261.0	1081.0	58.0	87.0

POST-TEST SCORES

RAW DATA

Calisthenics Group I

S	RGS	LGS	BLS	LLS	MPU	PU	AS	SS	Ht	Wt
1	46.0	48.0	195.0	990.0	18.0	0.0	250.2	1529.2	62.5	114.0
2	32.0	30.0	115.0	525.0	16.0	0.0	133.6	835.6	56.5	83.5
3	44.0	38.0	260.0	925.0	24.0	3.0	220.05	1487.05	59.0	81.5
4	50.0	50.0	275.0	950.0	32.0	13.0	456.75	1781.75	59.5	101.5
5	81.0	78.0	265.0	775.0	20.0	0.0	274.0	1473.0	61.0	127.0
6	50.0	48.0	265.0	475.0	25.0	14.0	319.8	1157.8	57.0	82.0
7	54.0	45.0	275.0	925.0	23.0	0.0	323.15	1622.15	62.0	120.5
8	50.0	50.0	175.0	950.0	45.0	13.0	487.2	1712.2	59.5	84.
9	68.0	48.0	250.0	935.0	40.0	13.0	694.3	1995.3	62.5	106.0
10	50.0	38.0	275.0	950.0	26.0	12.0	364.8	1677.8	59.0	96.0
11	66.0	52.0	320.0	825.0	29.0	0.0	301.6	1564.6	61.0	94.0
12	56.0	56.0	250.0	675.0	29.0	3.0	475.2	1512.2	66.0	88.5
13	64.0	50.0	300.0	950.0	41.0	4.0	553.5	1917.5	62.0	103.0
14	68.0	48.0	175.0	715.0	18.0	1.0	244.15	1250.15	61.0	118.5

S	RGS	LGS	BLS	LLS	MPU	PU	AS	SS	Ht	Wt
15	50.0	45.0	175.0	700.0	40.0	11.0	367.2	1337.2	55.0	72.0
16	45.0	44.0	180.0	650.0	33.0	9.0	396.9	1315.9	59.5	94.5
17	54.0	42.0	375.0	645.0	23.0	0.0	297.85	1413.85	61.0	119.5
18	52.0	45.0	175.0	610.0	40.0	1.0	305.45	1187.45	57.0	74.5
19	43.0	40.0	235.0	725.0	20.0	0.0	178.0	1221.0	51.0	89.0
20	55.0	60.0	250.0	650.0	40.0	5.0	432.0	1447.0	58.0	96.0
21	53.0	55.0	215.0	1100.0	35.0	5.0	400.0	1823.0	61.0	90.0
22	60.0	60.0	220.0	860.0	30.0	12.0	445.2	1645.2	61.0	96.0
23	68.0	78.0	250.0	1090.0	30.0	8.0	589.0	2075.0	64.0	115.0
24	74.0	68.0	200.0	500.0	31.0	2.0	404.25	1246.25	62.0	102.5
25	40.0	35.0	100.0	425.0	13.0	0.0	118.3	718.3	55.5	91.0
26	70.0	62.0	275.0	1150.0	24.0	6.0	378.0	1935.0	62.0	106.0
27	54.0	50.0	200.0	550.0	24.0	5.0	335.5	1187.5	62.0	95.0
28	60.0	59.0	175.0	440.0	17.0	5.0	230.0	964.0	61.0	95.0
29	55.0	44.0	185.0	900.0	20.0	2.0	286.0	1470.0	63.0	100.0
30	80.0	68.0	350.0	1120.0	70.0	19.0	809.9	3039.9	60.0	91.0

S	RGS	LGS	BLS	LLS	MPU	PU	AS	SS	Ht	Wt
31	83.0	68.0	320.0	1150.0	27.0	9.0	642.60	2263.6	66.0	118.5
32	56.0	45.0	220.0	700.0	32.0	20.0	504.4	1525.4	61.0	87.0
33	54.0	42.0	190.0	575.0	19.0	0.0	193.8	1054.8	59.0	102.0
34	48.0	48.0	200.0	420.0	20.0	9.0	424.85	1140.85	64.0	106.5
35	44.0	45.0	200.0	775.0	29.0	20.0	578.2	1642.2	62.0	98.0
36	62.0	68.0	290.0	775.0	20.0	2.0	354.2	1549.2	65.0	111.0
37	48.0	35.0	170.0	650.0	40.0	10.0	375.0	1281.0	57.0	75.0
38	44.0	40.0	195.0	775.0	41.0	5.0	379.5	1433.5	56.0	82.5
39	75.0	60.0	250.0	975.0	14.0	0.0	164.5	1524.5	60.0	117.5
40	62.0	64.0	270.0	730.0	22.0	11.0	397.65	1523.65	60.0	120.5
41	57.0	50.0	225.0	675.0	37.0	24.0	518.5	1525.5	57.0	85.0
42	70.0	74.0	200.0	1100.0	20.0	0.0	444.0	1888.0	66.0	162.0
43	85.0	60.0	325.0	790.0	39.0	2.0	664.2	1924.2	66.0	102.0
44	78.0	50.0	165.0	650.0	33.0	12.0	339.75	1282.75	56.0	75.5
45	88.0	88.0	260.0	885.0	14.0	2.0	315.2	1636.2	63.0	167.0
	74.0	75.0	305.0	700.0	42.0	24.0	877.8	2031.8	62.0	113.0

S	RGS	LGS	BLS	LLS	MPU	PU	AS	SS	Ht	Wt
47	85.0	78.0	375.0	1150.0	20.0	10.0	438.0	2126.0	63.0	116.0
48	79.0	78.0	370.0	1250.0	36.0	20.0	750.4	2527.4	63.0	104.0
49	65.0	60.0	225.0	875.0	42.0	20.0	939.30	2164.3	65.0	101.5
50	110.0	95.0	350.0	1350.0	50.0	14.0	1152.0	3057.0	65.0	130.0
51	76.0	68.0	390.0	1000.0	17.0	2.0	383.8	1917.8	67.0	132.0
52	76.0	50.0	300.0	950.0	24.0	1.0	505.0	1881.0	66.5	137.0
53	72.0	82.0	350.0	1500.0	11.0	1.0	210.0	2214.0	65.0	125.0
54	50.0	45.0	150.0	925.0	20.0	0.0	224.0	1394.0	61.0	102.0
55	82.0	64.0	350.0	1025.0	26.0	12.0	338.2	1859.2	60.0	89.0
56	50.0	48.0	220.0	540.0	19.0	5.0	285.6	1143.6	61.0	109.0
57	80.0	64.0	335.0	720.0	23.0	13.0	734.4	1933.4	66.5	139.0
58	56.0	60.0	250.0	1050.0	27.0	1.0	478.8	949.8	66.0	111.0

Circuit Training Group

1	34.0	20.0	225.0	625.0	55.0	23.0	507.0	1411.0	51.0	65.0
2	48.0	48.0	150.0	425.0	31.0	1.0	233.6	904.6	60.0	73.0
3	55.0	46.0	255.0	785.0	24.0	1.0	327.5	1468.5	61.0	121.0

S	RGS	LGS	BLS	LLS	MPU	PU	AS	SS	Ht	Wt
4	54.0	43.0	285.0	700.0	45.0	0.0	499.5	1581.5	61.5	96.0
5	58.0	59.0	275.0	925.0	38.0	11.0	663.95	1980.95	64.0	95.5
6	54.0	45.0	200.0	700.0	20.0	0.0	297.0	1296.0	64.0	108.5
7	68.0	60.0	240.0	950.0	30.0	11.0	504.3	1822.3	61.0	113.0
8	61.0	48.0	230.0	850.0	33.0	8.0	500.2	1689.2	62.5	97.0
9	56.0	58.0	330.0	865.0	22.0	8.0	477.0	1786.0	62.0	139.0
10	60.0	64.0	240.0	625.0	39.0	15.0	761.4	1750.4	63.0	111.0
11	60.0	48.0	225.0	875.0	34.0	2.0	396.0	1604.0	60.0	110.0
12	59.0	46.0	210.0	775.0	24.0	23.0	598.5	1688.5	60.0	105.0
13	58.0	40.0	225.0	710.0	25.0	0.0	211.25	1244.25	59.0	84.5
14	69.0	64.0	265.0	850.0	37.0	20.0	769.5	2017.5	62.5	110.0
	54.0	51.0	275.0	520.0	45.0	14.0	496.6	1395.6	57.5	84.0
	79.0	74.0	330.0	1025.0	40.0	22.0	886.6	2394.6	64.0	103.0
17	75.0	58.0	275.0	975.0	21.0	1.0	253.0	1636.0	60.0	115.0
18	54.0	41.0	270.0	875.0	32.0	10.0	495.6	1735.6	62.0	98.0
19	55.0	44.0	225.0	650.0	31.0	9.0	492.0	1466.0	62.5	98.0
		74.0	325.0	750.0	26.0	11.0	569.8	1796.8	63.0	124.0

S	RGS	LGS	BLS	LLS	MPU	PU	AS	SS	Ht	Wt
21	48.0	54.0	260.0	550.0	20.0	0.0	234.0	1146.0	60.0	117.0
22	48.0	42.0	160.0	525.0	24.0	29.0	540.6	1315.6	55.0	102.0
23	54.0	42.0	275.0	670.0	34.0	0.0	533.8	1574.8	64.0	117.0
24	32.0	32.0	100.0	550.0	23.0	3.0	187.2	901.2	57.5	72.0
25	45.0	40.0	225.0	600.0	25.0	8.0	341.55	1251.55	61.0	93.5
26	54.0	60.0	250.0	670.0	25.0	2.0	288.9	1322.9	59.5	107.0
27	50.0	40.0	250.0	660.0	20.0	3.0	243.8	1243.8	57.0	106.0
28	65.0	62.0	285.0	980.0	30.0	5.0	530.25	1922.25	63.0	121.5
29	65.0	60.0	295.0	875.0	53.0	20.0	773.8	2068.8	59.0	106.0
30	64.0	65.0	305.0	1050.0	50.0	23.0	1058.5	2542.5	63.0	115.0
31	68.0	48.0	265.0	1100.0	45.0	14.0	743.4	2224.4	62.0	106.0
32	50.0	54.0	300.0	650.0	50.0	17.0	556.1	1610.1	57.0	83.0
33	59.0	50.0	275.0	700.0	12.0	0.0	229.2	1313.2	61.0	181.0
34	50.0	38.0	260.0	825.0	37.0	17.0	469.8	1642.8	57.5	87.0
35	44.0	43.0	340.0	575.0	46.0	14.0	456.0	1458.0	58.0	76.0
36	59.0	35.0	200.0	850.0	38.0	15.0	524.7	1668.7	59.0	99.0

S	RGS	LGS	BLS	LLS	MPU	PU	AS	SS	Ht	Wt
37	59.0	54.0	225.0	850.0	45.0	10.0	668.25	1856.25	60.5	121.5
38	50.0	40.0	225.0	825.0	41.0	13.0	459.0	1599.0	58.5	85.0

Structured Play (Basketball) Group III

1	51.0	26.0	250.0	725.0	27.0	1.0	394.8	1446.8	64.0	101.0
2	45.0	52.0	300.0	875.0	21.0	6.0	282.15	1554.15	61.5	89.5
3	52.0	58.0	325.0	1075.0	22.0	6.0	268.8	1778.8	55.0	96.0
4	52.0	57.0	210.0	400.0	15.0	3.0	221.4	940.4	62.0	103.0
5	60.0	53.0	215.0	870.0	20.0	1.0	321.3	1519.3	64.5	108.0
6	45.0	39.0	260.0	1150.0	23.0	9.0	217.6	1711.6	56.0	68.0
7	45.0	39.0	225.0	675.0	60.0	3.0	677.25	1661.25	62.0	87.5
8	54.0	66.0	375.0	935.0	11.0	6.0	236.3	1666.3	62.0	119.0
9	55.0	40.0	225.0	775.0	19.0	0.0	283.1	1378.1	63.0	119.0
10	58.0	58.0	225.0	325.0	32.0	0.0	416.0	1082.0	62.0	110.0
11	54.0	48.0	250.0	400.0	10.0	3.0	159.25	911.25	60.0	122.5
12	56.0	46.0	270.0	865.0	52.0	0.0	912.60	2149.6	65.0	125.5
13	52.0	44.0	285.0	635.0	30.0	1.0	310.0	1326.0	59.0	100.0

S	RGS	LGS	BLS	LLS	MPU	PU	AS	SS	Ht	Wt
14	64.0	62.0	270.0	780.0	44.0	16.0	813.0	1989.0	63.0	105.5
15	64.0	44.0	250.0	825.0	31.0	1.0	297.6	1480.6	59.0	93.0
16	48.0	35.0	225.0	725.0	13.0	12.0	192.5	1225.5	57.0	77.0
17	70.0	70.0	275.0	785.0	31.0	4.0	518.0	1718.0	64.0	108.0
18	50.0	55.0	300.0	785.0	24.0	8.0	547.2	1737.2	64.5	126.0
19	38.0	32.0	75.0	470.0	9.0	7.0	94.4	709.4	52.0	59.0
20	50.0	46.0	175.0	730.0	14.0	5.0	364.8	1335.8	68.0	112.0
21	45.0	44.0	245.0	620.0	16.0	0.0	172.8	1126.8	60.0	108.0
22	72.0	68.0	470.0	725.0	33.0	9.0	630.0	1965.0	63.5	115.0
23	42.0	39.0	150.0	650.0	25.0	7.0	296.0	1177.0	58.6	92.5
24	32.0	40.0	250.0	485.0	21.0	1.0	173.8	980.8	55.0	79.0
25	56.0	50.0	255.0	725.0	9.0	0.0	140.4	1226.4	63.5	121.0
26	45.0	42.0	180.0	700.0	21.0	5.0	258.7	1225.7	59.0	99.5
27	53.0	40.0	310.0	725.0	16.0	10.0	235.3	1363.3	58.0	90.5

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