

AN EVALUATIVE STUDY OF THE EFFECTS OF A WEIGHT TRAINING
PROGRAM, USING A CIRCUIT TRAINING MACHINE, ON THE SIZE,
SPEED, AND STRENGTH OF HIGH SCHOOL ATHLETES

by 4589

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A MASTER'S REPORT

submitted in partial fulfillment of the
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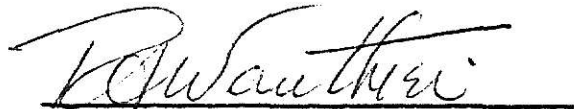
MASTER OF SCIENCE

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INTRODUCTION

At the present time there is greater emphasis being placed on weight training as an integral part of our high school athletic programs. So much has this emphasis increased the past few years that many high schools have invested two to three thousand dollars in self-contained weight training machines or circuit trainers, the most common name, and the name I will use when referring to the machine used in this study. Circuit trainers provide a very effective, safe, and efficient means of conditioning the athletes body through weight training.

During the fall of 1969, Manhattan High School, Manhattan, Kansas, purchased a circuit trainer to be used as a part of their physical education program and varsity athletics. The coaches wanted to initiate a weight training program, using a circuit trainer, to develop the size, speed, and strength of high school athletes.

Statement of Problem

The study was designed to deal with an evaluation of the results obtained from a concientious weight training program using a circuit trainer. More particularly, the purpose of this study was to examine the changes in size, speed, and strength for those boys who participated in the weight training program at Manhattan High School.

Scope of the Study

Ten high school athletes at Manhattan High School, Manhattan, Kansas, participated as subjects in this investigation. All the subjects were selected on a voluntary basis. They met five days a week for approximately forty minutes per day throughout the testing period which lasted six months. At the beginning of the program, each subject's height and weight, along with chest (expanded), upper arm, waist, neck, thigh and calf measurements were recorded. Each subject was timed on a forty yard dash and was also tested on four major power lifts to determine their strength. These lifts were: (1) three-quarter squat, (2) bench press, (3) military press, and (4) dead lift. Their maximum lift for each exercise was recorded. The same measurements were taken and tests given at the conclusion of the program in order to evaluate the difference in the results of the two tests.

Limitations of the Study

It was impossible to control the outside exercise activities of the subjects, as it was also impossible to ascertain the natural growth, speed, and strength gains that would be made during this same period of time without a weight training program. It is safe to assume, however, that the gains shown in this study would overshadow any normal gains over the same period of time.

Equipment

All of the weight training equipment necessary for the study was included in the Marcy Circuit Trainer* as it was received from the manufacturer.

REVIEW OF RELATED LITERATURE

A search was conducted in the local and university library to find material concerning this subject. No articles on this subject were found other than those offered by the manufacturer in the form of advertisements.

METHODS AND PROCEDURES

Description of the Subjects

The subjects chosen for the study were selected from the varsity football squad. They were chosen because they were not participating in a winter sport, and had expressed a desire to participate in the program. All of the subjects were juniors with one year of high school varsity football remaining. Each of the subjects had previous experience with weight training; however, most of this experience was gained through informal training at home.

* Marcy Circuit Trainer: Marcy Gymnasium Equipment Company, 1736 Standard Avenue, Glendale, California, 91201.

Description of the Circuit Trainer

There are several different types and brands of circuit trainers, but the only one described here is the one used in the study (Fig. 1 and 2).

The circuit trainer is a self-contained machine. The weights are permanently fixed on rods and can not be removed. They slide up and down these rods with a minimum amount of friction. The amount of weight to be used is selected and a pin is placed under the appropriate bar which has a number corresponding to the total weight above it (Fig. 3). Example: If the pin were placed in the hole under the bar marked sixty, the six, ten pound bars from ten pounds to sixty pounds would be lifted, thus totaling sixty pounds. Each of the lifting stations is constructed to accomodate a particular exercise or exercises.

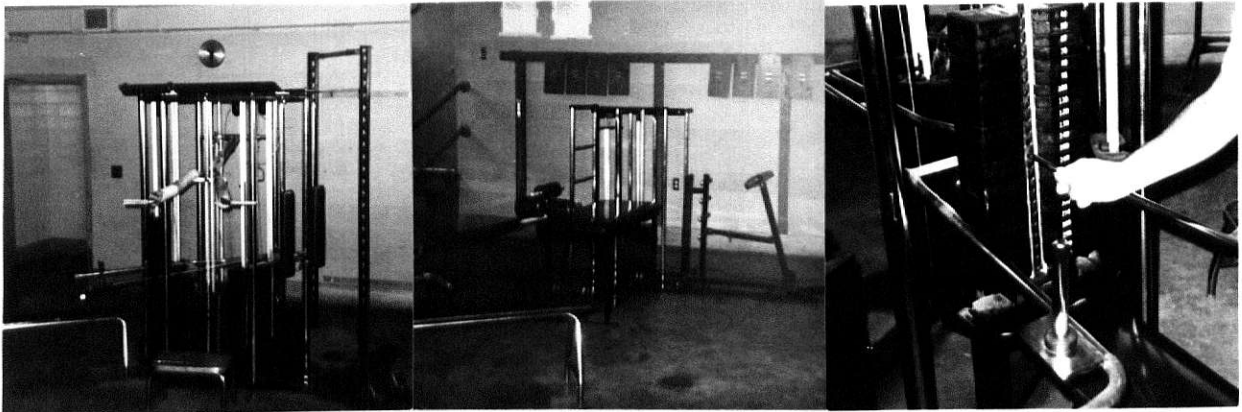


Figure 1.

Figure 2.

Figure 3.

Description of Training Program

The program was divided into two weight training sessions. Session one was devoted to work on the following areas of the body: chest, shoulders, arms, upperback, and stomach. Session two was spent working on the lower back, thighs, calves, and neck.

On alternating weeks, session one was held on Monday, Wednesday and Friday, and session two was held on Tuesday and Thursday. The following week, session two was on Monday, Wednesday and Friday, and session one was on Tuesday and Thursday.

The total weight training program consisted of ten basic (mandatory) exercises. The basic exercises included in session one were: (1) bench press, (2) military press, (3) lat pull downs, (4) curls, and (5) Roman chair sit ups. The basic exercises for session two were: (1) dead lift, (2) three-quarter squat, (3) running station, (4) leg extensions, and (5) leg curls.

Following are descriptions and illustrations of the ten basic exercises:

1. Bench Press. The subject assumes a supine position on the bench with head, shoulders and hips contacting it and the legs straddling it, feet flat on the floor. Using an overhand grip, the handle is grasped and the weight is pressed from the chest-

rest position to arms length. The weight is then lowered and repeated (Fig. 4 and 5).

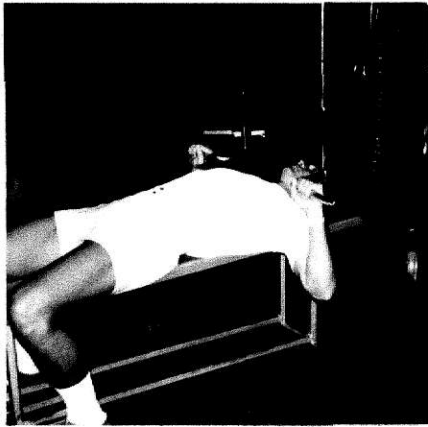


Figure 4.

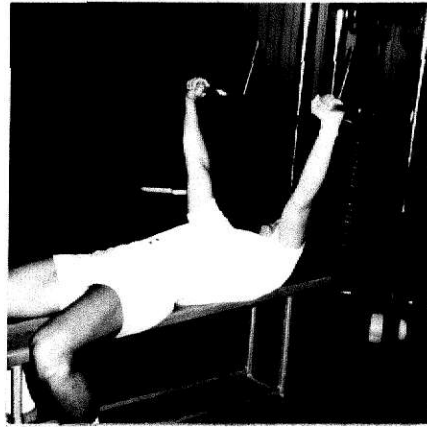


Figure 5.

2. Military Press. The subject sits erect on the stool provided with the handle at chest-rest position. The weight is pressed to an overhead position with both arms completely extended. Lower the bar to chest-rest position and repeat (Fig. 6 and 7).

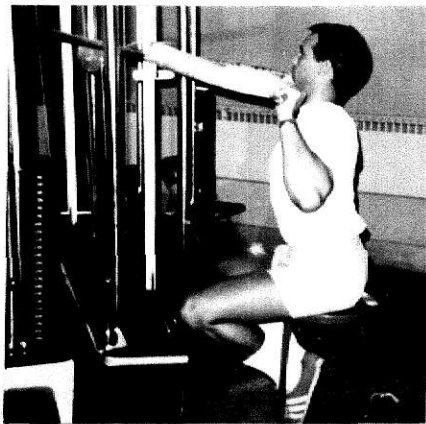


Figure 6.

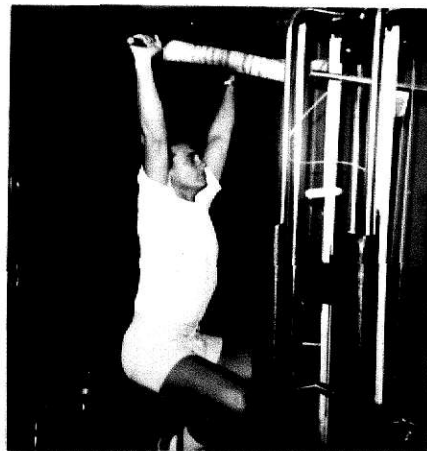


Figure 7.

3. Lateral Pull Downs. The subject positions himself under the pull down handle and takes a fairly wide grip. The handle is pulled down to a position behind the head. The handle is returned slowly to the starting position and repeated (Fig. 8 and 9).

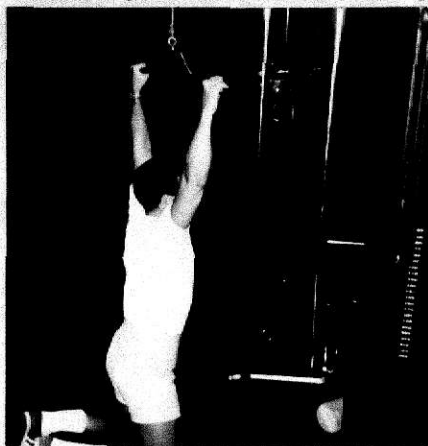


Figure 8.



Figure 9.

4. Two Arm Curl. The subject stands erect and grasps the handle with an underhand grip, shoulder width apart. With the handle at thigh-rest position, flex the arms at the elbow until the handle touches the chest. The upper arm is held motionless and close to the body. Return the handle to thigh-rest position and repeat (Fig. 10 and 11).

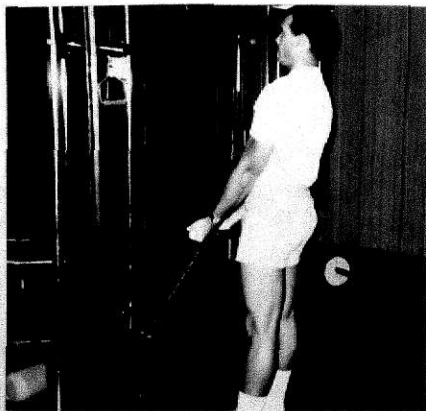


Figure 10.

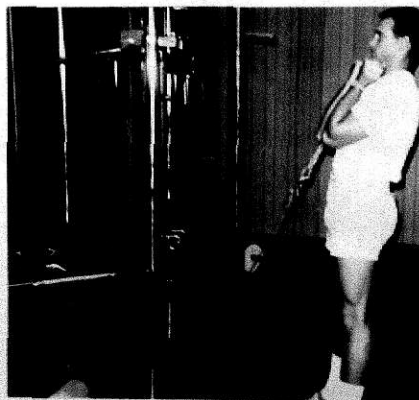


Figure 11.

5. Roman Chair Sit Up. The subject assumes a sitting position with the support pad resting behind the lower thigh. The feet are placed under the support bars. He then leans backwards until his head nears the floor, and sits back up to the starting position and repeats (Fig. 12 and 13).

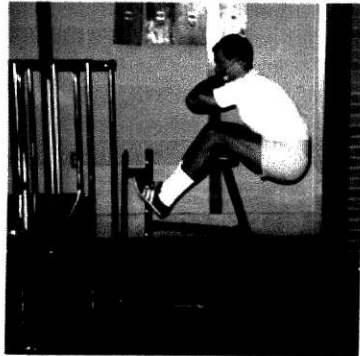


Figure 12.

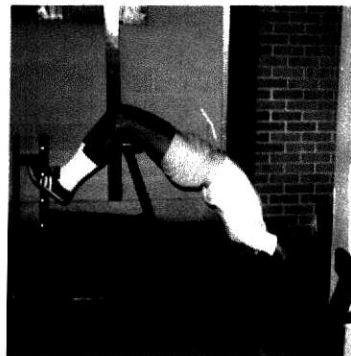


Figure 13.

6. Dead Lift. The subject bends at the waist and flexes his knees to grasp the handle with an overhand grip and the hands shoulder width apart. The handle is then pulled up by extending the legs and back to the thigh-rest position, the weight then lowered to the bottom and repeated (Fig. 14 and 15).



Figure 14.

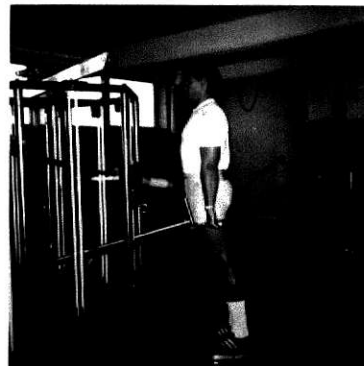


Figure 15.

7. Three-quarter Squats. The subject assumes a standing position with feet comfortably spread the width of the shoulders. The weight is rested on the shoulders. With back straight and chest high, the subject flexes at the knees, lowering to a position with the thighs being below parallel to the floor. The legs then push up returning to standing position and repeat (Fig. 16 and 17).

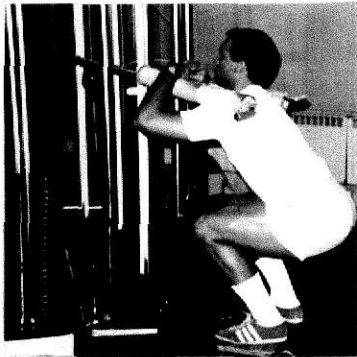


Figure 16.

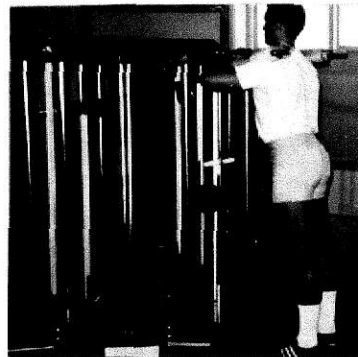


Figure 17.

8. Running Station. The subject places one foot on each of the pedals and braces his shoulders on the support pads. With head up and back straight, the legs are alternately driven back in a running motion (Fig. 18 and 19).

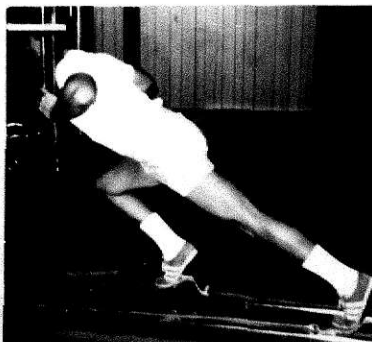


Figure 18.

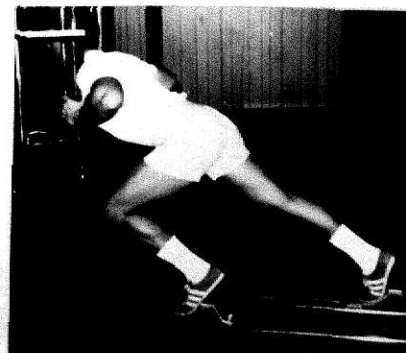


Figure 19.

9. Leg Extensions. The subject assumes a sitting position with the handle resting across the top of his feet. The legs are straightened and then returned to starting position slowly. Best results are attained when done with a two second hesitation when the legs are fully extended (Fig. 20 and 21).

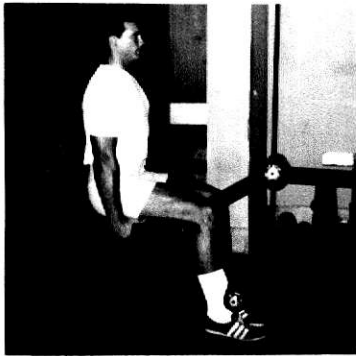


Figure 20.

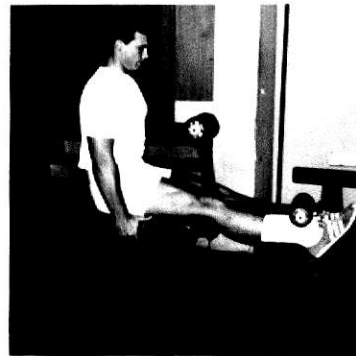


Figure 21.

10. Leg Curls. The subject lies face down on table with legs straight out. The bar is resting on the back of the lower legs. The knee is flexed, pulling the heels up as far as possible, legs then lowered and exercise repeated (Fig. 22 and 23).

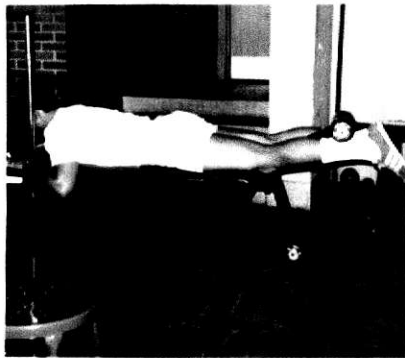


Figure 22.



Figure 23.

Each exercise is done in three consecutive sets with the repetitions varying with each exercise from six to ten per set. When the subject was capable of completing the three sets doing the specified number of repetitions correctly, he then added ten pounds of weight to the total he had been lifting. It is through this procedure of adding weight that greater strength is attained.

Various supplementary exercises are added to the basic ones to insure a complete workout of the body areas already concentrated on and those which are not of such great importance, but which should not be ignored.

Following is a concise description depicting the workouts of session one and session two including the supplementary exercises that correspond with the session:

Session One

Basic Exercises

	<u>Sets</u>	<u>Repetitions</u>
Bench Press	3	6
Military Press	3	6
Lat Pull Downs	3	6
Curls	3	6
Roman Chair Sit Ups	3	10

Supplementary Exercises

Dips	Pull Ups
Upright Rows	Lateral Raises
Tricep Extensions	

Session Two

Basic Exercises

	<u>Sets</u>	<u>Repetitions</u>
Dead Lift	3	6
Three-quarter Squat	3	10
Running Station	3	10
Leg Extensions	3	10
Leg Curls	3	10

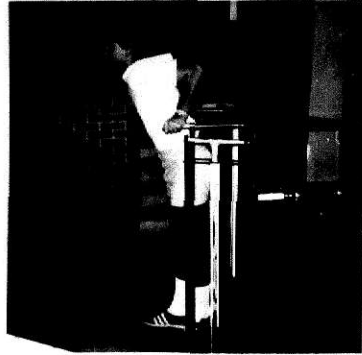
Supplementary Exercises

Toe Raises	Leg Raises
Sit Ups (incline)	One-quarter Squats (heavy)

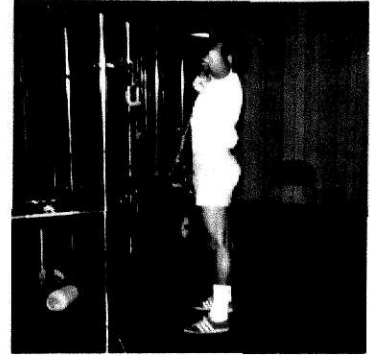
Neck Strap or Bridging

Each of these sessions takes approximately forty minutes to complete depending on the number of supplementary exercises done. The supplementary exercises are chosen in accordance with each individuals particular needs and are encouraged. The number of sets and repetitions of these exercises are selected accordingly. The subjects usually choose their own supplementary workout with guidance from their coach. This policy usually promotes a better attitude toward the workout. Pictured in Plates 1 and 2 are the supplementary exercises.

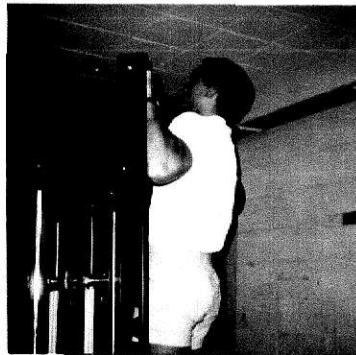
Plate 1. Supplementary Exercises



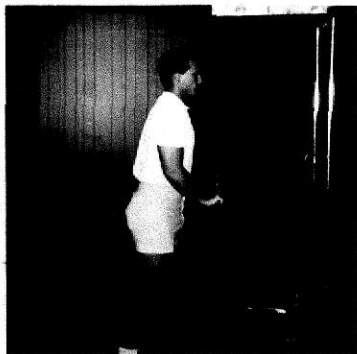
Dips



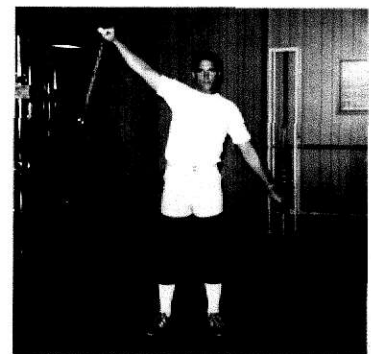
Upright Rowing



Pull Ups

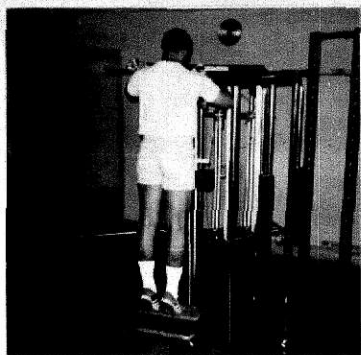


Tricep Extensions



Lateral Raises

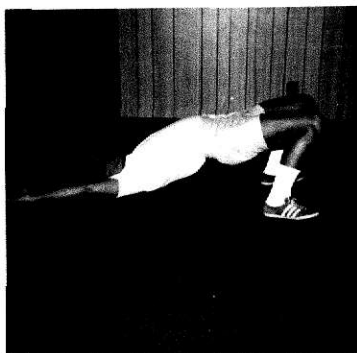
Plate 2. Supplementary Exercises



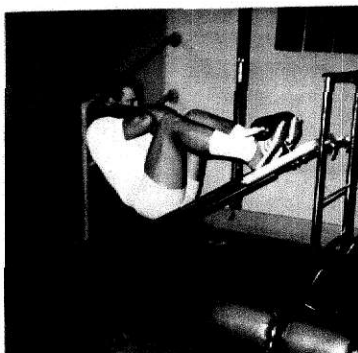
Toe Raises



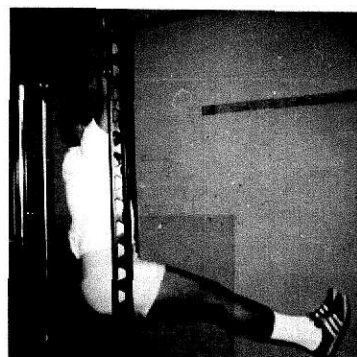
One-quarter Squats



Bridging



Incline Sit Ups



Leg raises

Training with a Purpose

For any weight training program to be a success, the participants must have a clearly defined purpose or goal towards which they are striving. The subjects of this study had as their goal, a football championship for Manhattan High in 1970. Through this weight training program, they dedicated themselves to the task of preparing both physically and mentally to achieve their goal.

Psychological Gains

As the size, strength and speed of the subjects increased, their feeling of confidence also increased. The progress made through this weight training program helped erase such negative thoughts as "I'm not as strong as that guy across the line", or "That guy is bigger than I am." With their added size, speed, and strength, these boys feel confident they can master any situation they may face. According to many coaches, half the battle is won when this positive attitude is instilled throughout the squad.

Motivating the Group

In the beginning, everyone trained vigorously, but then the enthusiasm began to wear off. This was especially true the first two or three weeks when soreness abounded and gains were hard to see. Once the subjects became aware of an

increase in muscle size, however, the motivation was self-sustaining.

Since success depends upon regular training, the coach must be alert for aids that will rejuvenate the group and keep them going.

Motivational aids found to be helpful in this study are listed below.

1. Testing and measuring before the program started and periodically throughout the program to show progress.
2. Stress was put on intergroup competition with personal improvement being of primary importance.
3. Mirrors were stationed around the room so gains may be observed.
4. Variations in supplementary exercises to help prevent boredom (it is necessary to adhere to the basic workout).
5. The coach must be a "cheerleader" handing out praise and giving a shove to keep the group going on "down" days.

Complimentary Activities

At the completion of the weight workout, the group usually indulged in a play period. Various high-activity games were played such as basketball, soccer, volleyball, handball, touch

football and softball. This "play" time usually lasted thirty minutes and allowed for any "boundness" to be worked out, and for a good sweat to be attained before showering.

Testing Procedure

Each subject was weighed to the nearest pound, measured to the nearest half inch, and timed to the nearest tenth of a second at the beginning of the program, and again at the end. This was done in an effort to measure the gains in size and speed throughout the program.

In an effort to measure the strength gained, a test was administered at the beginning and at the end of the program. Four of the basic exercises were chosen for the test. These were: (1) bench press, (2) military press, (3) three-quarter squat, and (4) dead lift. The subjects were instructed to lift the maximum amount of weight they were able to lift one time and still execute each lift properly. This amount was recorded after the initial and final tests and compared.

RESULTS AND DISCUSSION

The findings of this study have presented evidence on the effects of a six month weight training program using a circuit trainer upon the size, speed, and strength of the ten subjects.

The results as shown in Table 1 depict the increase in the height and weight of each subject.

Table 1. Height and Weight Statistics

Height (inches)				Weight			
Subject No.	Initial	Final	Gain	Subject No.	Initial	Final	Gain
1	71	72	1	1	163	178	15
2	70	71½	1½	2	157	170	13
3	73	73½	1½	3	185	201	16
4	69	70	1	4	183	204	21
5	73	74½	1½	5	160	172	12
6	69	70	1	6	146	168	22
7	70	70½	½	7	138	145	7
8	72	72½	½	8	155	167	12
9	70	71	1	9	138	150	12
10	68	69	1	10	143	154	11

All ten subjects in the study gained in height and weight. The smallest growth was ½ inch, while the greatest growth was 1½ inches, the average being .95 inches. The greatest weight gain was 22 pounds while the least gain was 7 pounds, the average being 7 pounds.

Table 2 shows the change in each subjects waist and chest measurements. The waist measurement was taken at navel level, and the chest measurement was taken with chests fully expanded.

Table 2. Waist and Chest Measurements

Waist				Chest			
Subject No.	Initial	Final	Gain	Subject No.	Initial	Final	Gain
1	33	32	-1	1	37	41	4
2	33	33	0	2	39½	42	2½
3	30	32	2	3	42	45	3
4	33	34	1	4	42	44½	2½
5	30½	31	½	5	36	39½	3½
6	32	32	0	6	36	40	4
7	30½	30	-½	7	38	41	3
8	32	33	1	8	37	41½	4½
9	28	29	1	9	35½	38½	3
10	30½	31	½	10	37	40	3

Those subjects who tended to be soft or overweight lost around their waist. The largest amount lost was 1 inch. The more slender subjects gained in size around the waist as much as 2 inches. The average change shown in waist measurement was a gain of .45 inches. Each subject gained in chest size, the largest gain being 4½ inches, the least being 2½ inches. The average gain was 3.3 inches.

Table 3 shows the upper arm and neck measurements. The upper arm measurement was taken with the arm flexed as large as possible. The neck was measured as if fitting for a shirt or in a natural state.

Table 3. Arm and Neck Measurements

Arm				Neck			
Subject No.	Initial	Final	Gain	Subject No.	Initial	Final	Gain
1	13	14	1	1	14½	15½	1
2	13½	14½	1	2	15	16½	1½
3	13	14½	1½	3	15	16½	1½
4	13	15	2	4	14½	16½	2
5	12	13½	1½	5	14½	15	½
6	12	13½	1½	6	15	15½	½
7	11½	13	1½	7	15	15	0
8	13	14	1	8	15	16	1
9	11½	13	1½	9	14½	15½	1
10	13½	14	½	10	14½	15	½

Every subjects arm measurement increased, and all but one gained in neck size. The greatest arm gain was 2 inches, and the least gain was ½ inch. The average arm gain was 1.3 inches. The greatest gain made in neck measurement was 2 inches. The average gain in neck size was .95 inches.

Table 4 shows the increases made in the thigh and calf areas. The thigh was measured around the largest part from a standing position with the muscle tightened. The calf was also measured in a standing position with the feet flat on the floor and leg tense.

Table 4. Thigh and Calf Measurements

Thigh				Calf			
Subject No.	Initial	Final	Gain	Subject No.	Initial	Final	Gain
1	21½	22½	1	1	15	15	0
2	21	22½	1½	2	14½	15	½
3	23	24	1	3	15½	16½	1
4	21½	23	1½	4	14½	15	½
5	21	22	1	5	14	14	1
6	21	21½	½	6	15	15½	½
7	21	22	1	7	14½	15	½
8	20½	21½	1	8	15	16	1
9	19½	21	1½	9	13½	14	½
10	21½	22	1	10	14½	15	½

Every subject gained in thigh size. The least gained was ½ inch and the most gained was 1½ inches, the average gained being 1.05 inches. Every subject but one increased his calf size. The most gained was 1 inch, the average being .6 inches.

Table 5 shows the increase in speed over forty yards that each subject made. The subjects were allowed to run as many forties as they chose, then their best time was recorded. These forties were run outdoors in gym clothes and track shoes.

Table 5. Forty Yard Time Chart

Subject No.	Initial (seconds)	Final (seconds)	Gain (seconds)
1	5.0	4.9	.1
2	4.9	4.8	.1
3	5.3	5.1	.2
4	5.4	5.1	.3
5	5.1	5.0	.1
6	5.0	5.0	.0
7	5.0	4.7	.3
8	4.8	4.7	.1
9	4.7	4.6	.1
10	4.8	4.7	.1

Every subject, except one, showed an increase in speed over a distance of 40 yards. The greatest increase being .3 seconds, gave an average increase of .14 seconds.

Table 6 shows the average increase for the entire group in each of the categories tested.

Table 6. Average Increases for All Categories

Catagories	Average Increase
Height (inches)	.95
Weight (pounds)	14.10
Speed (tenths of seconds)	.14
Chest (inches)	3.30
Arm (inches)	1.30
Neck (inches)	.95
Waist (inches)	.45
Thigh (inches)	1.05
Calf (inches)	.60

As one observes from the information included in Table 6, the entire group showed significant gains in each of the categories tested. The figures shown are the average gains made by the group in each category.

Table 7. A comparison of maximum explosive power as measured by the bench press and three-quarter squat, at the beginning and end of the program.

Bench Press				Three-quarter Squat			
Subject No.	Initial	Final	Gain	Subject No.	Initial	Final	Gain
1	160	220	60	1	180	300	120
2	180	240	60	2	180	320	140
3	160	250	90	3	200	340	140
4	180	250	70	4	180	290	110
5	110	210	100	5	120	260	140
6	130	200	70	6	170	280	110
7	110	170	60	7	140	220	90
8	160	240	80	8	140	240	100
9	130	200	70	9	170	260	90
10	110	170	<u>60</u>	10	150	220	<u>70</u>
	TOTAL		720		TOTAL		1110

Every subject gained in strength as measured by the bench press and three-quarter squat. The greatest gain in bench press was 100 pounds, and the greatest gain in squats was 140 pounds, with several boys accomplishing this 140 pound gain. The least gained in the bench press and three-quarter squat was 60 and 70 pounds respectively. The average gains were 72 pounds for the bench press and 111 pounds for the squats.