1956

The Effect of Prescribed Weight Training on a Selected Group of Varsity Basketball Players

Bernard Eugene Duffy

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THE EFFECT OF PRESCRIBED WEIGHT TRAINING ON A SELECTED
GROUP OF VARSITY BASKETBALL PLAYERS

By

Bernard Eugene Duffy

A Problem submitted
in partial fulfillment of the requirements for the
degree of Master of Science at South Dakota
State College of Agriculture
and Mechanic Arts

August 1956

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ACKNOWLEDGEMENTS

The writer wishes to express his most sincere appreciation to Mr. Rueben B. Frost for his able supervision of this study, and for his valuable suggestions and assistance in carrying out this research.

Expressions of appreciation are also due to the other faculty members and the students whose aid and cooperation made this study possible.

B. E. D.
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CHAPTER I

INTRODUCTION

In the field of physical education weight lifting has been regarded by many as not having a place in the program because of its hindrance to speed, reaction time, and flexibility in those training for athletics. In recent years it has been receiving more and more attention and experimentation as a supplement to the regular training program of those preparing for physical activities.

In this study an effort has been made to observe any influence a program of weight lifting might have upon basketball players in training for the ensuing season. This effect was measured through the use of the Sargent Jump test, tensiometer strength testing, and reaction time testing of twelve varsity basketball players. Of these basketball players six carried on a program of weight lifting during early season basketball practice and six did not.
CHAPTER II
RELATED LITERATURE

SARGENT JUMP

The Sargent Jump is a measurement of the individual's explosive power or the ability of the individual to move his body through space rapidly. The equation for power is:

\[ \text{Power} = \frac{\text{Weight}}{\text{Speed}} \]

Almost all tests of motor ability include the Sargent Jump in one variation or another. It is the single test most often used by coaches in determining general athletic ability.

Van Dalen\(^2\) in one study found a correlation of .810 between the Sargent Jump and four track and field events, and a correlation of .776 was obtained between the chalk jump and four track and field events.

In construction and evaluation of tests of potential basketball ability, H. N. Tibbett\(^3\) included the Sargent Jump as one of four items.

In measuring athletic power Capen\(^4\) used the Sargent Jump in testing

---

\(^1\) Charles Harold McCoy, *Tests and Measurements in Health and Physical Education*, p. 56.


his weight training. At the end of the period the members of his control group had increased their power and as a result their jumping ability increased.

Van Dalee⁵ stated that track and field events are known power events and include running, throwing, and jumping, all of which require maximum contraction in the minimum amount of time. It would therefore seem logical that the Sargent Jump would be used as an instrument to measure these qualities. From this it would be assumed that there is a high relationship between the Sargent Jump and basketball ability which consists chiefly of running, jumping and throwing.

**STRENGTH TESTING**

Muscular strength has been recognized for many years by physical educators and doctors as not only vital for participation in athletic competition but also necessary for healthy everyday living.

McCloy⁶ has described it quite significantly in the following paragraph:

Individuals who are twenty-five per cent overweight, or individuals who have only four-fifths of the normal amount of muscle for given weights suffer certain hardships. The undermuscled individuals tire easily, and this fatigue is cumulative to complete exhaustion. The overweight individuals carry too great a load for the muscle structure of their bodies. Thus muscle efficiency is lessened, because the efficiency of the muscle contraction is resisted by the muscle load. A muscle with a light load operates more effectively than one that is overloaded. This overload—so leads to fatigue, and constant fatigue becomes a health handicap, in that fatigued individuals are more liable to colds.

---

⁵ Van Dalee, op. cit., p. 112.

The effort to develop a system of measuring strength is not new, and as far back as 1880 Dudley A. Sargent, M. D.\(^7\) proposed a battery for measuring individual parts of the body. His work and suggestions were instrumental in development of the Intercollegiate Strength Test. This test persisted until 1925 when Dr. Frederick Reed Rogers\(^8\) modified it and included norms for interpreting physical condition, athletic performance, and muscular strength.

Since that time numerous tests have been devised for measurement of strength and various muscle groups.

The Roger's Strength Index (S. I.) and Physical Fitness Index (PFI) consists of weight and seven tests.\(^9\) They are: (1) back strength, (2) leg strength, (3) lung capacity, (4 & 5) right and left grip, (6 & 7) arm and shoulder strength (via pull-ups and push-ups). The Strength Index is the sum of the scores in the test divided by the norms for that age and weight group to obtain the PFI.

MacCurdy's Strength Test\(^10\) is constructed on a formula in which power equals force times velocity. Force is measured by the strength of the legs, back and arms, and velocity by jump divided by 100 equals the Physical Capacity Index. The reliability of this index is .93.

---


\(^8\) Frederick Reed Rogers, *Physical Capacity Tests in the Administration of Physical Education*, quoted in Clarke, *loc. cit.*


Vendler\textsuperscript{11} developed a Total Strength Index by measuring forty-seven different muscle groups with a dynamometer. The best combination of this group proved to be a measure of the thigh extensors, leg extensors, pectoralis major, arm flexors, the anterior trunk extensors, and the foot extensors.

Clarke\textsuperscript{12} developed a method of testing through the use of the tensiometer. He has drawn up joint angles and positions of the body for conducting these tests. High tension aircraft cables are used in conjunction with the tensiometer to obtain the recording. Test reliabilities are quite high and this method is especially suitable for measuring progress in muscle strength as has been demonstrated by its use in testing orthopedically disabled people.

Clarke\textsuperscript{13} devised twenty-eight tests in his original battery for measuring muscles that activate the body joints. Coefficients of objectivity between .92 and .97 were reached by the re-test method with varied testers using non-disabled college men. The original battery has been modified several times to produce higher coefficients of objectivity in some of the lower rated muscle groups.


\textsuperscript{12} A. Harrison Clarke, "Objective Strength Tests of Affected Muscle Groups Involved in Orthopedic Disabilities," \textit{Research Quarterly}, Volume XIX, (May 1948), p. 120.

\textsuperscript{13} Clarke, \textit{op. cit.}, p. 135.
REACTION TIME

Rapid response to stimuli is very important to success in athletics and vital to safe and efficient everyday living.

Westerland and Tuttle\textsuperscript{14} studied the reaction time of twenty-one university track men through the finger response to an electric light stimulation. They found speed of reaction time directly related to the speed of track men with short distance men having the faster reaction time.

Beise and Peasley\textsuperscript{15} in testing a group of university women skilled in archery, golf and tennis found that all had faster reactions than a similar group of non-skilled women. Of the skilled the tennis players were the fastest followed by the golfers and archers in that order.

Miles\textsuperscript{16} studied reaction times of eighty-seven football players to verbal stimuli. He found that backs were the fastest followed by the ends, guards, tackles, and centers in that order.

Burpee and Stroll\textsuperscript{17} measured forty-six men of an athletic club. The men were divided into four groups according to participation and attendance. They found a negative correlation between hand reaction and


success in physical education activities and a more negative relationship between reaction time and foot and whole-body movements.

Keller\textsuperscript{18} measured three-hundred and fifty-nine athletes and two hundred and seventy-five non-athletes for reaction time. The athletes responded faster than non-athletes and among the athletes the baseball, basketball, football, and track group were fastest in that order and were all faster than the gymnasts, wrestlers, and swimmers who were rated in that order.

Burley\textsuperscript{19} tested a group of high school and college letter winners against non-award winners. Non-letter winners had slower reaction times than letter winners with varsity swimmers being close behind. In order of speed the fastest were baseball players, football backs, football linemen, basketball players, high school letter winners, swimmers, and non-athletes in that order.

**WEIGHT TRAINING**

Weight training and (or) lifting has been frowned on for many years by coaches and trainers because of the beliefs that it decreases agility and increases "muscle boundness".

James E. Counsilman\textsuperscript{20} in testing three weight lifters, one of them


the "Mr. America of 1952", found them to be considerably above average in three tests of flexibility. Fifteen other weight lifters were then tested and the same results were obtained from them. In addition to flexibility they also were found to be above average in agility, power (tested by the Sargent Jump), strength, and physical fitness.

In the study by Chui\textsuperscript{21} it was found that those who participated in a system of weight training gained in power while those in the control group did not.

Zorbas and Karpovich\textsuperscript{22} in measuring the relationship of weight lifting to muscular contractions found that the weight lifters were faster in their rotary arm motions than the non-lifters.

Wilkin's\textsuperscript{23} study found the chronic weight lifter not muscle bound in the sense of the speed of movement. Capen\textsuperscript{24} in his study found that the weight training group improved in speed much more than the group engaged in a strenuous training program.

Wilson\textsuperscript{25} found that weight training reduced the subject's endurance which coincides with other opinions that weight training decreases circula-


\textsuperscript{24} Capen, op. cit., p. 22.

tory and respiratory endurance. He found also that it increases flexi-
bility, balance, and power.

McCloy\textsuperscript{26} has stated that when the strength of a muscle is increased fewer motor units will be used in specific amounts of exercise. The fewer motor units employed the longer they can be alternated in performing the exercise, and therefore, it would seem that an increase in muscular strength would be an increase in endurance.

Hoffman\textsuperscript{27} states that weight training is the most effective form of physical training for both visceral and skeletal muscular development. He believes that exercise with weights produces greater development in a shorter time.

Masley, Hairabedian, and Donaldson\textsuperscript{28} in tests found an increase in strength due to the weight training program, and after six weeks period an evident increase in speed and condition.

In a study by Capen\textsuperscript{29} it was found that in the power events, running, jumping, and throwing, the weight training group improved 14.9 per cent while in the same period non-weight trainers engaged in a strenuous conditioning program increased 8.6 per cent. Improvement in strength was 4.6 per cent for weight trainers and 2.7 per cent for non-weight trainers.

\textsuperscript{26} Charles Harald McCloy, "Endurance," \textit{The Physical Educator}, (March 1948), Quoted from Counsilman, op. cit., p. 18.

\textsuperscript{27} Robert Hoffman, \textit{Weight Lifting}, (1939)


\textsuperscript{29} Capen, op. cit., p. 90.
In another study at the University of Iowa\textsuperscript{30} a program was devised for developing muscles of the legs. After six weeks this group was tested with the Serpent Jump and an average increase of seven centimeters was noted with one individual reaching fifteen centimeters.

McCloy\textsuperscript{31} says that weight training does not make one slow and muscle bound when sensibly planned, but on the other hand should increase speed and raise efficiency.

\textsuperscript{30} McCloy, C. H., "The Development of Strength by Progressive Resistance Exercises and its Relationship to Improvement of Athletic Ability in Sports and Track and Field Athletics," State University of Iowa, (1955)

\textsuperscript{31} McCloy, op. cit., Strength Development and its Relationship to Track and Field Athletics, State University of Iowa.
CHAPTER III

METHOD

In conducting this experiment six varsity basketball players were used as the control group. They participated in no other type of physical training other than that conducted in regular practice for the entire team. Six other varsity basketball players in addition to their regular training carried on a prescribed weight lifting program with the emphasis being chiefly on exercises involving the extensor muscles. The weights were lifted three times per week prior to the regular practice period. From ten to fifteen minutes were required to do the entire group of exercises.

The tests were administered to different individuals several times prior to the regular testing to aid the writer in testing procedure and decrease the margin of error due to inexperience.

There was no standard by which the test scores were compared and comparisons were not made between the different subjects. The only comparisons were those made between the performances of the subjects from week to week.

Both groups were tested once each week on or near the same day barring interruptions due to trips or absence. The experimental group was tested for five weeks and the control group was tested for four weeks.

The method of exercising with the weights was adapted from a system used at the University of Iowa, while the number of repetitions for each exercise was arrived at by the author after a series of experimental liftings. Each lifter received a thorough check-out and was supervised during his first three weight lifting sessions.
WEIGHT TRAINING

The weight training exercises (see appendix) included the following:

1. Twelve wrist curls in which the forearms were placed upon a table in the supine position with fifteen pound bar-bells in each hand. The wrists were then flexed ventrally to their maximum and relaxed twelve times.

2. Ten forearms curls in which a thirty pound bar-bell was grasped at arm's length with the palms forward and the individual in the standing position. Flexing the elbows the bar-bell was raised to the shoulders utilizing the biceps.

3. Ten lateral rises in which the individual in the erect standing position grasped a fifteen pound bar-bell in each hand with the palms in the position of inversion. In a lateral plane, while keeping the arms straight, the individual then raised the bar-bells to their greatest height ten times.

4. Twelve overhead extensions or presses in which the individual in the standing position grasped a thirty pound bar-bell with the palms down. He then raised it to his shoulders and from there extended it to the arm's length above the head twelve times.

5. Ten forward rises in which the individual in the standing position grasped a fifteen pound bar-bell in each hand with the palms facing to the rear. Simultaneously the weights were lifted forward and upward, with the arms straight, to their greatest height ten times.

6. Twenty heel rises in which the individual placed the thirty
pound bar-bell on his shoulders with his toes resting upon an elevated plank, approximately three inches thick, with the heels remaining upon the floor. The individual then raised himself to his tip toes and returned his heels to the floor twenty times.

7. Ten walking squats in which the individual with the thirty pound bar-bell resting upon his shoulders took a long forward step. He then squatted down until the upper and lower parts of his forward extended leg formed approximately a ninety degree angle. He then returned to his full height and repeated the same process with the left leg until ten steps had been taken. This process was then reversed taking ten steps to the rear.

TESTING

Methods of testing were the Sargent Jump, reaction testing, and strength testing with the tensiometer.

The Sargent Jump is a measurement of the individual's ability to jump vertically into the air from the standing position. It was conducted in the following manner: the individual wet his finger tip and flat-footedly stretched to his maximum reach where a mark was recorded for that test and for all future tests. He then wet his finger tip again and jumped vertically, marking the board at his maximum height, with the distance he jumped being the distance between the two marks.

The reaction tests were conducted by using the driver training automotive mock-up. For the foot reaction-time the individual sat in front of the mock-up with his knees flexed at a ninety degree angle. This angle and all subsequent angles were measured with a goniometer. He then placed his right foot on the accelerator and watched for the green light to change red.
Upon changing to red the subject removed the right foot from the accelerator and depressed the brake pedal as rapidly as possible with the time required to complete the act registered on an electrical meter, calibrated in hundredths of a second, which is placed on the side of the mock-up.

For the hand reaction test the mock-up was raised to a table and the individual stood in front of it with a thirty degree angle at the elbow. His left hand hung down at his side, and with his right hand placed on the accelerator he again waited for the green light to turn to red, whereupon he immediately depressed the brake pedal as done previously in the foot reaction test. The shorter the time registered for the completion of the movement, the faster the reaction time.

In the strength testing with the use of the tensiometer, the tests were adapted from a set used by Harrison Clarke. The muscles tested were the extensor groups.

The first was the ventral flexion of the wrist. The subject placed his hand in a looped belt with the forearm resting upon a table, in the prone position, with the elbow flexed at about a seventy degree angle. Caution was used in this and all other tests to prevent the subject from employing other muscles of the body to advantage in taking the tests. A cable encircling the palm of his hand was extended perpendicular from the belt to a hook in the ceiling. The tensiometer was placed on the cable and the subject then ventrally flexed his wrist, with the recording being registered upon the tensiometer.

The second group of muscles to be tested were the foot extensors. The subject lay on a table in the supine position with the legs extended. The web belt was placed around the foot at the transverse arch and the cable was fastened perpendicular to the foot and extended back over the body to the wall behind. The tensiometer was placed on the cable and the subject then extended his foot to obtain the recording.

The third group was the extensors of the arms. The subject, still in the supine position, adducted his arm to one-hundred and eighty degrees and flexed it at the elbow to form a ninety degree angle. The web belt was placed around the wrist and the cable fastened to form a right angle with the forearm. The tensiometer was then placed on the cable and the subject extended his arm to obtain the recording.

The fourth test involved the extensors of the knee. The subject was sitting on a table with his legs hanging down forming a ninety degree angle at the knees. The web belt was placed around the ankle and the cable was attached forming a ninety degree angle with the lower leg. The tensiometer was then placed on the cable and the subject extended his knee to obtain the recording.
CHAPTER IV

RESULTS OF TESTING

SARGENT JUMP

As the weeks went by Group I (figure I) did show a slight increase. The average for these performances was 23.5 inches the first week, 24 inches the second, third, and fourth weeks, with an increase to 24.5 inches on the fifth week. This slight increase could have been due to the weight lifting. The difference was so slight, however, that it probably has little significance.

Very little difference was observed for Group II as the tests progressed. Group II (figure II) had an average of 25 inches the first week and 24 inches the succeeding three weeks. This slight decrease could have been due to fatigue during the first few weeks of strenuous basketball practice.

The average for the combined group (figure III) was exactly 24 inches for each of the weekly tests.

REACTION TIME

In the reaction time testing Group I (figure I), which had a faster initial reaction score, showed a slight decrease in reaction time with a greater fluctuation in scores. A decrease in reaction time constitutes an increase in speed. With the scores recorded in hundredths of a second, the first test showed a reaction time of 3.8 followed by 3.9, 3.6, 3.7, and 3.7 for the succeeding weeks.

Group II (figure II) showed a very slight decrease in reaction
<table>
<thead>
<tr>
<th>Sum of Strength Tests</th>
<th>Progress in Strength (Group Average)</th>
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<tbody>
<tr>
<td>160</td>
<td></td>
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<tr>
<td>154</td>
<td></td>
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<tr>
<td>148</td>
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<table>
<thead>
<tr>
<th>Time in Sec/100</th>
<th>Progress in Reaction Time (Group Average)</th>
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<tr>
<td>3.2</td>
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<tr>
<td>3.6</td>
<td></td>
</tr>
<tr>
<td>4.0</td>
<td></td>
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</tbody>
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<table>
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<th>Inches</th>
<th>Progress in Sargent Jump (Group Average)</th>
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<tr>
<td>28</td>
<td></td>
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<tr>
<td>24</td>
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<td>20</td>
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Figure 1.
Graphic results of Group I (weight lifters) averages in strength, reaction, and Sargent Jump testing.
Figure II.
Graphic results of Group II (non-lifters) averages in strength, reaction, and Sargent Jump testing.
Figure III.
Graphic results of Group I and II combined averages in strength, reaction, and Sargent Jump testing.
time. The score for the first week saw an average of 4.0 followed by 3.9, 3.8, and 3.9 for the succeeding weeks.

The combined average for both groups (figure III) was 3.9 for the first week and 3.9, 3.7, and 3.8 for the succeeding weeks.

Due to the calibration in hundredths of a second these decreases are relatively insignificant.

**WEIGHT LIFTING**

There was an evident increase in strength in Group I (figure I) over the testing period. This may have been due to the weight lifting program as well as the strenuous training being conducted for the basketball season. Group I had a sum of 151 in strength during the first week with 153 in the second week. The third week saw a return to 151 followed by a sharp rise to 156 the fourth week and 157 the fifth week.

Group II (figure II) while having a lower initial score showed a more steady increase in strength scores. The first week they registered a score of 143, followed by scores of 145, 153, and 157 in the succeeding three weeks.

The average for the combined group (figure III) was 148 the first week and 150, 153, and 156 on succeeding weeks.
CHAPTER V

SUMMARY OF RESULTS

In general it may be stated that this study did not bring out very
definite evidence of real effects of a weight training program.

It is felt that a study such as this should be carried on for a
much longer period and with more subjects.

It is believed that the methodology used in this experiment is
sound and that with an increased number of subjects and a longer period of
testing more definite results could be obtained.

What evidence there was indicated an increase in the Sargent Jump
in Group I with a substantial increase in strength on the part of all the
subjects. The reaction testing showed a very small decrease of equal pro-
portions in both groups. As stated previously, a decrease in reaction
time constitutes an increase in speed. The great increase in strength
may have been due to the learning of the testing methods by the subjects,
as it is doubtful that their strength actually increased to this extent.
LITERATURE CITED

BOOKS


PERIODICALS


UNPUBLISHED MATERIAL

APPENDIX

Individual Data

Pictorial Description of Exercises
WRIST CURLS

FOREARM CURLS

Figure IV
LATERAL EXERS

OVERHEAD EXTENSIONS

Figure V
FORWARD RISERS

HEEL RISERS

Figure VI
WALKING SQUAT

Figure VII
### Chart I

**RAW DATA OF INDIVIDUAL SUBJECTS**

**GROUP I** (weight lifters)

<table>
<thead>
<tr>
<th>Subject #1--V.H.</th>
<th>Subject #2--B.L.</th>
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<tbody>
<tr>
<td><strong>Weeks</strong></td>
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<tr>
<td>Hand Reaction</td>
<td>3.6</td>
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<tr>
<td>Foot Reaction</td>
<td>3.8</td>
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<tr>
<td>Reaction Average</td>
<td>3.753</td>
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<tr>
<td>Wrist Flexion</td>
<td>40</td>
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<tr>
<td>Foot Extension</td>
<td>155</td>
</tr>
<tr>
<td>Knee Extension</td>
<td>80</td>
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<tr>
<td>Forearm Extension</td>
<td>39</td>
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<tr>
<td>Strength Average</td>
<td>158</td>
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<td>Sargent Jump</td>
<td>22,523</td>
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<th>Subject #4--I.P.</th>
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<td><strong>Weeks</strong></td>
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<tr>
<td>Hand Reaction</td>
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<tr>
<td>Foot Reaction</td>
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<tr>
<td>Reaction Average</td>
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<tr>
<td>Wrist Flexion</td>
<td>40</td>
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<tr>
<td>Foot Extension</td>
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<td>Knee Extension</td>
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<td>Forearm Extension</td>
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<tr>
<td>Strength Average</td>
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<tr>
<td>Sargent Jump</td>
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<th>Subject #6--J.F.</th>
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<td>Foot Reaction</td>
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<td>Reaction Average</td>
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<td>Wrist Flexion</td>
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<td>Foot Extension</td>
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<td>Knee Extension</td>
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<td>Strength Average</td>
<td>170</td>
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<td>Sargent Jump</td>
<td>25.827</td>
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## Chart II

**RAW DATA OF INDIVIDUAL SUBJECTS**  
**GROUP II (non-lifters)**

<table>
<thead>
<tr>
<th></th>
<th>Subject #1--H.G.</th>
<th>Subject #2--D.E.</th>
<th>Subject #3--L.J.</th>
<th>Subject #4--J.S.</th>
<th>Subject #5--L.A.</th>
<th>Subject #6--L.A.</th>
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<td></td>
<td>Weeks 1 2 3 4</td>
<td>1 2 3 4</td>
<td>1 2 3 4</td>
<td>1 2 3 4</td>
<td>1 2 3 4</td>
<td>1 2 3 4</td>
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<td>Hand Reaction</td>
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<td>3.7 3.8 4.0 4.0</td>
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<td>26.5 23 25.5 26</td>
<td>22.5 24.5 24.5 24</td>
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