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The Effect of a Prescribed Pre-season Weight-training Program Upon a Select Group of Varsity Baseball Candidates

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THE EFFECT OF A PRESCRIBED PRE-SEASON WEIGHT-TRAINING
PROGRAM UPON A SELECT GROUP OF VARSITY
BASEBALL CANDIDATES

BY

PHILIP ELLIOT TROOEN

A thesis submitted
in partial fulfillment of the requirements for the
degree Master of Science, Department of Physical
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College of Agriculture
and Mechanic Arts

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This thesis is approved as a creditable, independent investigation by a candidate for the degree, Master of Science, and is acceptable as meeting the thesis requirements for this degree, but without implying that the conclusions reached by the candidate are necessarily the conclusions of the major department.

Thesis Adviser

Head of the Major Department

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PET

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CHAPTER I

INTRODUCTION

One of the stumbling blocks of collegiate and high school baseball in the upper midwest has been the weather element. Because of the usual late spring the squads are unable to practice in regulation field surroundings unless they journey to southern states or are fortunate enough to possess an adequate field house. Because of this situation many coaches have searched for means of conditioning their players without having to go out in cold, wet weather for early practice. Although much practice time is needed before the first contest, many coaches have hesitated to begin indoor practices too early in the spring because they have felt that it could cause boredom and staleness, as well as subjecting the players to unnatural playing conditions.

Need for the Study

The author felt that a weight-training program adapted to the baseball player could serve the purpose of partially conditioning players for the forthcoming season.

Lai confirmed that physical conditioning is the coach's first responsibility to his squad. He believed that judging a player's ability while performing at less than peak efficiency was unfair to the player as well as the coach. Considering the necessity for indoor practice in many parts of the country, Lai concluded that this period should be used for physical conditioning so that the practice time outdoors would be available for the other aspects of baseball.¹

Vogel stated that discomfort as well as pain would be present after early season exercise. This was generally believed to be the result of injury within the unconditioned muscle fiber. Those muscles which were used less frequently were more susceptible to this strain than were those conditioned through frequent use. Although this type of soreness would be experienced by all players, Vogel believed that through proper conditioning much of the soreness could be eliminated.²

The baseball player uses muscles which could be conditioned in ways other than playing baseball. For example, running speed could be improved without actually playing baseball. It was the author's consensus that an adapted weight-training program could ready the athlete for specialized training in baseball skills, while at the same time improve his throwing, hitting, and running speed although not training specifically for these skills. Conditioning of this type would leave more practice time to concentrate on the theory of the game, strategy, and fundamentals.

The individual player affected to the highest degree by early season training would probably be the pitcher. Although the length of the conditioning period varied with the individual, Vogel believed that a pitcher who reported "in good condition" should be ready and able to pitch a full nine innings after a training period of four weeks.³

Statement of the Problem

The purpose of this study was to determine whether or not a pre-season weight-training program would give baseball players a more advanced start conditionwise at the beginning of the baseball season

than they would have if they had not trained with weight. The conditioning with which the study was concerned was that affecting three important baseball skills: (1) the speed of running, beginning from a stationary start, (2) the total action of throwing a baseball, including the speed of the ball, and (3) the act of swinging a baseball bat.

Significance of the Problem

Weight training has been used as an experimentation subject in numerous studies. However, very few studies which concern weight training and its effects upon baseball skills have been completed. The author felt that this study might serve as a guide to baseball coaches concerning the use of pre-season weight training. He also felt that many coaches were prejudiced either for or against baseball weight training and that this study might help to clarify some of their misconceptions.

Delimitations

1. This study was limited to varsity baseball candidates who did not participate in other intercollegiate sports.
2. The weight-training program ran from January 15, 1962, to March 23, 1962.
3. There was no attempted control over diet, rest, or other general living habits of the subjects.
4. Motivation was not considered as a factor.
5. Only three one-hour training periods per week were utilized in the weight-training room over a span of six weeks.

6. The group was a captive audience of varsity baseball candidates and did not volunteer for the study.

7. Maturation of the individuals tested was not taken into consideration.

Definition of Terms

1. Weight training: a method of exercising which used weights to increase resistance to muscle contractions.

2. Weight lifting: a sport concentrating on the lifting of heavy weights.

3. Running speed: the total time measured from reacting to a stimulus, sprinting 90 feet, and stepping on a termination pad.

4. Batting speed: the total time involved between reacting to a stimulus and, from a prescribed batting stance, swinging a baseball bat through a termination switch.

5. Throwing speed: the total time involved between reacting to a stimulus and, from a prescribed fielding stance, throwing the baseball for a distance of 60 feet into a screen termination switch.

6. Hale Reaction-Performance Timer: an electronic machine designed to accurately measure an individual's reaction and/or performance time by utilizing a series of contact switches.

7. Stimulus: a signal to start a given action, in this case visual (the flash of a red light). This was used in conjunction with the Hale Reaction-Performance Timer.

8. Execution: one cycle of an exercise performed through its full range of motion.

9. Set: a prescribed number of executions used in the performance of an exercise.

10. Initial tests: those tests given before the six-week weight-training program.

11. Final tests: those tests given immediately following the six-week weight-training program.

12. Switch mat: a switch used to record the initiating or terminating of an action. This was used in conjunction with the Hale Reaction-Performance Timer.

CHAPTER II

REVIEW OF LITERATURE

In the field of research very little has been done with weight training as it relates to the sport of baseball. However, the past few years has seen a marked interest in weight training and its effect on throwing and running speed and on the velocity of the bat during the swing.

Weight training as gained in popularity and acceptance as applied to fields of physical education and athletics. According to Murray, Professor Arthur J. Wendler of the University of Iowa has stated: "I believe, and say so in all my classes, that any athlete will be a better athlete regardless of his sport, if he will engage in serious training with the weights."⁴

DeLorme stated that there are three important principles involved in determining a specific weight-training program:

1. Low repetition, high resistance exercises build strength and power; whereas high repetition, low resistance exercises produce endurance.
2. Each of these types of exercises is incapable of producing results obtained by the other.
3. To develop rapid hypertrophy in an atrophied muscle, the muscle should be subjected to strenuous exercise at regular intervals and to the point of maximum exertion.⁵

As stated by Zorbas,

Many coaches, trainers, and others associated with physical education are of the opinion that the use of weights will cause muscle to contract more slowly and therefore slow down the movements of the athlete; consequently, they prohibit weight lifting by men under their supervision.⁶

According to Massey and co-authors, weight lifting will contribute to the speed of a movement by improving the fitness of the

muscle. They also state that anyone wishing to increase the speed of some movement should use conditioning exercises for the muscle involved, and use maximal speed when practicing the movement desired.⁷

Stafford and Duncan indicated that good baseball players must be strong in the legs, shoulders, arms and wrists; yet they must not be so muscular that they are restricted in movement.⁸

Minor, in his study on the throwing power of high school baseball players, used three groups of boys, two of which were experimental. He had one group going through the throwing motion with weights, another actually throwing a $2\frac{1}{2}$ pound steel ball, and the third doing their regular daily practice routines. This training program was conducted for fourteen days. In his conclusions, Minor thought his experiments indicated that an increase of throwing velocity was obtained by training with the weighted ball. His results also indicated that training with dumbbells had little effect upon the power of the throw, even though they had a greater effect upon the strength of the individual. Minor concluded that it would be difficult to increase both strength and throwing power using the same exercises.⁹

In his study on the comparison of increased upper-extremity and shoulder-girdle strength, as it related to the velocity of a thrown baseball, Eckstrom used twenty-two subjects divided into an experimental and a control group. The experimental group participated in a weight-training program for ten weeks. After this program, Eckstrom discovered that the strength of the experimental group was significantly greater than that of the control group. He therefore concluded that it is possible to increase the velocity of a thrown baseball by participation in a

weight-training program that is designed basically to increase strength.¹⁰

Olsen made a study concerning bat swinging velocity, hitting and slugging ability, and running speed following a weight-training period of two months. He tested grip strength, leg lifting strength, running speed for ninety feet, and the velocity with which the subjects could swing a bat both before and after the weight-training program. A "Maroth Velocity" bat was used to test swinging velocity. In the two areas of leg-lifting strength and running speed, a significant improvement was found. The right hand grip was significantly improved, but the left hand grip was not. Even though these improvements were made, the hitting and slugging averages of the players were not significantly increased. However, no harmful results from the weight-training program were found.¹¹

In his study on the effects of weight training as it affected running, Meisel measured two matched groups of fifty-two students on their free running speed over a distance of ten yards. He then initiated a six-week weight-training program for the experimental group and followed it up with another period of testing. Meisel found that the leg strength of the experimental group had been increased as measured by the back and leg dynamometer. As for the speed of running, he found that the experimental group decreased to a point that was statistically significant at the 2 per cent level of confidence. No statistical significance was found in the control group. The critical ratio between the groups was also significant at the 2 per cent level of confidence.¹²

Quenette studied the effect of a weight-training program on baseball pitching accuracy. Two groups of subjects were used with the

experimental group undergoing a systematic six-week weight-training program. Accuracy was measured by having the subjects throw at a target which was marked with five designated areas. In his final testing, Quenette found that both the control and the experimental group had increased in accuracy. However, even though the experimental group made a larger increase than did the control group, neither group showed a statistically significant change.¹³

Tominaga found in his study that weight training did not increase throwing speed. He explained, however, that there was no significant decrease.¹⁴

Hooks observed that during the last four years there have been experiments conducted which have shown a "very high correlation between strength and success in hitting and throwing a baseball." He also stated, "There is a definite improvement in the ability of the individual when his strength is noticeably increased."¹⁵

Hooks maintained that there is a close relationship between baseball ability and strength, but he questioned the best way to acquire this strength. He believed that the environment of the present-day athlete necessitates training with weights or utilizing some other overload procedure in order to strengthen muscles. The reason for this necessity is the lack of manual labor performed with the hands and arms. If it were true that all baseball players did work hard to keep their strength at a high level, the only exercises that would then be necessary would be those to stretch tight muscles, plus much running for leg conditioning.¹⁶

Even though Race concluded that the hands and wrists moved through their arc of motion the fastest of any body member, he found that the

rotation of the hips was the most important phase of the baseball swing. He did state, however, that in order for the swing to be fully effective, the swing had to be culminated by a quickly executed and powerful wrist movement.¹⁷

Munroe concluded that weight training given during basketball training produced greater results than did a program of only basketball training. It didn't seem to make any difference during which half of the program the training was given. When the weight training was removed from the program, there was a noticeable decline in all of the tested areas.¹⁸

Campbell found that a "6½ week program of progressive resistance weight-training and flexibility exercises" increased leg strength. It also increased the subjects' free running speed over a distance of twenty yards. However, he also stated that increased leg strength appeared "to have a slight slowing effect on free running speed."¹⁹

Throughout the study of review of literature a number of authors suggested various weight-training programs to increase both strength and speed.

According to Hanson, such baseball stars as Kiner, Mantle, and Williams have used weight-training exercises. He gave a weight-training program which should be used three times per week for the three months preceding the baseball season. It included sit-ups, the side-to-side swing, 3/4 squat, jump squat, bent arm pullover, bench press, alternate dumbbell presses, hyperextensions, calf raises, wrist roller, reverse barbell curls, and push-ups on finger tips.²⁰

Wickstrom advanced the theory that a baseball weight-training

program will improve strength and will thereby help the individual realize his full potential. He also believed that baseball injuries may be prevented by weight training. The program outlined by Wickstrom is intended to be conducted on a three-day-a-week basis. Noticeable results would be obtained in six to eight weeks, but a program of three months would be better. The exercises utilized include the repetition clean and press, straight-arm pull-overs, sit-ups with weight, supine press, bent-over lateral raise, one-half squats, ulnar flexion of wrist, and ordinary wrist curl.²¹

As stated by Coker, hands play a role of major importance in the majority of the sports played in the United States. Catching, fielding, throwing and batting all require excellent strength in the hands of baseball players. One of the basic exercises used for development of the wrists is the simple curl, for both the hands and wrists.²²

Some of the exercises recommended for baseball by Murray and Karpovich included wrist curls, forward shrugging of shoulders from a supine position, ulnar flexion of the wrists, squats, press, clean, and running. They claimed a three-day-a-week weight-training program would bring desirable results in "the one or two months immediately preceding the start of the season."²³

Quenette seemed to think that from eight to twelve or fifteen repetitions of an exercise were sufficient to develop the overall muscle tone and fitness which is desired for baseball players. Although he stated that a six- or eight-week training program was sufficient to develop increases in the desired aspects, he also indicated that more improvement would be evident with longer training periods. The exercises

used by Quenette included the clean and press, biceps curl, supine shoulder shrug, wrist curl, standing lateral raise, supine bench press, internal shoulder rotation, and progressive bar hanging.²⁴

Meisel, in his weight-training program, incorporated the arm curls, shoulder press, heel raises, squats, right and left leg flexion, and the right and left gluteus pull. He conducted his weight-training program three days a week for six weeks.²⁵

In his study of strength and throwing velocity Eckstrom used the pull-over, forearm press, wrist curl, supine lateral-raise, and sit-ups. He used a ten-week program with three workouts per week.²⁶

Olsen used ten exercises in his three-day a week, six-week program. These included the bending lateral raise, wrist curls, lateral raise, bicep curls, supine side raise, sit-ups, shoulder shrug, squat and rise to toes, pullover, and clean and press.²⁷

The nature of the stimulus greatly affected the required reaction time, according to Morehouse. The sound or touch stimuli seemed to be somewhat faster than the visual. Length was added to all reaction as the stimuli were complicated.²⁸

DeMay stated that auditory stimuli seemed to get a faster response from an individual than did visual stimuli.²⁹

CHAPTER III

PROCEDURES

The purpose of this study was to determine whether a specific weight-training program would improve hitting, running, and throwing skills of varsity baseball candidates at South Dakota State College. To measure these skills objectively, the author constructed tests to measure performance times in hundredths of seconds. The skills were measured before and after a six-week training program.

Selection of Subjects

Subjects for this study were chosen on the basis of their inter-collegiate baseball competition the preceding year. After an examination of the varsity and freshman scorebooks from the preceding year, the author requested players who did not participate in other inter-collegiate sports to co-operate in the weight-training program. This study was fully supported by the South Dakota State College baseball coach, and his help was utilized in determining the subjects to be used. Fifteen candidates began the weight-training program during the winter quarter of the 1961-1962 college year. Twelve members completed the weight-training program. The reasons for not completing the program by three subjects were dropping out of school, not having sufficient time to complete the weight-training program, and giving up baseball before the season began. No control was exercised over the subjects during the weight-training period other than making sure that the prescribed training exercises were completed.

Test Apparatus and Methods

The testing program was initiated Monday, November 27, 1961, at which time the subjects were given one week to participate in loosening-up exercises. This was done to prevent injury to the participating candidates. Beginning on Monday, December 4, 1961, the subjects were tested individually in the areas of running, throwing, and batting. In consideration of Christmas vacation, it was decided to start the weight-training program on January 15, 1962, and to conduct the program through March 2, 1962. At this time another week was spent in exercising, utilizing regular baseball drills and conditioning exercises. Beginning March 12, 1962, the subjects were given their final battery of tests. Because of absences from practice, a week was used in finishing the testing program.

Three tests were utilized in this study. The subjects were measured on running speed from a stationary start for a distance of 90 feet, the total action of throwing a baseball for a distance of 60 feet, and the total action of swinging a bat from an accepted batting stance. A general warm-up period was held before each of the tests was given; the drills stressed total body warm-up. The running, batting, and throwing tests were given in the order listed. This was done to permit a longer period of conditioning for the throwing arm and thereby to decrease the chance of arm injury. (The description of the complete testing procedures are listed in Appendix A.)

Although the review of literature seemed to indicate a faster response time was obtainable with auditory or tactile stimuli, the author felt that because baseball actions for the most part are activated

by visual events, a visual stimuli was used for all testing procedures.

Running

The Hale performance timer was used to time the subjects' speed of running. Two switch mats were used as a starting point and a termination mat was used for the finish. Although the size of this termination mat was only six inches by eight inches, the author felt that because baseball players must cut stride to hit first base, it would be permissible to make the subjects cut their stride to hit this termination mat. The stimulus used in this test was a flash of a red light which was activated by the tester and connected to the Hale performance timer. The running distance was ninety feet, and the time was recorded to the nearest hundredth of a second. Each subject was permitted to warm up thoroughly and to run the testing course for familiarization purposes. Working in groups of two, each subject was given three trials, alternating with his partner. The author administered all of the testing to insure consistency.

Batting

The Hale performance timer was used to measure the time necessary for the subject, from a prescribed batting stance, to swing a baseball bat through a point at which a pitched ball would normally be. A switch mat was used as a starting point and a specially constructed screen termination target was used to determine the end of the tested action. (See Figure I). For authenticity the screen target was constructed the same size as a regulation baseball. The stimulus was a red light which was controlled by the tester. Each subject was given a thorough warm up which included swinging a bat before this test was taken. As practice

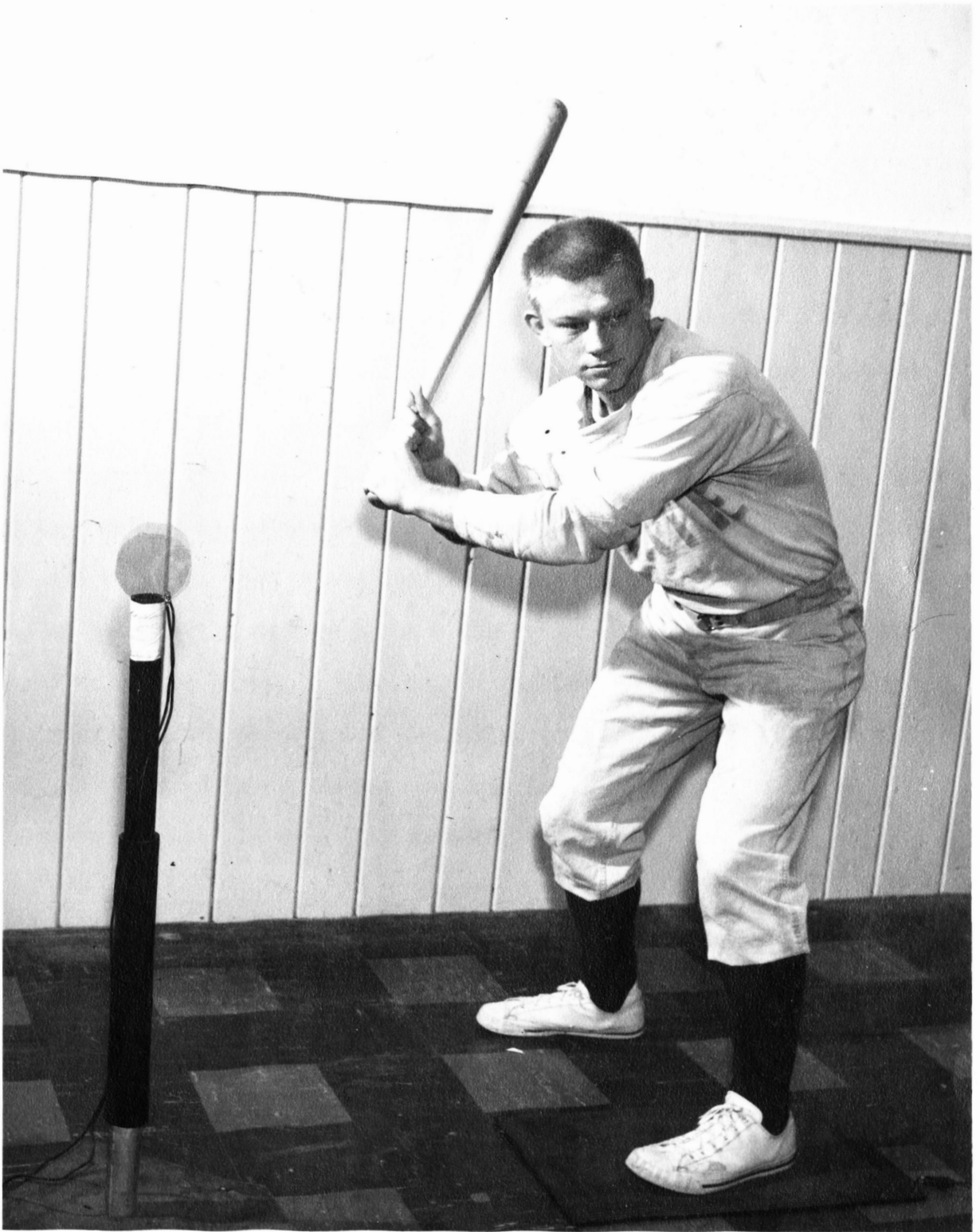


Figure I. Batting Test

the subject was allowed to swing through the target until he felt that he was able to consistently hit it. Each subject was then given five consecutive trials. An additional trial was given for each "miss." The performance times were recorded to the nearest hundredth of a second. To assure homogeneity, the author administered all tests.

Throwing

The Hale performance timer was used to determine the time needed for a throw of 60 feet. A switch mat was used as a starting point and a large double screen was used for termination. A red light was used as a starting stimulus. To protect the throwing arm of the subject from injury, a thorough warm up which included throwing was conducted. When the subject felt that he was sufficiently warm, he was instructed to throw the baseball as hard as he could from a prescribed position into the termination screen as soon as the red light was flashed. (See Figure II). Each subject was given five consecutive trials, plus one for each "miss"; the speed was recorded in hundredths of seconds. All tests were administered by the author.

Experimental Program

The weight-training program used in this study was conducted on a six-week, three periods-per-week basis. The subjects were given the choice of working on a Monday-Wednesday-Friday or Tuesday-Thursday-Saturday basis. The first training period was spent in orientation of the procedures to be used and available equipment. The following training periods were supervised periodically by the author to check on exercising form and to answer any questions which might have arisen. If

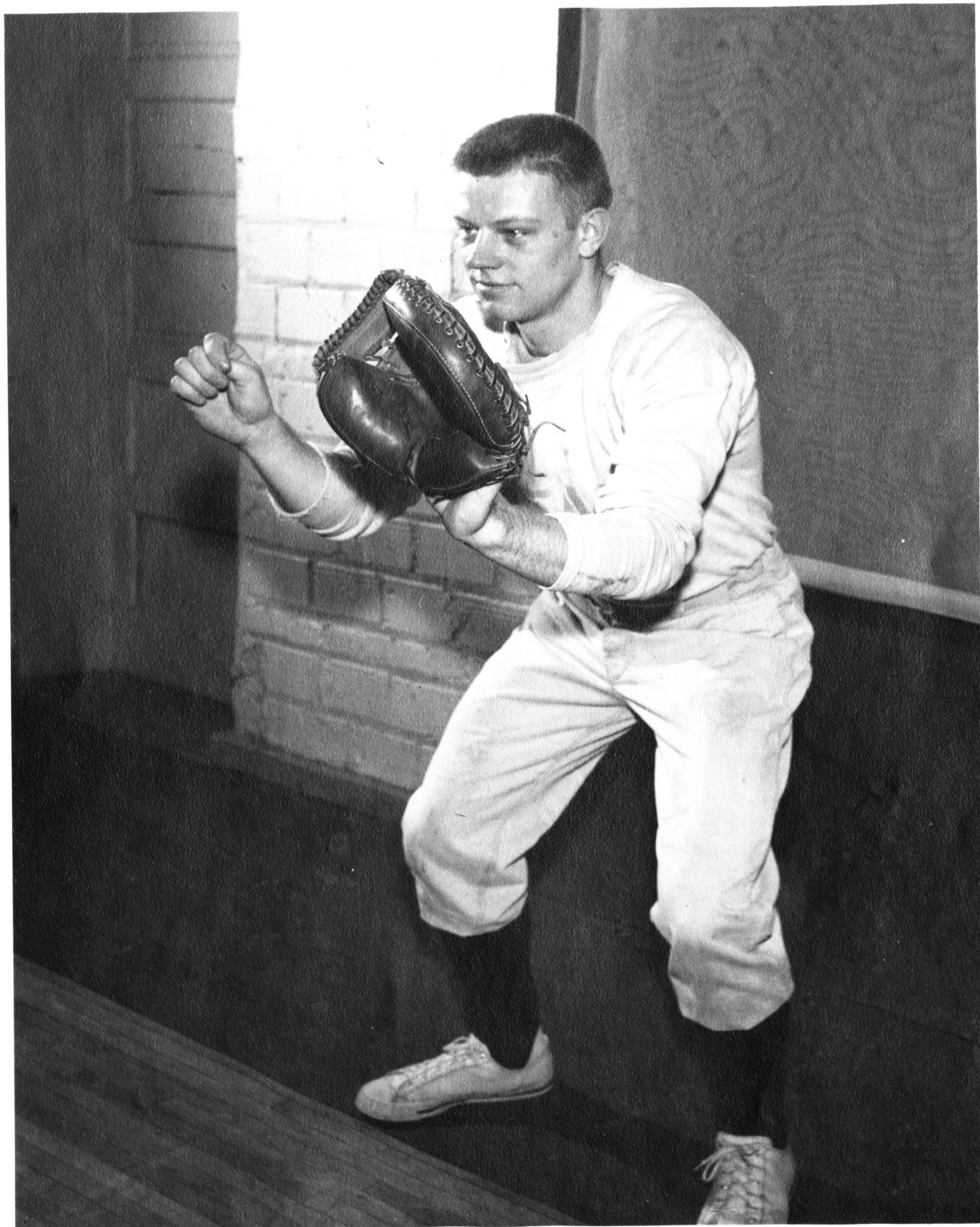


Figure II. Throwing Test

a subject was forced to miss a training period, he was permitted to make it up as soon as possible. At the conclusion of the weight-training program each subject had a total of 18 training periods.

The body areas on which development was specifically focused were the wrists, arms, shoulders, abdominal muscles, and legs. The purpose of the program was to develop over-all body condition that would be particularly helpful to a baseball player.

The progressive resistance program included the ordinary wrist curl, ulnar flexion of wrist, sit-ups with weight, one-half squats, bent-over lateral raise, and bench press. A stretching exercise was also included in the program in an attempt to prevent the shoulder and arm muscles from tightening as a result of weight training. To accomplish this, the subject was instructed to hang by the arms from a chin-ning bar for three minutes or as long as he could. (See Appendix B for description of weight-training program).

CHAPTER IV

TREATMENT AND ANALYSIS OF DATA

The purpose of this study was to determine the influence of a specific weight-training program upon the physical condition of baseball players and how this effected their baseball skills.

Differences in Test Scores

The first computations were made to show the differences between means obtained from the initial and final scores of the three tests. The significance of these differences was then tested at the five per cent level of confidence. The null hypothesis was applied to each of the three cases.

The experimental design used was the single group method. The difference between means was computed from the raw scores of the same tests, which were administered at different times to the same group. Since the experimental group in this study involved only 12 subjects, the "difference method" was employed in determining the critical ratio (t) for each test item.³⁰

To find the difference between the means in each test item, the author subtracted the mean of the initial test from the mean of the final test. ($M_2 - M_1$)

The following formula was used to compute the standard deviation of the mean:

$$S D = \sqrt{\frac{\sum x^2}{N-1}}$$

The standard error of the difference between the means was determined by using the following formula:³¹

$$S E_{m_d} = \frac{S D}{\sqrt{N}}$$

The t-values were found by using the following formula:³²

$$t = \frac{D-0}{S E_{m_d}}$$

With 11 degrees of freedom (N-1), the t-value for significance at the five per cent level of confidence was 2.20.³³

Table 1 presents the results obtained from administering the batting test to the experimental group. A mean improvement of 48.20 hundredths of a second was found in the final testing, which was administered after six weeks of weight training following the initial testing. Computation of the critical ratio of this test found that the changes resulting from the weight-training program were significant at the five per cent level of confidence, as may be seen from the t-value of 2.58. Because a significant gain was found, the null hypothesis was rejected and the gain was recognized as being real.

Table 1. Differences between the Means, Standard Error of the Differences, and Critical Ratios Computed From the Initial and Final Scores on the Varsity Baseball Batting Test Item

M_1 (Initial Test)	M_2 (Final Test)	Diff M_D ($M_1 - M_2$)	S E $_{Diff}$	<u>t</u>	Level
650.40	602.20	48.20	1.61	2.58	5%

Table 2 gives the results obtained from administering the running test to the experimental group. A mean improvement of 2.20 seconds was found between the initial and final tests, which were administered before and after a six-week weight-training program. In computing the critical ratio of this test, the author found that the changes resulting from the weight-training program were not significant as may be seen by the t -value of .20. Because no significant gain was found, the null hypothesis was accepted.

Table 2. Differences between the Means, Standard Error of the Differences, and Critical Ratios Computed From the Initial and Final Scores on the Varsity Baseball Running Test Item

M_1 (Initial Test)	M_2 (Final Test)	Diff. M_D ($M_1 - M_2$)	S E Diff	t	Level
57.84	55.64	2.20	.04	.20	None

Table 3 shows the results obtained from the administration of the throwing test to the experimental group. The mean improvement found in this test was .52 seconds between the initial and final testing periods, with the weight-training program conducted between the two tests. In computing the critical ratio of this test, the author learned that the changes resulting from the weight-training program were not significant, as may be seen by the t -value of .30. Because no significant gain was found, the null hypothesis was accepted.

Table 3. Differences between the Means, Standard Error of the Differences, and Critical Ratios Computed From the Initial and Final Scores on the Varsity Baseball Throwing Test Item

M_1 (Initial Test)	M_2 (Final Test)	Diff $_{M_D}$ ($M_1 - M_2$)	S E $_{Diff}$	\underline{t}	Level
18.47	17.95	.52	.01	.30	None

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The purpose of this study was to determine the effects of a six-week weight-training program on the running, hitting, and throwing skills of baseball. Six exercises were used in the program, and a plan of ten executions of each exercise was utilized.

An experimental group of fifteen varsity baseball candidates at South Dakota State College participated in the weight-training program during the winter quarter of 1962.

Training sessions for this weight-training program were held three times per week, for six weeks. An attempt was made to maintain a training schedule in which training periods were not held two days in succession.

Tests to measure running speed as well as swinging a bat or throwing a ball were administered before and after the weight-training program. The initial tests were administered during the fall quarter, 1961, and the final tests were administered during the spring quarter, 1962.

The testing data were recorded and analyzed to determine whether the speed of the actions involved had been increased following the weight-training program. The initial test scores were compared with the final test scores to determine if any significant difference could be attributed to the training program which was used.

The speed of swinging a bat was improved to a degree which was

significant at the .05 level. Although running and throwing speed were improved, the degree of improvement was not sufficient to be significant.

Conclusions

Conclusions drawn from the administration of a six-week weight-training program upon baseball players at South Dakota State College are as follows:

1. A significant improvement in batting speed was attributed to the weight-training program.

2. Although an improvement was noticed in the running speed of the subjects, the difference was not sufficient to be significant.

3. Although the throwing action was accelerated, the difference was not statistically significant.

4. It is the author's opinion that test results indicated that weight training is a good pre-season conditioner for college baseball players.

Recommendations

Based on the results and experiences of this study, the author makes the following recommendations:

1. That weight training be used as a pre-season conditioner for all baseball players not participating in other intercollegiate athletics.

2. That a similar study be conducted with a greater number of participants.

3. That a similar study be undertaken using a control group.

4. That a similar study be conducted which includes a study of reaction time.

5. That a similar study be undertaken utilizing a different set of weight-training exercises.

6. That a study be undertaken to determine if weight-training exercises have any different effect between players who play different positions or who use unorthodox batting styles.

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APPENDIX A

DESCRIPTION OF TESTING PROCEDURES

All subjects wore tennis or basketball shoes and a regulation physical education uniform or similar T-shirts and trunks for all tests.

Running Test

Equipment: Hale Reaction-Performance Timer, red stimulus light, two switch mats, and a termination pad.

Instructions:

1. Subject stands with one foot on each switch mat so that the toes are even with the front of the mat.
2. Subject takes a semi-flexed position so it is easier to get a good start.
3. Upon the flash of the red light the subject begins to run as quickly as possible. Take-off is allowed with either foot.
4. Subject runs 90 feet and steps on the termination pad, breaking stride if necessary.

Recording: Three tests were administered to each subject, the times recorded to the nearest hundredth of a second. The mean of the three scores was then found for use in the statistical procedure. If the subject at any time tripped, fell, or missed the termination pad an additional test was administered.

Batting Test

Equipment: Hale Reaction-Performance Timer, one switch mat, red stimulus light, Voit rubber batting tee, Hanna BATRITE baseball bat number W.T.A.S., and a specially constructed termination switch to fit on top of the batting tee.

Instructions:

1. Subject takes hitting position next to batting tee with lead foot on the switch mat. Heed the following instructions as to batting form: keep feet parallel, keep shoulders level, keep rear elbow up, use a short stride, keep hands comfortably away from chest, have end of bat back to the plane of scapulas, and set batting tee slightly ahead of lead foot and slightly above belt buckle.
2. When the red light flashes, stride off of the mat and swing the bat through the target affixed to the top of the

batting tee.

Recording: Each subject was given five trials after numerous practice swings. Each score was recorded to the nearest hundredth of a second. For each "miss" the subject was given an additional trial. The mean of these five scores was then found for use in the statistical procedure.

Throwing Test

Equipment: Hale Reaction-Performance Timer, one switch mat, red stimulus light, regulation baseball, and a specially constructed three foot by four foot screen target.

Instructions:

1. Subject stands with his lead foot on the switch mat, keeping both feet behind the front of the mat. Subject is flexed at the waist and is holding a baseball with both hands within one foot of the floor.
2. Upon the flash of the red stimulus light, subject takes his stride off the mat and throws the baseball into the screen target.

Recording: The subject was given five trials and each was recorded to the nearest hundredth of a second. For each "miss" scored by the subject an additional trial was given. The mean of the five scores was then found for use in the statistical procedure.

APPENDIX B

DESCRIPTION OF TRAINING PROGRAM

General Rules

Subject was instructed to warm up well before each period of work. Between the different exercises he was instructed to take three to five minutes rest. Each subject was instructed to utilize spotters for the heavy lifts. As soon as a subject could complete an exercise ten times he was instructed to increase the weight load. A personal daily record was kept by each subject. Workout periods were scheduled either on a Monday-Wednesday-Friday or Tuesday-Thursday-Saturday basis.

Ordinary Wrist Curl

Starting position: Sitting on chair, feet on floor shoulder-width apart, trunk leaning forward, back of forearms resting against front of thighs, wrists one inch beyond knees, bar grasped with reverse grasp, hands shoulder-width apart.

Exercise: Raise bar upward and backward as far as possible with curling motion. Forearms remain in contact with thighs during entire movement.

Suggested starting weight: 35 pounds.

Ulnar Flexion of Wrist

Starting position: Standing, holding bar of dumbbell in right hand, thumb side of hand at end of bar away from end where weight is attached.

Exercise: With arms extended downward and held at side of body, raise weight backward and upward as far as possible.

Suggested starting weight: 5 pounds.

Sit-ups with Weight

Starting position: Supine, feet shoulder width apart, heels on floor within 6-8 inches of hips, feet held down by partner, weight held behind head.

Exercise:

- a. Curl trunk upward and forward and touch left knee with right elbow.
- b. Return to starting position.
- c. Curl trunk upward and forward and touch right knee with left elbow.
- d. Return to starting position.

Suggested starting weight: Begin with regular sit-ups using no weight.

Bench (Supine) Press

Starting position: Supine on low bench, legs spread, lower legs flexed, feet planted firmly on floor, arms extended upward and vertical to floor, barbell held with wide, ordinary grasp.

Exercise:

- a. Lower bar until it touches chest.
- b. Extend arms and push bar upward to starting position. Upward movement should begin immediately after chest has been touched.

Suggested starting weight: 1/4 of body weight.

One-half Squats

Starting position: Standing with feet shoulder-width apart, bar resting across top of shoulders and back part of neck, hands holding bar with wide, ordinary grasp.

Exercise:

- a. Keeping back straight and head up, go into squat position where angle formed by knees is 90° or slightly less.
- b. Return to starting position.

Suggested starting weight: 1/2 of body weight plus 10 pounds.

Bent-over Lateral Raise

Starting position: Standing, feet 24 inches apart, trunk bent forward at 90° angle, arms extended downward, hands grasping dumbbells with palms facing inward.

Exercise: a. Keeping arms straight, raise dumbbells sideward to position slightly higher than shoulders.
 b. Return to starting position. Dumbbells must be under control during entire movement.

Suggested starting weight: 5 pounds

Stretching Exercise

Starting position: Using a forward grasp on a chinning bar, let your body hang to a full extension.

Exercise: Without attempting any pull-ups or chins, let your body hang at full extension for three minutes or as long as possible.

APPENDIX C

RAW SCORES OF PRELIMINARY AND FINAL TESTS

Running Test

		Running Test				
		Initial			Final	
A.	4.86	4.90	4.87	4.80	4.68	4.83
B.	4.88	4.69	4.61	4.58	4.53	4.51
C.	4.80	4.69	4.78	4.66	4.57	4.66
D.	4.68	4.71	4.69	4.56	4.54	4.50
E.	4.70	4.71	4.70	4.65	4.71	4.48
F.	4.95	4.89	4.87	4.82	4.81	4.86
G.	5.08	5.07	5.00	4.88	4.77	4.81
H.	4.76	4.80	4.77	4.60	4.54	4.54
I.	4.64	4.67	4.72	4.51	4.73	4.53
J.	5.06	5.06	5.10	4.63	4.75	4.66
K.	4.73	4.80	4.78	4.57	4.52	4.50
L.	4.78	4.84	4.80	4.59	4.55	4.48

Batting Test

	Initial					Final				
A.	43	42	51	44	40	44	44	44	46	46
B.	67	63	64	58	56	61	60	56	44	50
C.	50	69	54	57	50	50	47	48	45	47
D.	62	62	63	56	55	54	56	56	60	57
E.	58	54	47	55	51	51	54	51	46	50
F.	64	62	67	55	58	47	47	45	43	50
G.	48	43	43	48	45	50	52	48	51	51
H.	61	65	58	54	56	63	59	53	49	51
I.	50	46	48	46	52	40	40	38	36	38
J.	60	60	63	53	49	56	58	54	52	50
K.	64	59	63	57	50	62	54	52	53	52
L.	53	44	43	43	52	54	56	48	47	45

Throwing Test

	Initial					Final				
A.	1.39	1.41	1.35	1.35	1.38	1.32	1.35	1.34	1.35	1.33
B.	1.70	1.71	1.71	1.67	1.72	1.62	1.65	1.67	1.71	1.66
C.	1.64	1.55	1.58	1.62	1.59	1.61	1.47	1.57	1.51	1.53
D.	1.59	1.67	1.60	1.64	1.64	1.56	1.58	1.58	1.56	1.55
E.	1.47	1.44	1.43	1.45	1.49	1.50	1.45	1.48	1.48	1.45
F.	1.66	1.60	1.64	1.64	1.62	1.59	1.55	1.54	1.53	1.53
G.	1.44	1.46	1.46	1.45	1.47	1.51	1.54	1.56	1.56	1.50
H.	1.64	1.43	1.48	1.55	1.52	1.50	1.43	1.44	1.42	1.43
I.	1.49	1.45	1.37	1.36	1.43	1.39	1.46	1.44	1.35	1.34
J.	1.62	1.69	1.74	1.70	1.69	1.62	1.62	1.58	1.60	1.59
K.	1.51	1.56	1.50	1.52	1.48	1.50	1.46	1.42	1.44	1.43
L.	1.53	1.45	1.48	1.48	1.44	1.52	1.38	1.43	1.33	1.35