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The Effect of Bench Jump Training on the Leg Strength and on the Vertical Jumping Ability of the Student

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THE EFFECT OF BENCH JUMP TRAINING ON THE LEG STRENGTH AND ON THE VERTICAL JUMPING ABILITY OF THE STUDENT

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The effect of bench jump training on the development of leg strength and on the vertical jump of the student was studied. Twenty-eight junior and senior boys in a physical education class were divided into two equated groups with the experimental group participating in the bench jump training. The results supported both null hypotheses, that bench jump training will not significantly increase the leg strength of the student or significantly increase the vertical jumping ability of the student.

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Chapter 1

INTRODUCTION

The importance of vertical jumping ability in basketball has long been accepted because it increases athletic effectiveness in so many areas of the sport. The basketball player with an exceptional vertical jump could have an advantage in rebounding, defense, jump shooting, and other basketball skills requiring an explosive vertical jump.

Pryse, Berger, Jacobs, and Bangerter were among those researchers who found the vertical jump to be increased through various weight training methods. However, the author found no research regarding the effect of bench jump training on the vertical jump or on the leg strength of an athlete.

Statement of the Problem

The purpose of this study was to determine if an intensive period of bench jump training would result in a significant increase in the vertical jumping ability of the student-athlete.

As the researcher began the search of related literature, an interest in the relationship between vertical jump and leg strength was developed. As a result, a subpurpose would be to determine if an intensive period of

bench jump training would result in a significant increase in the leg strength of the student-athlete, accompanied by a significant increase in the vertical jump of the student athlete.

Importance of the Study

Although it does not appear leg strength correlates significantly with the vertical jump, there is some evidence the vertical jump can be increased through several different weight training methods. However, many junior high and high schools have little or no weight training facilities. Possibly, an even larger number of junior high and high schools have weight training facilities but have limited access to those facilities. Therefore, it is possible many programs do not receive full benefit of the opportunity to increase the vertical jump and the leg strength through weight training.

If bench jump training will significantly improve the vertical jump, then physical educators and coaches will have a readily accessible training tool to help improve performance in a very critical area of basketball.

Hypothesis

In order to answer the purpose of this study, the following null hypotheses were proposed: (1) intensive bench jump training will have no significant increase in the vertical jumping ability of the student-athlete; and (2) intensive bench jump training will have no significant increase in the leg strength of the student-athlete.

Delimitations of the Study

The study will be conducted with one advanced boys' physical education class numbering twenty-eight students from Eastmont High School. This will allow for fourteen students to be in the control group and fourteen students in the experimental group. The training period will be for ten weeks with five training sessions each week.

Limitations of the Study

The following limitations were realized during the development of this study: (1) the small number of participants involved; (2) all participants may not be motivated to improve vertical jump through bench jump training; (3) the instructor cannot control absenteeism, which could limit the participation in the bench jump training; (4) some members of the experimental group developed shin splints, limiting their participation in the bench jump training; and (5) both the experimental group and the control group could not be controlled beyond the physical education class.

Definition of Terms Used

For the purpose of this study the following definitions will be used:

Vertical Jump Reach. The ability to thrust the body upward from a crouched position as measured by Sargeant's jump and reach test.

Bench Jump. The student will start with one side of his body closest to the bench with feet squarely under

the body and parallel to the bench. A bench jump will be when the student jumps off both feet and lands on the opposite side of the bench with both feet placed under the body and parallel to the bench.

Dynamometer. An instrument for measuring the force or power in the legs of the student.

Hypothesis

Beginning the study, the following hypotheses were made: (1) the bench jump training will not significantly increase vertical jumping ability; and (2) bench jump training will not significantly increase leg strength.

Chapter 2

REVIEW OF RELATED LITERATURE

The vertical jump has been a popular topic for study ever since its introduction to physical educators by D.A. Sargeant in 1921. Originally conceived as a test of neuro-muscular efficiency, it became well known as a test of musculature power.

Although there have been those who questioned the validity of the vertical jump to assess the total power of the legs, W.L. Sargeant (25:55) observed there was a high correlation between athletic ability and the height jumped. He theorized that a decrease in the time necessary to perform a given amount of work would cause an increase in power. Sargeant then concluded the test is more nearly a measure of power than of work.

McCloy (22:236-242) stated the Sargeant jump test is not a strength test. Rather, it is a measure of the way force can combine with the highest possible contraction - velocity of the number so as to project the body upward to a maximum height. He concluded that the Sargeant jump is not the one perfect test, but it is probably the one best test for predicting explosive power.

More recently, researchers have concluded that the Sargeant jump test is indeed a valid measure of genuine leg

power.

Capen (8:91) found that a systematic weight training program gave greater general improvement in musculature strength than did a conditioning program without weight training.

Although Chui (9:193) did not compute the t-statistics to indicate at what level of significance the differences were, he did find a general increase in the amount of potential power through the systematic weight training exercises, whereas the subjects not using weights did not show consistent increases.

Hoffman (15:89), while failing to produce documented evidence, did conclude that weight training is the most effective form of physical training for both visceral, skeletal, and musculature development. Weight training will produce an optimum physical condition in a minimum of time.

Galvin (7:393) found that the experimental group made statistically significant gains in all of the selected anthropometrical and strength measurements at the one percent level of confidence.

Perhaps the value of weight training in athletics was illustrated best by Hooks (17:1) when he stated, "strength is the key to success in modern athletics," and by Diovanna (13:21) when he stated, "explosive power is associated with athletic power."

The physical educator or coach looking for methods or techniques in weight training to improve the strength of

the student-athlete can find a variety of methods from which to choose.

Although Scott (26:43) found both isotonic and isometric exercises, if used diligently, will add to the high school student's strength, there is some evidence to indicate the degree of leg strength developed during the training period and the amount of strength retained following the training period will differ according to methods.

For example, while Ball (2:233) found isometric weight training to significantly increase strength, Waddell (30:51) concluded that isometric weight lifting actually showed a greater gain in strength than the isotonic weight lifting. However, the isometric group showed a greater loss of strength than the isotonic group during the first nine weeks after both groups stopped lifting.

While there are no lingering doubts that weight lifting does indeed increase leg strength, there does remain a question as to what degree the increase in leg strength will actually lead to an increase in the vertical jump.

The author found many researchers who preferred the isotonic weight training over the isometric weight training as the best weight training method to build strength.

Hamola (16:9) stated that:

> For all around strength-building purposes, isotonic weight training is by far the most effective. Scientific research, for example, has demonstrated conclusively that barbell exercises performed through a full range of movement will actually increase flexibility by stretching muscles, joints, and tendons; and the heavier the resistance the greater the increase in strength.

Hamola continued by stating:

> Static isometric exercises, on the other hand, do not force complete extension and flexion in the muscles and joints, and they develop and maintain only a fraction of the strength through progressive resistance exercise with barbells and dumbells.

Sims (27:38) believed the universal gym to be as effective as barbells in developing leg strength. Both weight lifting methods, the universal gym and barbells, showed a similar increase in leg strength over a twelve week training period while the control group actually lost leg strength during the same twelve week period.

Smith (28:408) believed vertical performance to have no relationship to leg strength, that individual differences in vertical jumping performance have little or no relationship to explosive leg strength or the ratio of leg strength to body mass. This supports the hypothesis that strength exerted against a dynamometer involves a different neurometer pattern or program from that controlling the muscles during a movement.

Ball (2:233) found that while isometric training significantly increased leg strength, the increase was not accompanied by an increase in vertical jumping ability.

McClements (21:78) suggested that gains in strength do not necessarily ensure gains in power performances.

Pryse (23:45) stated that leg strength does not necessarily indicate vertical jumping ability. He also found that while there was no significant differences in leg strength between the control group, the isotonic group, and

the isometric group following a nine week training period, there was, however, a difference in vertical jumping ability among the groups. The experimental groups both showed to be significantly better at vertical jumping than the control group.

Considine and Sullivan (11:415) found only a low to moderate relationship between leg strength and leg power variables. They concluded that leg strength seems to be a singular component, which makes only a moderate contribution to the oblique, complex factor of leg power.

Similarly, Start (29:558) contended that the factors of speed and power possess similarities but speed and strength are separate entities.

Harrison (10:229) found that no strength test correlated significantly with vertical jump performance.

Although leg strength does not appear to correlate with vertical jumping ability, there is some evidence that the vertical jump can be increased through the use of weights.

Berger (5:423) found that dynamic overload training was more effective for increasing vertical jumping ability than static overload training. Also, a significant increase in static strength does not guarantee an improvement in vertical jumping ability.

Jacobs (19:40) concluded that the Exer-Genie program is superior with respect to the development of jumping ability when compared to a control which used only calisthentics in their conditioning program.

Bangerter (3:436) stated specific muscle groups, either knee extensors, hip extensors, or the combination of the two, contribute to vertical jumping. When these muscles were strengthened isotonically, there was a significant gain in the vertical jump.

The research mentioned above does indicate several weight training methods available to increase strength. However, before the author can conclude that an increase in strength through weight training will lead to the greatest increase in vertical jumping ability for the student athlete, more research will have to be done using other methods.

Chapter 3

RESEARCH PROCEDURES

The research procedures used in this study are presented in this chapter. The subjects, grouping procedure, and statistical analysis used for each hypothesis are presented in this chapter.

Subjects

Twenty-eight male students enrolled at Eastmont High School, East Wenatchee, Washington, were included in this study. These students ranged in age from sixteen to eighteen years of age, and they had voluntarily enrolled in an advanced physical education class.

Testing Procedure

Two tests were given to all students prior to the grouping of the subjects for this study. The first test given was the Sargeant's vertical jump and reach test. The student was asked to jump three times in succession with a brief rest period between jumps. The best score of the three jumps was then recorded as his vertical jump reach.

The second test administered was a test for leg strength, and it was conducted with the assistance of a dynamometer. The student was carefully instructed on the proper techniques to insure an accurate test of leg strength.

Following the instructions, the student was given one lift and that lift was then recorded as his leg strength.

Grouping of the Subjects

At the conclusion of the vertical jump and reach test, all scores were placed in rank order with the highest jump reach score ranking first and the lowest jump reach score ranking last.

In order to insure equality between the control group and the experimental group, the highest score was placed in Group A. This was followed by placing the second and third score in Group B. The fourth and fifth scores were placed in Group A. This procedure was continued until all scores were placed in one of the two groups. The experimental group was then chosen by flipping a coin with the experimental group being "heads".

With the equated groups established, it was determined that both groups would complete the regularly scheduled physical education activities for each class period during the ten weeks the bench jump training was to take place. However, only the experimental group was to participate in the bench jump training.

The bench jump training was to consist of consecutive bench jumps for sixty seconds followed by a sixty second rest. With the conclusion of the rest period, there would then be consecutive bench jumps for another thirty seconds. The bench jump training was to take place five days a week, Monday through Friday, for ten consecutive weeks.

Each student was responsible for counting his own bench jumps for both the sixty second and thirty second jumps. Each student's jumps were recorded daily. The daily scores were closely examined for trends or patterns that could be helpful in getting maximum performance from each member of the experimental group. It was believed such information could provide incentive for members of the experimental group to make an honest effort during the bench jump training.

The bench to be used for jumping was 17¼ inches in height and 9½ inches in width. It was the type of bench commonly found in most physical education locker rooms.

One bench jump consisted of a student jumping off both feet and landing on the other side of the bench. The students were instructed at the beginning of the bench jump training that the easiest and most effective method of jumping the bench was to stand with either side of the body closest to the bench with both feet under the body and pointing parallel with the bench. The jump could then be completed easily and in position to quickly jump the bench from the same position but with the opposite side of the body closest to the bench.

Chapter 4

ANALYSIS OF DATA

In this study, the vertical jumping ability and the leg strength of a control group was compared to the vertical jumping ability and the leg strength of an experimental group.

Both groups were involved in normal physical education activities during a ten week period with the experimental group participating in an extensive period of bench jump training following the regularly scheduled class activities.

The purpose of the study was to determine what effect the extensive bench jump training had on the vertical jumping ability and on the development of leg strength of the students. Twenty-eight junior and senior male physical education students, at Eastmont High School, were divided into one control group and one experimental group. Each group consisted of fourteen students. Each student was pre-tested with Sargeant's jump reach test to determine the vertical jumping ability and tested with the dynamometer to determine the amount of leg strength.

Following the ten week testing period, the participants were then post-tested in exactly the same manner, using Sargeant's jump reach test and the dynamometer to determine

once again the vertical jumping ability and the leg strength of each student.

Because the dynamometer requires a certain amount of expertise, it was necessary for the author to establish a high degree of objectivity. To accomplish this, an objectivity co-efficient was run between the committee chairman, Dr. Irish, and the author. Thirty-one subjects from a male, sophomore physical education class were used. The objectivity co-efficient, .797, was considered high enough for this experiment.

The following table illustrates the difference in t scores for leg strength. Because the degree of freedom is 26 and because the test is a one-tailed test, the t achieved must be 1.71 to be of significance at the .05 level of confidence.

TABLE 1

t's for Leg Strength

	V1	V2	V3	V4
V1		1.08	.67	
V2				.80
V3				1.55
V4				

V1 - Leg Strength Control Group (Pre-test)

V2 - Leg Strength Experimental Group (Pre-test)

V3 - Leg Strength Control Group (Post-test)

V4 - Leg Strength Experimental Group (Post-test)

The t obtained between the control group pre-test and the control group post-test in leg strength, as measured by the dynamometer, was .67, which is not significant.

The t obtained between the experimental group pre-test and the experimental group post-test in leg strength, as measured by the dynamometer, was .80, which is not significant.

The t obtained between the control group pre-test and the experimental group pre-test in leg strength was 1.08, which indicates there is some difference in leg strength between the control group and the experimental group. Because the difference in the post-test of the control group and the post-test of the experimental group will approach significance, it may be of interest to point out the mean of the pre-test for the control group in leg strength is 942.1 pounds, while the mean of the pre-test for the experimental group in leg strength is 1,042 pounds.

In the t obtained between the post-test of the control group and the post-test of the experimental group in leg strength, the difference was 1.55 which, while not significant at the .05 level of confidence, is beginning to approach significance. The mean of the post-test for the control group in leg strength is 952.9 pounds, a gain of only 10.8 pounds, while the mean of the post-test for the experimental group in leg strength is 1,152.1 pounds, a gain of 110.1 pounds. Therefore, bench jump training may,

to a small extent, improve leg strength.

Table 2 will illustrate the difference in t scores for the vertical jumping ability as measured by Sargeant's jump reach test. The degree of freedom is 26 and the t score achieved must be 1.71 to be of significance at the .05 level of confidence.

TABLE 2

t's for Vertical Jumping Ability

	V1	V2	V3	V4
V1		.51	.08	
V2				.34
V3				.16
V4				

V1 - Vertical Jump Control Group (Pre-test)

V2 - Vertical Jump Experimental Group (Pre-test)

V3 - Vertical Jump Control Group (Post-test)

V4 - Vertical Jump Experimental Group (Post-test)

The t obtained between the control group pre-test and the control group post-test in the vertical jump was .08, which indicates almost no change in the vertical jump of the control group as a result of normal physical education activities.

The t obtained between the experimental group pre-test and the experimental group post-test is .33, which indicates very little improvement and is not significant at

the .05 level of confidence.

The t obtained between the control group pre-test and the experimental group pre-test in the vertical jump is .51, which indicates little difference and is not significant at the .05 level of confidence.

The t obtained between the control group post-test and the experimental group post-test in the vertical jump is .16, which indicates almost no improvement in the vertical jumping ability of those participating in the bench jump training and is not significant at the .05 level of confidence.

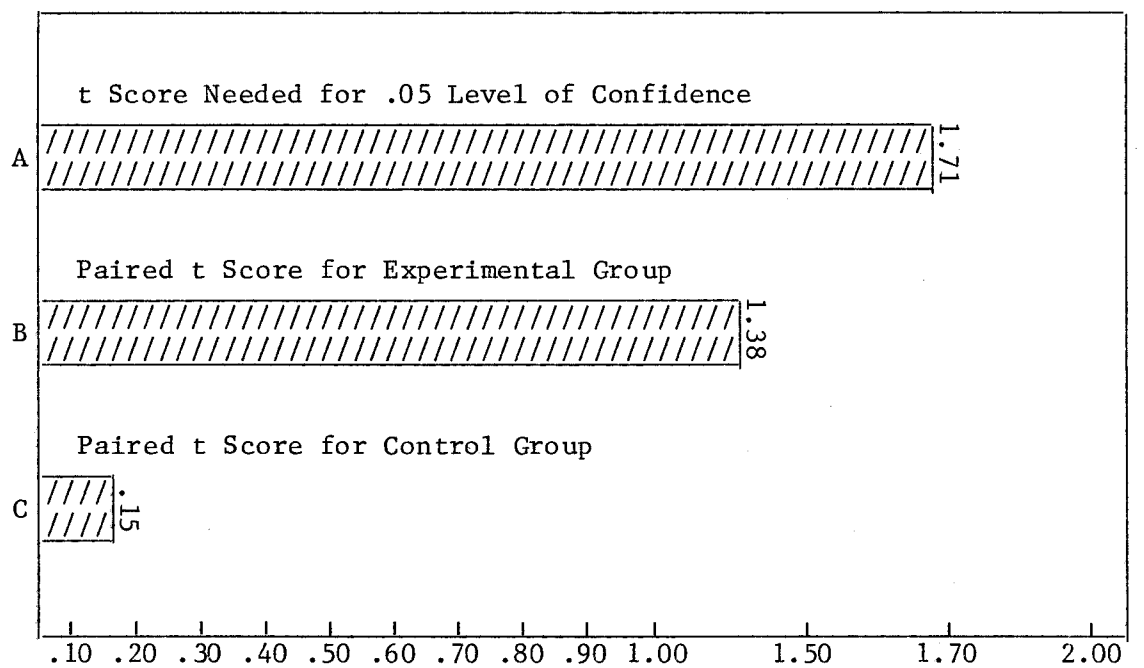
While there may be a slight improvement in leg strength of the student as a result of the bench jump training, the improvement in leg strength is not accompanied by an improvement in the vertical jumping ability of the student.

In an attempt to determine, as completely as possible, the effect of intensive bench jump training on the leg strength and on the vertical jump of the student, a paired t score was computed by comparing the pre-test score of each student with the post-test score of the same student to determine if there is improvement and if the improvement is significant at the .05 level of confidence.

Table 3 will illustrate the difference in paired t scores for the leg strength of each individual in both the control group and the experimental group.

TABLE 3

Paired t's for Leg Strength



The A bar illustrates the t score needed to be significant at the .05 level of confidence. The paired t score which must be achieved to be significant is 1.71.

The B bar illustrates the paired t score achieved by comparing each student's pre-test score in the experimental group with each student's post-test score. The bar indicates that, while the experimental group's paired t score of 1.38 does show improvement, it is not significant at the .05 level of confidence.

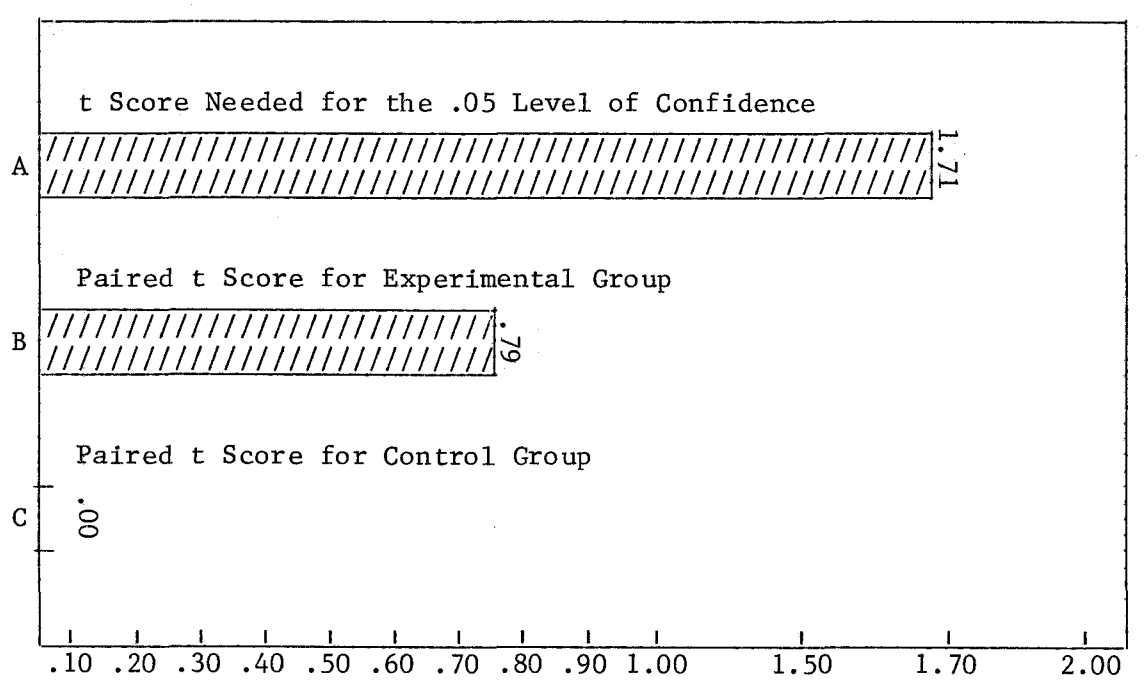
The C bar illustrates the paired t score of the

control group's individual pre-test and post-test scores. The paired t score of .15 indicates the control group did not achieve improvement approaching the .05 level of confidence. However, the experimental group had a great deal more improvement than the control group, and under different circumstances might have reached significance.

Table 4 will illustrate the difference in paired t scores for the vertical jump of each individual in the control group and in the experimental group.

TABLE 4

Paired t Scores for the Vertical Jump



The A bar illustrates the paired t score needed to be significant at the .05 level of confidence. The t score needed to be significant is 1.71.

The B bar illustrates the paired t score achieved with the experimental group by comparing the student's pre-test score with the same student's post-test score. The t score achieved with the experimental group is .79, which, while indicating a very slight improvement, does not approach significance at the .05 level of confidence.

The C bar illustrates the paired t score achieved with the control group. The t score achieved is .00, which indicates there is no improvement between the pre-test score and the post-test score of the control group. However, this is understandable because the control group participated in no activities other than the normal physical education activities.

As in the paired t's for leg strength, the paired t's for the vertical jump showed that the experimental group, while not significant, did exceed the gain of the control group.

Chapter 5

SUMMARY AND CONCLUSIONS

Summary of Results

This study was an attempt to determine if a ten week period of bench jump training would have an effect on the vertical jumping ability and on the leg strength of the student.

The study involved twenty-eight junior and senior boys enrolled in an advanced physical education class. The students were placed into two equal groups based on the results of Sargeant's jump reach test. Both groups were involved in normal physical education activities. However, only the fourteen students in the experimental group were involved in bench jump training.

The bench jump training consisted of a sixty second period of bench jumps. After a brief rest period, there followed a thirty second period of bench jumps which concluded the bench jump training for that day. The bench jump activity was a daily activity, Monday through Friday, for a ten week period.

The results of the experiment were computed into t scores with a t score of 1.71 being necessary to show significant improvement at the .05 level of confidence.

The results of the study indicated that bench jump

training did lead to an improvement in the leg strength of the student, but the improvement did not achieve significance at the .05 level of confidence.

A further result of the study is the indication that while there is some improvement in leg strength as a result of bench jump training, there is little corresponding improvement in the vertical jumping ability of the student as a result of the bench jump training.

This study concurred with the findings of Aegerter, Ball, Berger, Considine and Sullivan, McClements, Pryse, and Smith when it was determined that an improvement in leg strength did not lead to a corresponding improvement in the vertical jump.

Conclusions

The conclusions for this study are given as responses to the hypotheses posed in the first chapter. These conclusions are based on the differences between the computed t scores in the various statistical analyses used in this study.

Hypothesis 1. Intensive bench jump training will have no significant increase in the vertical jumping ability of the student.

The t scores computed from the statistical analyses showed almost no improvement in the vertical jump of the student as a result of bench jump training. Therefore, the author's first hypothesis is correct.

Hypothesis 2. Intensive bench jump training will have no significant increase in the leg strength of the student.

The t scores computed from the statistical analyses indicated that, while there is an increase in leg strength approaching significance as a result of bench jump training, there was not significant improvement at the .05 level of confidence. Therefore, the author's second hypothesis is correct.

Recommendations for Further Research

The following suggestions for future research have developed because of this study.

1. Use virtually the same study, but replace the physical education students with members of a basketball program who could be more motivated to improve leg strength and vertical jumping ability through bench jump training.

2. Increase the bench jump training from daily to twice daily and determine what effect this will have on the leg strength and on the vertical jumping ability of the student.

3. Do a study to determine the effect of bench jump training on the agility of the student.

4. Increase the number of participants, which might result in higher t's.

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