

An Experimental Study on the Effect of Lower Body Strength Training with Different Loads on the Vertical Jumping Ability of Volleyball Players

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Abstract: This study takes the effect of different loads of lower limb strength training on the special long jump ability of volleyball players as the research perspective, uses different loads of half-squat exercises and combines the differences in the technical characteristics of field positions of athletes of the same gender and the physiological differences of athletes of the opposite gender to carry out experimental research on the improvement of long jump ability of volleyball players, uses the experimental method and other research methods to analyze the effect of different loads of lower limb strength training on the improvement of long jump ability of male and female volleyball players. The following conclusions were drawn: 1. 80% of 1RM lower limb strength training method has a significant effect on male volleyball players' lower limb explosive power and long jump ability. 2. 70% of 1RM training method has a significant effect on female volleyball players' one-step assisted running and assisted long jump height; 90% of 1RM lower limb strength has a significant effect on their in-situ long jump and one-step assisted running height. The effect of 1RM lower body strength on the height improvement of the in-situ vertical jump and one-step assisted running was significant.

1. Introduction

In recent years, The relevant state departments promulgated the Opinions on Comprehensively Strengthening and Improving School Sports in the New Era and "Opinions of the Ministry of Education on Further Strengthening the Management of the Construction of High-level Sports Teams in Ordinary Higher Education Schools" and other important documents state that "School sports is a fundamental project to achieve the fundamental task of building moral character and improving the comprehensive quality of students, is an important work to accelerate the modernization of education and build a strong country of education and sports, for promoting the core values of socialism, cultivating the spirit of patriotism, collectivism, socialism and the will

quality of students to strive for excellence and hard work, to achieve the wisdom of sports, to sporting heart has a unique function." As an important part of school sports, the construction of high-level sports teams in colleges and universities plays an active role in promoting the cultivation of a good campus sports atmosphere and promoting the physical health level of students. Volleyball is a skill-driven, net-dominated confrontation sport, with the characteristics of intense confrontation and fast offensive and defensive transitions. In high-level volleyball games, many technical actions are completed in the air after jumping, such as passing, dunking, blocking, serving, etc. These technical actions are the most important link between offense and defense are the most effective means of scoring, and to some extent determine the trend of the game. With the development trend of refinement and heightening of volleyball, volleyball's special longitudinal jumping ability has become the key to supporting the complex and changeable techniques and tactics of volleyball, and all of its technical movements and tactics need good physical quality, and the physical quality of strength is the foundation, especially the lower limb strength. Among the functional training methods of lower limb load for volleyball players who want to improve their vertical jumping ability, half-squat exercises are the most functional exercises that conform to the morphological and physiological characteristics of movements such as dunking and net jumping, so weighted half-squat exercises are one of the most effective training methods. In this paper, we analyze the specific technical characteristics of male and female high-level volleyball players at the Minzu University of China and design a three-dimensional experimental program that combines their individual and gender differences, and investigate the effect of different loads of lower limb strength training on their vertical jumping ability based on the experimental test results and the gender differences of the athletes. The experimental test results combined with the gender differences of the athletes were used to investigate the effects of different lower limb strength training on their long jump ability, so as to develop a strength training program to effectively improve the long jump ability of volleyball players and a more effective and useful training method, to improve the sports injuries and unscientific training, and to provide some reference basis for the volleyball coaches in the future lower limb strength training.

2. Research Objects and Methods

2.1 Research Subjects

The effect of lower body strength training with different loads on the special long jump ability of college high-level volleyball players is the object of this study.

2.2 Research Methodology

2.2.1 Documentary method

Through the electronic media such as China Knowledge Network (CNKI) and China Outstanding Master's and Doctoral Theses Database, we used "volleyball players", "lower limb strength" and "vertical jump ability" as the keywords. We searched and reviewed related works and literature to understand the methods and means of lower limb strength and load training, and provided theoretical support for writing the dissertation by summarizing and analyzing the literature.

2.2.2 Experimental Method

(1) Experimental subjects

There were 16 high-level men's volleyball players and 16 women's volleyball players from Minzu University of China, a total of 32 subjects. The above 32 athletes were randomly divided into 6 groups according to gender.

(2) Experimental design and test metrics

During the experiment, the 1RM value of the individual half-squat will change to a certain extent. In the experiment, the male group 1 and the female group 1 took about 70% of the 1RM, the male group 2 and the female group 2 took about 80% of the 1RM, and the male group 3 and the female group 3 took about 80% 1RM. Take about 90% of 1RM, so that the variation of experimental load intensity is always within the range. To ensure that the total training load is the same, the above exercises are performed at least 24 hours, 3 times a week. Each training session lasts about 1 hour. The training begins with the first week of adaptive exercises, the second week, and a 15-minute warm-up preparation before training every week. Each exercise is carried out in strict accordance with the requirements, and 15 minutes of stretching and relaxation activities are carried out after the end. After 8 weeks, the athletes were tested again, and after obtaining the relevant data of the 6 groups of men and women, the data was statistically and analyzed by spss, and the 6 groups were compared within and between groups to analyze the effect of lower limb strength training with different loads on the height. The specific effect of the specific vertical jump ability of horizontal volleyball players.

In the early stage of the experiment, the students will be screened for relevant motor functions, and on the premise of ensuring that the training plan can be implemented, the athletes will be subjected to pre-test and post-test of the quality index experiment. After consulting relevant experts on relevant indicators, the three indicators are the content of the relevant quality test (Table 1).

Table 1: Test indicators

Test indicators		
vertical jump in situ	One-step run-up and jump	run-up jump

2.2.3 Mathematical Statistics

Data processing and statistical analysis were performed on the data obtained by the experiment using Excel. Differences within and between groups were tested using the SPSS T test. $P > 0.05$ has no significant difference, $P \leq 0.05$ has significant difference, $P < 0.01$ has highly significant difference.

3. Results and Analysis

3.1 Analysis of the Evaluation Index Data before and After the Experiment of 70% 1rm Lower Body Strength Training Program

According to Table 2, it can be seen that the paired T-test results of the test data before and after the experiment in the male group 1 in the evaluation index of in-situ take-off and touch height show that the sig value is 0.06, and the P-value is > 0.05 , indicating that the post-experiment data and the pre-experiment There is no difference in the data. Therefore, the author believes that 70% 1RM lower body strength training is not obvious for improving male volleyball players' ability to reach a

height in the vertical jump in situ; in the evaluation index of one-step approach and take-off height, the paired T-test results of the test data before and after the experiment show that the sig value is 0.11, P-value>0.05, indicating that there is no difference in the test data before and after the experiment. Therefore, the author believes that 70% 1RM lower body strength training is not obvious for improving male volleyball players' ability to reach height in one-step run-up and jump; in the evaluation index of run-up and jump height, the paired T-test results of test data before and after the experiment show that the sig value is 0.00, and the P value is 0.00. <0.01, indicating that the test data before and after the experiment were significantly different. Therefore, the author believes that 70% 1RM lower body strength training is beneficial to improve male volleyball players' ability to run, jump, and reach heights.

The paired t-test results of the pre-experimental and post-experimental test data of the female 1 group in the evaluation index of in-situ jumping and touch height showed a sig value of 0.37 and a p-value > 0.05, indicating that there was no difference between their post-experimental test data and the pre-experimental test data. Therefore, I believe that 70% 1RM lower limb strength training is not significant to improve the ability of female volleyball players to jump and touch height in situ; in the one-step assisted jump and touch height evaluation index, the paired t-test results of the pre-experimental and post-experimental test data showed that the sig value was 0.04, and the p-value was <0.05, indicating that the pre-experimental and post-experimental test data were significantly different. Therefore, I believe that 70% 1RM lower limb strength training is beneficial to improve the one-step assisted jump touch height ability of female volleyball players; in the evaluation index of assisted jump touch height, the results of paired t-test of pre-experimental and post-experimental test data showed that the sig value was 0.01 and the p-value was ≤0.01, which indicated that the pre-experimental and post-experimental test data were highly significant differences. Therefore, the author believes that 70% 1RM lower limb strength training is beneficial to improve the ability of female volleyball players to assist in jumping and touching height.

In volleyball training, longitudinal jump height is the decisive factor in volleyball dunking technique, from the perspective of actual combat, the running jump height affects the dunking height of the attacker on the court; one step running jump is mostly seen in "dunking probe ball" and other sudden situations where it is too late to make a retreating jumping technique and directly dunk the ball; in situ jump height is related to The height of in-situ jump is related to the height of volleyball players' net setting. From the above data analysis, I believe that 70% of 1RM lower body strength training is beneficial to improve the height of men's volleyball players' spike, which is in turn beneficial to improve their spike technique athletic ability and combat effect; 70% of 1RM lower body strength training program is beneficial to women's volleyball players' spike and sudden attack and spike height of side attack and sub-attack.

Table 2: T-test results of paired samples for pre-test and post-test of 70%1RM group

Indicators	Groups	Pre-experiment	After the experiment	P-value
In-situ vertical jump touching high (cm)	Male group 1	326.33±3.08	327.50±3.27	0.06
	Female group 1	274.20±6.61	274.40±6.80	0.37
One-step assisted jump touch high (cm)	Male group 1	329.17±3.97	330.17±4.07	0.11
	Female group 1	276.00±5.79	278.40±6.23	0.04
Jumping and touching high (cm)	Male group 1	333.83±3.76	341.00±4.10	0.00
	Female group 1	282.25±7.19	283.60±6.30	0.01

3.2 Data analysis of Evaluation Indexes of 80%1rm Lower Limb Strength Training Program Pre and Post-Test Experiments

According to Table 3, the paired t-test results of pre and post-experimental test data of male 2 groups in the evaluation index of in situ jump touch height showed a sig value of 0.00 and a p-value <0.01, indicating that their pre and post-experimental test data showed highly significant differences. Therefore, I believe that 80% 1RM lower limb strength training is beneficial to improve the in situ jumping and touching ability of male volleyball players; in the one-step assisted jumping and touching evaluation index, the paired t-test results of the pre and post-test data showed that the sig value was 0.00 and the p-value was <0.01, indicating that the pre and post-test data were highly significant differences. Therefore, I believe that 80% 1RM lower limb strength training is beneficial to improve the one-step assisted jump touch height ability of male volleyball players; in the evaluation index of assisted jump touch height, the results of paired t-test of pre and post-test data showed that the sig value was 0.01 and the p-value was ≤ 0.01 , which indicated that the pre and post-test data of the experiment were highly significant differences. Therefore, I believe that 80% 1RM lower limb strength training is beneficial to improve the running jump touch height ability of male volleyball players.

The paired t-test results of the pre and post-test data of female 2 groups in the evaluation index of in situ jump touch height showed a sig value of 0.70 and a p-value > 0.05, indicating that there was no difference between their post-test data and pre-test data. Therefore, I believe that 80% 1RM lower limb strength training is not significant to improve the ability of female volleyball players to jump and touch height in situ; in the one-step assisted jump and touch height evaluation index, the paired t-test results of the pre-experimental and post-experimental test data showed that the sig value was 0.01 and the p-value was ≤ 0.01 , indicating that the pre-experimental and post-experimental test data were highly significant. Therefore, I believe that 80% 1RM lower limb strength training is beneficial to improve the one-step assisted jump touch height ability of female volleyball players; in the evaluation index of assisted jump touch height, the results of paired t-test of pre and post-test data showed that the sig value was 0.01 and the p-value was ≤ 0.01 , which indicated that the pre and post-test data of the experiment were highly significant differences. Therefore, the author believes that 80% 1RM lower limb strength training is beneficial to improve the ability of female volleyball players to assist in jumping and touching height.

From the above data analysis, I believe that 80%1RM lower body strength training is beneficial to improve the height of men's volleyball players' spike and blocking height, which in turn is beneficial to improve their spike and blocking technique athletic ability and actual combat effect; while 80%1RM lower body strength training program is beneficial to women's volleyball players' side attack and vice attack of strong attack and sudden situation of spike height.

Table 3: T-test results of paired samples for the 80%1RM group pre-test and post-test

Indicators	Group	Pre-experiment	After the experiment	P-value
In-situ vertical jump touching high (cm)	Male group 2	317.80±9.76	322.60±9.50	0.00
	Female group 2	281.00±5.83	281.60±6.11	0.70
One-step assisted jump to touch high (cm)	Male group 2	321.40±9.45	326.80±8.93	0.00
	Female group 2	284.00±6.67	287.80±7.05	0.01
Jumping and touching high (cm)	Male group 2	327.60±9.50	334.40±10.33	0.01
	Female group 2	287.40±8.02	291.20±7.16	0.01

3.3 Data Analysis of Evaluation Indexes of 90% 1RM Lower Limb Strength Training Program Pre and Post Tests

According to Table 4, the paired t-test results of the pre- and post-experimental test data of the male 3 groups in the evaluation index of the in situ jump touch height showed a sig value of 0.04 and a p-value of <0.05, indicating that their pre- and post-experimental test data were significantly different. Therefore, I believe that 90% 1RM lower limb strength training is beneficial to improve the in situ jumping and touching ability of male volleyball players; in the one-step assisted jumping and touching evaluation index, the paired t-test results of pre and post-test data showed that the sig value was 0.04 and the p-value was <0.05, indicating that the pre and post-test data were significantly different. Therefore, I believe that 90% 1RM lower limb strength training is beneficial to improve the one-step assisted jump touch height ability of male volleyball players; in the evaluation index of assisted jump touch height, the paired t-test results of pre and post-test data showed that the sig value was 0.70, and the p-value was >0.05, indicating that there was no difference between the post-test data and the pre-test data. Therefore, the author concluded that 90% 1RM lower limb strength training was not significant to improve the assisted jump touch height ability of male volleyball players.

The paired t-test results of the pre- and post-experimental test data of the female 3 groups in the evaluation index of ground jump touch height showed that the sig value was 0.00 and the p-value was ≤ 0.01 , indicating that their pre- and post-experimental test data showed highly significant differences. Therefore, I believe that 90% of 1RM lower limb strength training is beneficial to improve the in situ jumping and touching ability of female volleyball players; in the one-step assisted jumping and touching evaluation index, the paired t-test results of pre and post-test data showed that the sig value was 0.00 and the p-value was ≤ 0.01 , which indicated that the pre and post-test data were highly significant differences. Therefore, I believe that 90% 1RM lower limb strength training is beneficial to improve the one-step assisted jump touch height ability of female volleyball players; in the evaluation index of assisted jump touch height, the paired t-test results of the pre-experimental and post-experimental test data showed that the sig value was 0.77, and the p-value p-value > 0.05, indicating that there was no difference between its post-experimental test data and the pre-experimental test data. Therefore, the author concluded that 90% 1RM lower limb strength training was not significant to improve the ability of female volleyball players to assist in jumping and touching height.

From the above data analysis, I believe that 90% 1RM lower body strength training is beneficial to improve the blocking height of male and female volleyball players and the height of the bucket in response to unexpected situations, which in turn is beneficial to improve their blocking and "bucket ball" techniques and other athletic abilities and combat effects.

Table 4: T-test results of paired samples for the 90%1RM group pre-test and post-test

Indicators	Groups	Pre-experiment	After the experiment	P-value
In-situ vertical jump touching high (cm)	Male group 3	310.00±12.79	315.60±11.50	0.04
	Female group 2	272.00±5.51	277.00±2.08	0.00
One-step assisted jump to touch high (cm)	Male group 2	310.00±12.79	315.60±11.50	0.04
	Female group 2	274.50±5.93	279.00±5.55	0.00
Jumping and touching high (cm)	Male group 2	327.40±12.64	328.00±12.90	0.70
	Female group 2	279.50±6.35	279.67±7.34	0.77

3.4 Summary Analysis of Index Data from 6 Groups of Pre-Test and Post-Test Experiments

Based on the comparative analysis of the above group data, it can be seen that the use of different load lower-body strength training methods for male and female volleyball players have different effects on the improvement of the three indexes of the in-situ vertical jump touch height, one-step assisted jump touch height and assisted jump touch height. 70% of the 1RM lower-body strength training is beneficial for male and female volleyball players to improve the one-step assisted jump touch height and assisted jump touch height, but not significant for improving the in-situ vertical jump touch height. 80% of the half-squat 1RM training methods were beneficial for improving men's and women's volleyball players' ability to feel high in the long jump, one-step jump, and running jump. 90% of the half-squat 1RM training methods were beneficial for improving men's and women's volleyball players' ability to feel high in the long jump and one-step jump. The method of half-squat 1RM training is beneficial to improve the touching ability of both male and female volleyball players in the long jump and one-step jump, but it is not significant to improve the touching ability of the running jump.

In summary, the three load dimensions of lower limb strength training are effective in improving the longitudinal jumping ability of male and female volleyball players, but the test results of each dimension are slightly different, combined with the technical application characteristics of volleyball players' field positions, I believe that the training method of 80% half-squat 1RM is the most applicable training method to improve the explosive power and longitudinal jumping ability of male volleyball players, and it has a more significant effect on improving the special jumping ability of volleyball in actual combat. In female athletes, 70% of 1RM is more suitable for their field position technology use characteristics, the load training to improve the attacker's attack height, and then improve their dunking technical ability. It can be seen that in order to gain the advantage of confrontation in the game and thus occupy the initiative of the game, one must have good strength quality, pay more attention to special strength in daily training, and adopt targeted lower limb strength training methods with appropriate loads to meet their needs.

4. Conclusions and Recommendations

4.1 Conclusion

The lower limb strength training methods with different loads had a significant effect on male volleyball players' longitudinal jump height improvement such as in-situ longitudinal jump touch height, one-step assisted jump touch height, assisted jump touch height, etc. Among them, the 80%1RM lower limb strength training method had a significant effect on male volleyball players' lower limb explosive power and longitudinal jump ability improvement.

Different load of lower limb strength training methods were effective on longitudinal jump height such as in-situ longitudinal jump touch height, one-step assisted running jump touch height and assisted running jump touch height of female volleyball players, but there were differences in tendency. Among them, 70% of the 1RM training methods are effective on their one-step assisted running and assisted running vertical jump height; 90% of the 1RM lower body strength is effective on their in situ vertical jumps and one-step assisted running height.

4.2 Recommendations

For male athletes, the lower limb strength training with different loads is effective in improving the special vertical jumping ability such as in-situ vertical jumping touch height, one-step assisted jumping touch height, assisted jumping touch height, etc. The training method of 80% 1RM can be used as the preferred practice program to improve the technical ability of attackers and second passers in teaching and training such as dunking and netting.

For female athletes, different loads of lower limb strength training are effective in improving their special vertical jumping ability such as in-situ vertical jumping touch height, one-step assisted jumping touch height and assisted jumping touch height, of which 70% of half squat 1RM can be used as the preferred practice program to improve the special ability of the attacker's dunking technique teaching training, 90% of 1RM training method can be used to improve the attacker's and the second passer's blocking technique teaching training improvement². The first choice of the program.

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