The Effect of Weighted Jump Rope Training as an Intervention on the Shoulder Strength of Division III College Volleyball Players

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Abstract

The goal of this action research project was to examine the impact of weighted jump rope training on shoulder strength of college volleyball players. The independent variable was the type of training exercise, and the dependent variable was the shoulder strength of the participants as measured by the kneeling power ball throw. The measurement tool was a kneeling overhead throw. This study used the use of a pre-test/post-test design, with one person in each condition, to compare data from before and after the intervention was administered. Due to small group sizes secondary to COVID-19 precautions, results were not subjected to statistical analysis and hypotheses were not formerly tested. Both groups increased from pre-test measures to post-test. The weighted training group had a larger gain of five inches after intervention, as compared to the unweighted jump rope group that had a gain of 1.33 inches.

CHAPTER I

INTRODUCTION

Overview

The goal of this action research project was to examine the impact of weighted jump rope training on shoulder strength of college volleyball players. There has been significant research on the effect of jump ropes on cardiovascular health and endurance. There has been less research on the impact of weighted jump rope training in athletes.

In 2012, more than 1.35 million children under the age of 19 received medical treatment for sport and recreational musculoskeletal injuries, a significant number of which were overuse injuries (Rawashdeh et al., 2016). High school athletes sustain approximately 116,000 shoulder injuries yearly, of which 39% are musculoskeletal strains and sprains. While injuries are hard to predict, coaches and training staff try to implement injury preventative measures to avoid missed playing time. Volleyball players are at high risk for overuse shoulder injuries due to the focused, repetitive motions involved in hitting and blocking skills. Shoulder injury prevention is critical because the shoulder does not recover well from injury, and some athletes encounter lasting effects (Stickley et al., 2008).

As an Assistant Coach for a women's volleyball team at a Division III institution, the researcher did not want her athletes to have shoulder problems or career ending injuries due to shoulder overuse. The researcher had noticed that athletes were participating in many complex training regimes, and she wanted to find a simple intervention. The university athletic department did not currently use weighted jump ropes for any of their sports.

Statement of Problem

The purpose of this study was to examine the effect of jump rope workouts on college volleyball players' shoulder strength with particular interest in the differential impact of using weighted jump ropes.

Hypothesis

The first null hypothesis is that volleyball players that participate in weighted jump rope training and non-weighted jump rope training will not improve significantly in shoulder strength. The second null hypothesis is that there will be no significant difference in the shoulder strength of the volleyball player that participated in weighted jump rope training as compared to the volleyball player that participated in non-weighted jump rope training.

Operational Definitions

Below are the operational definitions for all variables and concepts relevant to this study.

Weighted Jump Rope Training: A jump rope workout that involved the participant continuously jumping rope for five minutes with a 2-pound jump rope.

Non-weighted Jump Rope Training: A jump rope training that included jumping rope continuously for five minutes straight with an unweighted, speed rope.

Shoulder Strength: Shoulder strength was measured by the kneeling power ball throw. While in a kneeling position, the participant threw a 4-pound weighted ball for maximum distance. The ball started from in front of the participant, was brought back over the head, and then was thrown forward at a 45-degree angle using both arms. The participant was not allowed to favor one arm when throwing. Each participant was given one practice throw and then the next three were recorded in inches. The average of the three measures was the participant's shoulder strength. If incorrect form was used, the throw was not counted.

Training Period: Each participant completed their respective training plan three times a week for three weeks.

CHAPTER II

REVIEW OF THE LITERATURE

This review of the literature discusses interventions for increasing shoulder strength to prevent injury in volleyball players. Section one covers volleyball movement and shoulder strength. Section two covers the impact of different training methods on athletic performance. Section three covers different injury prevention methods that have been studied on athletes. Lastly, section four covers how jump rope training impacts volleyball players.

Volleyball Movement and Shoulder Strength

Volleyball is an extremely fast-paced sport that requires explosive lateral movements and powerful arm swings to earn points. Many coaches use plyometric training, which involves speed and force from different movements to build muscle and power. Some plyometric exercises include pushups, running, squatting, kicking, and jumping. According to Silva et al. (2019), many studies reveal that plyometric training appears to increase vertical jump height, strength, horizontal jump performance, flexibility, and agility in volleyball players. In this systematic review of current studies, Silva states that the different stimuli from plyometrics lead to the improvement in strength and coordination.

Strength is needed in volleyball skills, such as hitting and blocking. Muscular strength, specifically in the shoulder, can give athletes an advantage above their competition. Hand dominance must be considered when evaluating shoulder strength because shoulder strength favors the dominant side in both male and female volleyball players (Hadzic et al., 2014). In addition, Hadzic gathers that an increase in internal rotation strength is associated with a proportional increase in external rotational strength in female players that have not had a previous shoulder injury. Females that have had a previous shoulder injury display external

rotational strength deficits, like the male volleyball players in the study. It is important that female players maintain shoulder strength, as it is difficult to regain the same strength after a shoulder injury.

Injuries are statistically higher in games than in practices; however, the highest practice injury rate occurs in preseason (Hootman et al., 2007). Many injuries come from player contact, so sports like volleyball, which have low contact with other players, have a smaller difference between practice and game injury rates. Decreasing physical contact with others is helpful to reduce uncertainty that can lead to injury. Identifying the problem is the first step to injury prevention. Once a problem is determined, methods to avoid or change behaviors must be established, implemented, and evaluated. The systems should be reevaluated through continued surveillance to determine their effectiveness.

Training Methods for Improving Athletic Performance

Training is an extremely important part of an athlete's life. Players use weightlifting, agility drills, and practice exercises to improve their skill level. Different coaches use different types of workouts to help their players, yet they have a common goal to strengthen athletes' bodies to avoid injury. According to Mugele et al. (2018), general sports injury preventative practices tend to be more effective than sport-specific injury prevention measures. However, both types of preventative practices contribute to a reduction in risk of an athlete sustaining a sport injury. During training, it is important that athletes perform each exercise with proper form and execution. General injury prevention programs implement plyometric, balance, resistance, agility, and/or flexibility exercises. The multidimensional approach prevents hamstring and anterior cruciate ligament (ACL) injuries, which contribute a high percent of injuries each year,

by altering various risk factors. General sports training aims to improve the body by strengthening muscles and joints that are commonly used.

Multidimensional exercises allow athletes to enhance coordination, balance, strength, and power. Jump rope is a non-specific exercise that benefits an athlete's conditioning, balance, and coordination. The inclusion of jump rope exercise within regular sport-specific training can encourage further growth in children's motor skills (Trecroci et al., 2015). By incorporating jump rope training at the beginning of practice, preadolescent soccer players were able to improve motor coordination and balance over an eight-week period. The inclusion of jump rope training added to the benefits of the sport-specific training. The combination of general and sport-specific training can support athlete growth, yet further research should be done to determine the amount of each type of training that is optimal.

Volleyball specific training involves game-like movements that can be in any direction. The variation in pace and irregularity in movements can cause an overload of one body part, such as ankles, knees, or shoulders (Piech et al., 2020). Continuous use of one part of the body increases the risk for injury. The repetitive movements required in volleyball can predispose volleyball players to a higher risk of overuse injuries. According to Piech et al., asymmetry was observed in the majority of volleyball players, with the lowest functional movement score in the shoulder. Exploitation of a given muscle group can lead to muscular dystonia, or involuntary muscle twitches, which can increase the frequency of injury by about 25-35%.

To prevent overuse injuries, volleyball players may use differential jump training to improve balance and strengthen ankles. Differential training utilizes movement variability to allow for individual adaptions in neuromuscular activation patterns (Fuchs et al., 2020). This intervention provides improvements in sport-specific jump training and postural control, which is

an indicator of injury risk. Differential training can be implemented for the entire team or for individuals that can't fully participate in practice because the training does not risk overtraining or overuse.

Injury Prevention Measures in Athletes

Due to the unpredictable nature of athletic competition, athletes want to find ways to strengthen their bodies to avoid injury. In an effort to prevent injury, athletes have worn motion sensors to capture their movements to identify potentially hazardous and dangerous movements. By providing real time feedback, the athlete can be aware of how many times a certain motion has occurred. Rawashdeh et al. (2016) conducted a study using body worn sensors to track overhead movements in sports, such as volleyball and baseball, that are more susceptible to shoulder overuse injury. The sensors were able to detect when the subject's arm was elevated and moving at a high rotation rate, while differentiating between movement of a baseball throw and a volleyball swing. The sensors were able to track arm motions with 86% accuracy. Results of this study provide coaches and training staff with a reasonable estimate of arm movement volume to reduce overuse injuries in the upper extremities.

With swinging motions being a large part of the game, volleyball players are likely to have high arm movement levels, but not all players experience shoulder problems. According to Stickley et al. (2008), rotator cuff strength was not found to be predictive of injury history in participants, and there was no difference in shoulder strength ratios among skill levels. Players with a history of injury display lower external shoulder rotation, as compared to those players without a shoulder injury, due to a lack of eccentric strength. As skill level is increased, the difference in the shoulder strength of those with and without previous shoulder injury history becomes greater. Differences in medial and lateral shoulder rotation strength appears to be more

related to injury prevalence than absolute strength. Preventative shoulder strengthening programs that focus on improving eccentric strength and imbalances between medial and lateral rotators are beneficial for female volleyball players. Shoulder injury prevention is critical because the shoulder does not recover well from injury, as some athletes encounter lasting effects.

Injuries can be prevented with a variety of training methods, including therapeutic shoulder strengthening. Yanagisawa et al. (2003) looked at the effects of various therapeutic measures on shoulder strength and muscle soreness, occurring after baseball pitching. Therapeutic measures utilized included ice treatment, light shoulder exercise, ice with light exercise, and a no treatment control group. Athletes received one of the treatments to their dominate shoulder immediately after throwing 98 pitches, to simulate a single game. The study concludes that the ice with light exercise was optimal for increasing shoulder strength post-exercise and decreasing muscle soreness from repetitive motion. Athletes perform at their top capacity when their strength is elevated, and their muscle soreness is minimal.

Jump Rope Specific Training for Volleyball Players

Jump rope training is beneficial to an athlete's strength by improving cardiovascular health and coordination. To enhance the effects of jump rope training, athletes can use a weighted jump rope. Volleyball players that participated in a 12-week training program with a weighted jump rope performed better on strength test than players that participated in jump rope training or sport-specific training (Ozer et al., 2011). The weighted jump rope training group improved by greater rates on speed, coordination, and lower extremity eccentric endurance tests. A similar study was conducted by Duzgun et al. (2010), where 13 to 16-year-old volleyball players participated in a 12-week jump rope training program that specifically looked at isokinetic shoulder strength. Eccentric shoulder movement increased in the weighted jump rope

group, while decreasing in the standard jump rope group. The weighted jump rope group increased external-rotation peak torque, while other groups peak torque remained the same. Jump rope training programs are beneficial to overall conditioning; however, weighted jump rope training is better for overhead athletes because of its direct benefits to shoulder strength.

Conclusion

Injury prevention continues to be a crucial problem among all athletes. The impact of injury not only affects a player's training, but also their playing development by potentially keeping them out of the game for extended periods. Researchers have identified many training methods and injury prevention measures related to athletics. Approaches to minimize injuries are applied and studied by many researchers, as well as coaches and medical trainers. Nevertheless, reducing injury rates in athletes requires further research to observe how the body reacts to different training methods and which training is suitable for the athlete's specific sport requirements.

CHAPTER III

METHODS

The purpose of this study was to determine if weighted jump rope training impacts shoulder strength in volleyball players.

Design

This study incorporated a quasi-experimental pretest-posttest control group design. However, due to constraints related to COVID-19 and equipment availability, each group consisted of only one subject. Subjects were selected based on convenience and were not randomly assigned. The kneeling power ball overhead throw served as the pre- and post-test for both the experimental and control group. The pre-test was utilized to determine that the groups did not differ significantly on shoulder strength prior to the intervention. The independent variable was the type of training exercise, and the dependent variable was the shoulder strength of the participants as measured by the kneeling power ball throw.

Participants

The participants in this action research project were all members of the women's varsity volleyball program in Division III at a college in the mid-Atlantic region. The researcher was a coach at the school where the participants competed. Most of the team was not on campus because the team was not competing at the time of the experiment. The school season was postponed from the fall, and spring training was delayed due to COVID-19. The researcher pulled students from the team that were in the local area of the campus. The participants from the team in the area were randomly assigned to their respective training programs. The researcher provided the jump ropes for the participants. The participants ranged from age 19 to 21. There

was one participant in the weighted jump rope training group and one participant in the non-weighted jump rope training group.

Instruments

To measure shoulder strength, participants partook in the kneeling overhead power ball throw. The ball was thrown forward from above the head at a 45-degree angle using both arms. The weighted ball was 4-pounds and was thrown while the participant was kneeling. The throws were measured in inches. Each participant was provided one warm-up throw. The next three throws were averaged out to calculate the participant's average shoulder strength.

Procedure

This study was completed from February to March 2021. The participants were in their spring off season and did not compete in their fall season in 2020 due to COVID-19. Even though the players were not participating in competition, they were expected to continue strength training at home in the fall and spring. The player workout included volleyball specific exercises that could be completed at home. Most players on the team did not have access to weight rooms due to COVID-19 local restrictions. The workouts included full body training, which included leg, arm, and ab exercises. The players completed three days of training per week with each day including different exercises. The standard team training included some shoulder exercises such as push-ups and dips.

Participants added their respective jump rope work out on top of their team workout expectations. Each participant completed a pre-test for shoulder strength. After averaging out the three throws, each participant was given a baseline shoulder strength score.

After the pre-test was completed and documented, the training workout was implemented. The control and experimental group completed their workouts three times a week

for three weeks. Participants were not allowed to do back-to-back training days, so as to allow time for rest on the days between training. The training was added on top of each participant's normal routine. The participants completed five minutes of continuous jump rope using their respective training rope. After each training session, the participant was to check in to notify the researcher that the training was completed and discuss any issues that arose from the training program, such as injury or soreness.

After completing the three-week intervention program, the participants completed a post-test for shoulder strength. Each participant completed the same kneeling power ball throw test that was used before the intervention. The shoulder strength score was the average of the participant’s three throws.

Due to there being only one subject in each group, results were considered descriptively and not subjected to statistical analysis.

CHAPTER IV

RESULTS

The goal of this action research project was to examine the impact of weighted jump rope training on the shoulder strength of college volleyball players. The independent variable was the type of training exercise, and the dependent variable was the shoulder strength of the participants as measured by the kneeling power ball throw. Since there was only one subject in each condition, only descriptive statistics are being reported and the results are considered qualitatively.

The pre-test results for both training groups were similar, at two inches difference. Both groups increase from pre-test measures to post-test. The weighted training group had a larger gain of five inches after intervention, as compared to the unweighted jump rope group that had a gain of 1.33 inches. The standard deviations of both groups were larger during the pretest. With so few subjects, it was not possible to make a definitive conclusion about the null hypothesis. The first null hypothesis was that volleyball players that participate in weighted jump rope training and non-weighted jump rope training would not improve significantly in shoulder strength. The second null hypothesis was that there would be no significant difference in the shoulder strength of the volleyball player that participated in weighted jump rope training as compared to the volleyball player that participated in non-weighted jump rope training. However, the subject using the weighted rope had a greater gain in strength.

Table 1

Means and Standard Deviations for Shoulder Strength of the Weighted and Unweighted Jump Rope Training Groups, Pre- and Post-Intervention

Condition	N	Mean of 3 Trials	SD	Gain
Weighted pre-test	1	165	12.77	5 inches
Weighted post-test	1	170	7.21	
Unweighted pre-test	1	163	17.44	1.33 inches
Unweighted post-test	1	164.33	4.16	

CHAPTER V

DISCUSSION

The purpose of this action research project was to examine the impact of weighted jump rope training on shoulder strength of college volleyball players. With so few subjects, it was not possible to make a definitive conclusion about the null hypothesis. The first null hypothesis was that volleyball players that participate in weighted jump rope training and non-weighted jump rope training would not improve significantly in shoulder strength. The second null hypothesis was that there would be no significant difference in the shoulder strength of the volleyball player that participated in weighted jump rope training as compared to the volleyball player that participated in non-weighted jump rope training.

Implication of Results

The value of remaining healthy throughout a playing career has been a long-standing issue at all levels of collegiate athletics. As the popularity of collegiate athletics continues to rise and physical expectations of the student athlete becomes more demanding, the issue of injury prevention needs to be addressed. By looking at the shoulder strength of student-athletes before and after this intervention, the results could disclose some new injury preventative exercises.

According to the results of the study, there is not significant evidence to support that the weighted jump rope training is effective in improving athletes' shoulder strength. However, the researcher collected qualitative data to support the positive effects of the intervention on shoulder strength in volleyball players. The implications of this study are that athletic programs should use weighted jump ropes to improve shoulder strength. The implementation of this intervention strategy showed the improvement in shoulder strength over the use of standard jump rope training.

Threats to Validity

The outcomes of the research present several different threats to validity. First, the sample size was small, therefore reducing the power to find group difference. There can be a lot of variability from one throw to the next within the same athlete, which was reflected in the higher standard deviations of throws. This made the limitations related to the number of subjects even more significant because there were not other subjects in the study to help balance out when a subject had a particularly weak throw. There seemed to be a greater amount of variability during the pretest throws. The small number of students was due to the number of athletes that were available to the researcher. The school where the researcher worked was participating in remote learning due to COVID-19. There were a small number of players on campus that the researcher could pull from.

Furthermore, these results cannot be generalized beyond the narrow scope of the study. The participants in the study were athletes between the ages of 19 to 21, who were members of the women's varsity volleyball program in Division III at a college in the mid-Atlantic region. Duplicating this intervention in a different setting likely would yield different results. In a setting where the athletes had been training in the weight room consistently for months before the intervention, athletes likely would have built up more shoulder strength. With a stronger base of overall fitness, the intervention possibly would have different results.

Additionally, the only measure of shoulder strength in this study was kneeling overhead throw. Because this measure is based on specific shoulder muscles, the researcher cannot generalize the results of this study to all shoulder muscles.

Connections to Previous Studies

Every year, coaches look to build an advantage over their competition. One way to be successful is to keep players healthy and on the court, which can be aided with injury prevention techniques and training. According to Mugele et al. (2018), general sports injury preventative practices tend to be more effective than sport-specific injury prevention measures. However, both types of preventative practices contribute to a reduction in risk of an athlete sustaining a sport injury. The variation in pace and irregularity in volleyball movements can cause an overload of one body part, such as ankles, knees, or shoulders (Piech et al., 2020). Continuous use of one part of the body increases the risk for injury. The repetitive movements required in volleyball can predispose volleyball players to a higher risk of overuse injuries. Although this study focused solely on the effect of weighted jump rope training on shoulder strength, the results could be used for future research to determine how weighted jump rope training on student-athletes in Division III correlates to shoulder injuries and length of playing career.

This study was inspired by the research that was conducted on the use of weighted jump rope training. Jump rope training is beneficial to improving cardiovascular health and coordination, but to enhance the effects, athletes can use a weighted jump rope. After a 12-week training program, Ozer et al. (2011) concluded that the weighted jump rope training group improved by greater rates on speed, coordination, and lower extremity eccentric endurance tests, compared to the jump rope and sport-specific training groups. Likewise, the weighted jump rope group increased external-rotation peak torque, while the standard jump rope group peak torque remained the same (Duzgun et al. 2010). Jump rope training programs are beneficial to overall conditioning; however, weighted jump rope training is better for overhead athletes because of its direct benefits to shoulder strength.

The research conducted at this Division III institution could use the results produced from this study in conjunction with the intervention of Ozer et al. and Duzgun et al. to implement new training regimens with the goal of shoulder injury prevention. Nevertheless, reducing injury rates in athletes requires further research to observe how the body reacts to different training methods and which training is suitable for the athlete's specific sport requirements.

Implications for Future Research

Future research related to ways injury prevention measures for shoulders in volleyball players might address threats to validity identified in the current study. For example, future research could include more participants. These participants should be randomly assigned to the control and experimental groups. A broader, more representative population would limit the impact of variation in kneeling overhead throws between participants in the study. Random group assignment would control for any pre-existing differences in shoulder strength.

Additionally, future research could build on elements of this study by selecting athletes from different divisional subgroups. By comparing the impact of weighted jump rope training on Division I, II, and III athletes, the researcher could determine if there is a difference in the effects on athletes from different competing levels. It would be beneficial to compare subgroups of athletes with and without shoulder injuries to target the athletes that would benefit most from the weighted jump rope training.

Furthermore, future research may consider increasing the frequency of the training days or the length of time in each training day. This will help to find a balance between strengthening and overusing the shoulder muscle. Future research should seek to implement other injury prevention techniques to see which interventions are the most effective with collegiate student-athletes.

Summary and Conclusion

In summary, the findings of this research appear to support the notion that weighted jump rope training improves shoulder strength more than standard jump rope training. The purpose of this action research project was to examine the impact of weighted jump rope training on shoulder strength of college volleyball players. With so few subjects, it was not possible to make a definitive conclusion about the null hypothesis.

The results of this study showed a larger pre- to post-test improvement in shoulder strength of the athlete that participated in the weighted jump rope training than the athlete that participated in standard jump rope training. The current results indicate that weighted jump rope training increases shoulder strength in volleyball players. However, it would be important to test the implications of the training at more Division III institutions to see the magnitude of the training.

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