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The Analysis of Effective Plyometric Exercises on Jump Explosiveness Performance of Women's Volleyball Athletes

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Abstract- The Plyometric training is commonly used to enhance physical performance in various sports including activities that require sprinting, jumping, and agility in changing directions (Kons et al,. 2023) This study investigates the effectiveness of plyometric exercises on female volleyball athletes' jump explosiveness, particularly the setters and liberos of Polytechnic University of the Philippines Women's Volleyball Team. Through a four-week intervention involving two control groups performing different exercise routines. The participants' jump explosiveness was assessed before and after the 4-week intervention through the use of Vertec. It is a type of vertical jump assessment that uses coloured plastic swivels arranged in half-inch increments attached to a tube rather than using chalk or being next to a wall. The participants were given three (3) tries with 3minute rest in between using a two-footed no-step approach. (Klavora, Peter 2000) The highest record out of the three (3) tries will be their pre-test and post-test record. The results of this study revealed that a 4-week plyometric training intervention has no significant effect on the jump explosiveness of both controlled groups. It was also revealed in this study that there is no significant difference between the results of both control groups. However, it is worth noticing that both groups exhibited improvements during the intervention. The lack of significant effect in this study may be attributed to the small number of participants (Martínez et al, 2014), low intensity and volume of exercises used during the intervention as well as the duration of the intervention. (Davies et al., 2015).

Keywords: Plyometric training, jump explosiveness, vertical jump, women's volleyball, athletic performance, Vertec measurement, sports intervention, explosive power, volleyball training program.

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INTRODUCTION

Plyometric exercises play a crucial role in fostering power development, serving as a fundamental element for athletes to hone their sport-specific skills. It is a widely embraced method of physical conditioning, incorporating body weight jumping exercises utilizing the stretch-shortening cycle (SSC) muscle action (Bedoya et al, 2015). Whether engaged in competitive sports or recreational pursuits, the demand for athletic movements necessitates a blend of strength and speed to generate the essential outcome known as power. Over time various professionals, including strength and conditioning specialists, performance enhancement coaches, and athletic trainers have consistently explored methods to boost power levels for the purpose of improving overall athletic performance.

Kons et al. (2023) also stated in his study that plyometric exercises are commonly employed to enhance physical performance in various sports that require jumping, sprinting, and agility. Chelly et al. (2015) revealed that a 10week plyometric training intervention has a significant effect on both vertical and horizontal jump of 27 male track athletes. However, Sozbir (2016) concluded in his study that a 6-week plyometric training intervention has no significant effect on the vertical jump of 24 highly physically active students.

The researchers adapted the exercises box jump and single leg side to side shuffle (Control group I) and depth jump and double leg side to side box jump (Control group II) for enhancing jump explosiveness from the studies by Davies et al., (2015) and Ciminelli et al., (2016). The participants' jump explosiveness were tested through the use of Vertical Jump test which is a standard test primarily used by athletes who play volleyball, basketball, and high jumps (Prabowo et al., 2020). Proper test administration was ensured by following the Vertical Jump test protocols of Yingling et al., (2018). To categorize the level of jump explosiveness of the participants, this study utilized the normative data for vertical jump height of collegiate volleyball athletes by Woods (2012).

While there are numerous studies regarding the positive effect of plyometric exercise among different types of athletes, only few studies have been published that aims to determine the effectiveness of plyometric exercise from one another. This study aims to address the research gap by conducting an experimental study that aims to compare and determine the effectiveness of different plyometric exercises from one another and to address the conflicting results of different studies regarding the effectiveness of plyometric training intervention in improving vertical jump explosiveness.

LITERATURE REVIEW

Different studies consistently highlight the substantial impact of plyometric exercises on enhancing the jump explosiveness performance of diverse individuals. Their studies consistently demonstrate the positive influences of plyometric training on jump explosiveness capabilities across a range of subjects (Sorbiz, 2016; Chandler et al., 2018; Radenković et al., 2020; Pomo Haci et al., 2021)

Various researchers on plyometric exercises across sports, including basketball, reveal conflicting findings. Some studies report significant improvement in jump performance height after performing plyometric training, while other studies reported that plyometric exercises delivered little to no effects to the athlete. The contrasting outcomes underscore the complexity of evaluating the effectiveness of plyometrics across diverse athletic contexts (Chelly et al., 2015; Verma et al., 2015; Harmandeep S. et al., 2015; Sozbir, 2016; Tsoukos et al., 2016; Stark et al., 2016; Marián eet al.,2016; Hester et al., 2017; Zekri et al., 2019; Ploeg et al., 2020; Ramirez-Campillo et al., 2020; Makaruk et al., 2020; Correia et al., 2020; Gustavo et al., 2020; Strate et al., 2021; Rajh et al 2022; Rajan & Navaneethan 2023; Kryeziu et al. 2023)

Studies show that plyometric exercises have a significant effect on jump performance of volleyball athletes and emphasize the importance of plyometric exercises in terms of improving athletes' explosiveness needed for a better jump height (Cojocaru & Cojocaru 2019; Sari, A.N. et al. 2020; Ramirez-Capillo et al. 2020; Gradinaru, L. 2021).

METHODOLOGY

(Our demonstration methodology is designed to effectively exhibit the effectiveness of plyometric training on jump explosiveness among women's volleyball athletes. The approach is organized into the following key phases:

1. Objective Definition

Clearly articulate the study's primary goal: to evaluate the effect of specific plyometric exercises on the vertical jump performance of selected women's volleyball athletes at PUP.

Define measurable success criteria using pre-test and post-test vertical jump scores, analysed statistically for significance using paired t-tests.

2. Scenario Development

Create realistic training scenarios by dividing athletes into two control groups, each performing different plyometric routines (e.g., weighted box jumps and side-to-side box shuffle vs. weighted depth jumps and Double leg side-to-side box jumps).

Ensure each training protocol reflects real volleyball training settings, targeting positions (libero/setter) to align with the study's relevance to actual sports performance.

3. Setup and Configuration

Prepare the test and training environment using standardized equipment such as the Vertec for measuring jump height and 1kg ankle weights for resistance.

Employ a four-week training intervention, conducted three times a week post-regular team practice, to simulate actual athletic schedules.

Validate all testing and training protocols to ensure reliability and consistency between pre- and post-test conditions.

4. Step-by-Step Execution.

This study follows a structured step-by-step procedure to assess the analysis of effective plyometric exercises on jump explosiveness of PUP women's volleyball using a pre-test and post-test experimental design:

1. Research Design and Ethics: The study's objective is to analyse the plyometrics on jump explosiveness was defined, and ethical approval was secured to ensure compliance with research standards and participant safety.

2. Participant Selection: The target population was identified as setters and liberos of Polytechnic University of the Philippines women's volleyball. Four (4) participants were selected based on position, health status and current team. Ensuring to give the data needed in the study.

3. Pre-Test Jump Explosiveness Assessment: Vertical jump test was conducted as baseline measurement. The research gave a verbal explanation of the jump test and a physical demonstration by a research assistant, the participants' standing reach height was measured, and from a standing position, they will attempt to jump three jumps as high as possible to the Vertec vanes. The highest jump will be recorded as their baseline.

4. Group Assignment: Participants were divided into two (2) groups; control group I and control group group II, each consisting of one (1) setter and (1) libero that will perform a different set of plyometric exercises for each group.

5. Plyometrics Intervention: A distinct set of plyometric exercises will be performed by the control group. Weighted box jumps (1 kilograms) and side-to-side box shuffles will be performed in experiment I, and weighted depth jumps (1 kilograms) and double-leg side-to-side box jumps will be performed in experiment II (Davies et al., 2015, and Ciminelli et al., 2016) with 3 set and 10 repetition. Researchers are sure that participants have rest before doing plyometric exercises and have a 30 second rest interval between exercises.

6. Post-Test Jump Explosiveness Assessment: After the intervention of plyometric exercises both experiment groups will conduct a post-test vertical jump under the same condition as the pre-test. The equipment, and place were consistent to ensure reliable results.

7. Data Collection and Confidentiality: The baseline jumps explosiveness tests are recorded and protected. In order to maintain participant privacy, the results were anonymised.

8. Data Analysis: The collected data was analysed using statistical methods to determine whether the plyometric exercises had a significant difference and effect on jump explosiveness performance of women's volleyball. A comprehensive report was prepared based on the finding

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A distinct set of plyometric exercises will be performed by the control group. Weighted box jumps (1 kilograms) and side-to-side box shuffles will be performed in experiment I, and weighted depth jumps (1 kilograms) and double-leg side-to-side box jumps will be performed in experiment II (Davies et al., 2015, and Ciminelli et al., 2016) with 3 set and 10 repetition. Researchers are sure that participants have rest before doing plyometric exercises and have a 30 second rest interval between exercises.

6. Evaluation and Iteration

This study used a quantitative research approach to gather and analyse the data from the vertical jump test made by the participants before and after the 4-week intervention

7. Conclusion and Next Steps

For the significant effect between the pretest and post-test on the level of jumping explosiveness, the control group A made an increase, but these changes didn’t attain the said measurement to be called significant effect. While the control group B made a decline in the performance and had no significant difference.

Researchers suggest the following for future research on how plyometric effective on jump explosiveness to the performance of athletes. It is recommended enlarging the sample size beyond what the study has offered. Future studies should consider making the intervention last longer than 4 weeks to comprehend potential long-term effects and benefits. The future researcher can use experimental group A results as a baseline and modify them for better training outcomes. The future researcher could include increasing sets and repetitions, raise exercise intensity, or introduce extra weights. This information may be used to guide decisions regarding athletic training regimens, resource allocation, and the overall development of the school's athletic potential. For a more comprehensive investigation, it can help shape sports growth by increasing the effectiveness of plyometric activities in women's volleyball and other sports. Coaches might incorporate the study in the exercises of their training programs to improve jump explosiveness with the use of this knowledge. Athletes will learn about different plyometric programs that could improve their jump explosiveness from the training provided

RESULTS & DISCUSSION

What is the level of jumping explosiveness of the participants before the intervention?

Table 1

	Control Group I		Control Group II	
	Participant 1	Participant 2	Participant 3	Participant 4
Pre test	50cm	57cm	58cm	53cm

The initial jump explosiveness of the participants as indicated in table show range from 50 cm to 58cm between two control groups. The lowest explosiveness jump recorded on control I and the highest is from control II. Vertical jump normative indicates that the range of >70 is excellent, 61-70 is very good, 51-60 above average, 41-50 is average (Woods, 2012) which the control I raw data will categorize as above average and very good and control II categorized as very good for an athlete.

What is the level of jumping explosiveness of the participants after the intervention?

Table 2

	Control Group I		Control Group II	
	Participant 1	Participant 2	Participant 3	Participant 4
Post test	54cm	60cm	56cm	50cm

Table 2 presents the post-test after the intervention of jump explosiveness performance of the participants. The data reveal that the highest jump explosiveness was recorded from control I which is 60cm and the lowest from control II which is 50cm. The recorded jump explosiveness of control I fall under the category of very good and control II fall under very good and above average for an athlete (Woods, 2012)

Is there any significant difference between the pre-test and post-test on the level of jumping explosive?

Table 3

	Mean	**t-value**	**p-value**	**Discussion**	**Remarks**
Pre-test	53.50	-7.0000	0.0903	Do not Reject Ho	Not Significant
Post-test	57.00				

Table 3 shows the jump performance of control group I before and after plyometric training of weighted box jumps and side-to-side box shuffle for four (4) week intervention. The mean jump height on pre-test was 53.50, which increased to 57.00 during post-test. Nevertheless, statistical analysis showed a non-significant difference (t-value = -7.000) (p-value= 0.0903), implying that this increase is statistically not significant

Table 4

	Mean	t-value	p-value	Decision	Remarks
Group I	57.00	0.9428	0.4453	Do not Reject Ho	Not Significant
Group II	53.00				

Table 4 shows the jump performance of control group II; it underwent similar plyometric training using weighted depth jumps and double leg side-to-side box jump. At the beginning of the study, the average jump height achieved stood at 55.50 but declined to 53.00 after the post-test. Statistical analysis also showed a non-significant difference (t-value= 5.0000) (p-value= 0.1257).

After the statistical treatment of data, it was concluded that there is no significant difference between the pretest and post-test of both control group 1 and 2. The p-value for control group II is 0.0903 while for experimental group II is 0.1257, both p-values are below 0.5 which indicates that there is no significant difference between the pretest and post-test of the two experimental groups

The results of pretest 55.50 to 53.00 post-test may be due to fatigue, in inline to the study of Aquino et al, (2022), The impact of fatigue on performance can be detected through the decrease in power production, directly correlating to a decrease in force production during vertical test. Additionally, the stressed Athletes encounter significant stress due to rigorous training, and lifestyle factors. These challenges often result in both acute and residual fatigue, which can impact performance and overall well-being (Doherty et al., 2021).

Is there any significant difference between the post-test on the level of jumping explosiveness of the participants?

Table 5
Post-Test of Jump Performance

	Mean	t-value	p-value	Decision	Remarks
Group I	57.00	0.9428	0.4453	Do not Reject Ho	Not Significant
Group II	53.00				

Table 5 shows the jump explosiveness after the intervention of both control groups. Control I with mean of 57.00 and control II is 53.00 The results showed that there are no significant differences between the post test of control group I

and II as shown on the table (t-value=0.9428) (p-value= 0.4453). This means that regardless of difference in plyometric exercises used, neither program could produce a significant jump improvement for the participants.

Based on the statistical results of our study, the p-value of the two post-tests from control group I and II is 0.4453. It was concluded that there is no significant difference found between the post test of control group I and II. The results align to the study where it said that volume should be increased in a progressive manner to decrease risk of injury or overtraining. Intensity is the actual percentage of effort required by the athlete to perform the activity (Davies et al., 2015). In the study there is no progression of the set and repetition in the study, there is no regression of the set and repetition that can also affect.

CONCLUSION

Based on the information above, the study came to the following conclusion:

After implementing the exercises, the researchers were able to conclude that the majority of the participants' pretest falls under the category of very good for an athlete.

The result of the four (4) week intervention shows that the participants from control group A have made improvements. While the participants from control group B, the results showed decline to their performance; Still the majority of the participants' level of jumping explosiveness falls under the category of very good for an athlete.

For the significant effect between the pretest and post-test on the level of jumping explosiveness, the control group A made an increase, but these changes didn't attain the said measurement to be called significant effect. While the control group B made a decline in the performance and had no significant difference.

For the significant difference between the post-test of the two (2) control groups, the result showed a non-significant effect. Which implies that regardless of the different plyometric exercises used, neither of the programs can produce a significant jump improvement for the participants.

RECOMMENDATIONS

Based on the information summarized above, this study came to the following recommendation:

1. It is recommended enlarging the sample size beyond what the study has offered.

2. Future studies should consider making the intervention last longer than 4 weeks to comprehend potential long-term effects and benefits.

3. The future researcher can use experimental group A results as a baseline and modify them for better training outcomes

4. The future researcher could include increasing sets and repetitions, raise exercise intensity, or introduce extra weights.

5. This information may be used to guide decisions regarding athletic training regimens, resource allocation, and the overall development of the school's athletic potential.

6. For a more comprehensive investigation, it can help shape sports growth by increasing the effectiveness of

plyometric activities in women's volleyball and other sports.

7. Coaches might incorporate the study in the exercises of their training programs to improve jump explosiveness with the use of this knowledge.

8. Athletes will learn about different plyometric programs that could improve their jump explosiveness from the training provided

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