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THE EFFECT OF FAST AND SLOW RHYTHM DOUBLE LEG HOP PROGRESSION TRAINING ON LEG MUSCLE EXPLOSIVE POWER IN VOLLEYBALL ATHLETES OF THE IMPEESA CLUB, NORTH MOROWALI

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ABSTRACT

Explosive power of the leg muscles is essential in volleyball, as it directly influences jumping ability for spiking, blocking, and rapid movements on the court. The purpose of this study was to determine whether fast and slow rhythm double leg hop progression training affects the improvement of leg muscle explosive power. This study used a quasi-experimental method with a pretest–posttest two-group design. The population consisted of 30 volleyball athletes from the North Morowali Impeesa Club, divided equally into two groups: 15 athletes in the fast rhythm double leg hop progression group and 15 athletes in the slow rhythm group. Leg muscle explosive power was measured using the vertical jump test as the primary instrument. The findings indicated that both training methods significantly increased leg muscle explosive power. The fast rhythm group showed an improvement from a mean pretest score of 30.4 to a posttest score of 43.7, resulting in an average increase of 13.3. The slow rhythm group improved from a mean pretest score of 29.4 to a posttest score of 42.2, with an average increase of 12.8. Statistical analysis using a paired sample t-test demonstrated significant improvements in both groups ($p < 0.05$). Additionally, an independent sample t-test showed that the fast rhythm training method had a significantly greater effect compared to the slow rhythm method ($p < 0.05$). Therefore, fast rhythm double leg hop progression training is more effective than slow rhythm training in enhancing leg muscle explosive power among volleyball athletes.

Keyword: Volleyball, Double Leg Hop Progression Training, and Explosive Leg Muscle Power.

INTRODUCTION

Sport is a physical activity oriented toward achieving optimal performance through systematic and measurable training processes. In achievement sports such as volleyball, biomotor components—particularly explosive power—are fundamental determinants of success (Daulay, 2018). Volleyball performance is not only influenced by technical mastery but also by the athlete's physical readiness (Murtono, 2021). Smashing and blocking are highly dependent on vertical jump height generated by the explosive power of the leg muscles. Insufficient leg muscle power limits spike and block effectiveness even when technique is properly executed (Daulay, 2022).

Therefore, structured physical training strategies are essential to enhance competitive performance (Suhairi, 2022).

Plyometric training has consistently been shown to improve lower-body explosive power in volleyball athletes (Ramírez-Campillo et al., 2020; Moran et al., 2021; Slimani et al., 2021; Arazi et al., 2022; Pereira et al., 2023). However, most recent studies focus on training volume, intensity, or surface type, while limited attention has been given to movement rhythm or tempo as a specific training variable. In plyometric exercises such as double leg hop progression, rhythm manipulation (fast vs. slow cadence) may influence stretch–shortening cycle utilization, ground contact time, neuromuscular activation, and reactive strength development. Fast rhythm emphasizes minimal ground contact time and reactive force production, whereas slower rhythm increases time under tension and force control.

Despite evidence supporting plyometrics, there remains scientific debate regarding whether reactive-focused (fast cadence) or force-control–oriented (slower cadence) execution produces greater improvements in explosive power. This gap highlights the importance of examining rhythm as a distinct and novel variable. Investigating cadence differences in double leg hop progression provides practical implications for coaches seeking more precise programming strategies to optimize vertical jump performance in volleyball athletes.

In practice, many volleyball athletes demonstrate good technical proficiency yet exhibit relatively low vertical jump performance, reducing the effectiveness of attacking and defensive actions. High-level volleyball performance is strongly influenced by leg muscle explosive power, as jump height directly determines the success of spiking and blocking (Irfandi, 2022). To address this gap, plyometric training has been widely applied to enhance neuromuscular efficiency and optimize the stretch–shortening cycle (SSC), which plays a central role in explosive jump actions. Recent international evidence confirms that plyometric interventions significantly improve vertical jump height and lower-body power in volleyball and team-sport athletes (Ramírez-Campillo et al., 2020; Moran et al., 2021; Slimani et al., 2021; Pereira et al., 2023; Arazi et al., 2022).

Among various plyometric forms, double leg hop progression was selected because it closely replicates bilateral take-off mechanics commonly used in volleyball jumping. This exercise emphasizes repeated SSC activation, ground reaction force optimization, and reactive strength development, making it biomechanically relevant to spike and block movements. However, beyond exercise selection, movement rhythm represents a critical yet underexplored variable. Fast rhythm execution emphasizes minimal ground contact time and reactive force production, potentially enhancing SSC efficiency and neural firing frequency. In contrast, slow rhythm execution increases time under tension and force control during the eccentric–concentric transition. Despite growing research on plyometric volume and intensity, limited studies have directly compared cadence manipulation as a determinant of explosive power adaptation. Therefore, investigating fast and slow rhythm double leg hop progression provides methodological novelty and practical implications for optimizing vertical jump performance in volleyball athletes.

Plyometric training is widely recognized as an effective method to enhance explosive power through optimization of the stretch–shortening cycle (SSC). This method emphasizes rapid transitions from eccentric to concentric muscle actions, improving neuromuscular efficiency, motor unit recruitment, and elastic energy reutilization (Karo-Karo et al., 2022). Recent evidence confirms that plyometric interventions significantly improve vertical jump performance and lower-body power in volleyball athletes (Ramírez-Campillo et al., 2020; Moran et al., 2021; Slimani et al., 2021; Pereira et al., 2023; Arazi et al., 2022). Mechanistically, performance gains occur through improved reactive strength, increased musculotendinous stiffness, and enhanced rate of force development (RFD), all of which are critical for explosive jumping actions in volleyball.

Among various plyometric forms, double leg hop progression was selected due to its biomechanical similarity to bilateral take-off patterns in spike and block movements. The manipulation of movement rhythm (fast vs. slow cadence) represents a theoretically meaningful variable. Fast rhythm execution aims to minimize ground contact time (GCT) in order to maximize elastic energy efficiency and reactive SSC utilization, thereby enhancing explosiveness. Conversely, slower rhythm execution may place greater emphasis on RFD by prolonging eccentric phase control, increasing time under tension, and optimizing force production capacity during the transition phase. Although plyometric training is well established, limited research has directly compared cadence manipulation as a determinant of adaptation.

In the context of North Morowali Impeesa Club athletes, preliminary observations indicated adequate technical skill but suboptimal jump height and reactive performance. Training sessions also lacked structured explosive power programming. Therefore, examining fast and slow rhythm double leg hop progression training is not merely exploratory, but grounded in biomechanical theory and practical performance needs within the club setting.

METHOD

This study is quantitative and employs an experimental research method to determine the effect of specific training treatments under controlled conditions (Zaqiyah, 2024). The research design used is a pretest–posttest two-group experimental design, involving initial measurements before treatment to obtain accurate baseline data and final measurements after the intervention (Triastuti, 2022). The independent variable consists of fast-cadence and slow-cadence double leg hop progression training, while the dependent variable is leg muscle explosive power. Explosive power was measured using the Vertical Jump Test (Sargent Jump Test), which is widely used to assess lower-body power.

The research was conducted at the Impeesa Club Volleyball Court in North Morowali, Beteleme Village (94966), over eight weeks: one week for pretest preparation, six weeks of treatment, and one week for posttest and reporting. The training program was conducted three times per week. Each session consisted of 4–6 sets of double leg hop progression exercises, with 8–12 repetitions per set. Training intensity was categorized as moderate to high intensity, emphasizing maximal effort in each jump. The fast-cadence group performed movements with minimal ground contact time to optimize reactive strength, whereas the slow-cadence group performed jumps with longer ground contact time to emphasize force control. Rest intervals between sets ranged from 60–90 seconds to allow adequate recovery while maintaining training stimulus. This structured manipulation of volume, intensity, and rest ensured that the intervention specifically targeted improvements in leg muscle explosive power.

The participants of this study were 30 male volleyball athletes from the North Morowali Impeesa Club (age range: 18–22 years; training experience: more than 2 years). All participants were actively involved in regular club training and were physically healthy during the research period. The inclusion criteria required athletes to be registered club members, participate consistently in training sessions, have no lower-limb injuries in the last six months, and be willing to follow the six-week training program. Because the total population consisted of fewer than 100 athletes, this study applied a Total Sampling technique, meaning all 30 athletes were included as research subjects.

After the pretest was conducted using the Vertical Jump Test, the participants were ranked based on their scores. The sample was then divided into two experimental groups using the Ordinal Pairing method, ensuring that both groups had relatively equal initial abilities. Fifteen athletes were assigned to the fast rhythm double leg hop progression group and fifteen athletes to the slow rhythm group.

The instrument used to measure leg muscle explosive power was the Vertical Jump Test (Sargent Jump Test). This test was selected because it is widely recognized as a valid and reliable measure for assessing lower-body explosive power in volleyball players (Markovic, 2007; Ramirez-Campillo et al., 2015). Explosive leg power is essential in volleyball performance, particularly in executing effective jumps for smashing and blocking (Haetami, 2021).

RESULTS

The following table presents complete pretest and posttest vertical jump data for volleyball athletes from the Impeesa Morowali Utara Club who participated in fast and slow rhythm double leg hop progression training. The data are combined into one table to facilitate clearer comparison between both training groups.

No	Group	Pretest (cm)	Posttest (cm)
1	Fast Rhythm	30	52
2	Fast Rhythm	28	40
3	Fast Rhythm	32	45
4	Fast Rhythm	29	39
5	Fast Rhythm	31	41
6	Fast Rhythm	27	46
7	Fast Rhythm	33	40
8	Fast Rhythm	30	50
9	Fast Rhythm	34	51
10	Fast Rhythm	29	39
11	Fast Rhythm	28	42
12	Fast Rhythm	31	40
13	Fast Rhythm	35	45
14	Fast Rhythm	30	44
15	Fast Rhythm	29	42
16	Slow Rhythm	29	41
17	Slow Rhythm	27	40
18	Slow Rhythm	31	45
19	Slow Rhythm	28	42
20	Slow Rhythm	30	40
21	Slow Rhythm	26	39
22	Slow Rhythm	32	51
23	Slow Rhythm	29	33
24	Slow Rhythm	33	45
25	Slow Rhythm	28	43
26	Slow Rhythm	27	39
27	Slow Rhythm	30	43
28	Slow Rhythm	34	50
29	Slow Rhythm	29	40
30	Slow Rhythm	28	42

Table 1. Pretest and Posttest Vertical Jump Results in Fast and Slow Rhythm Double Leg Hop Progression Training

The fast rhythm group showed pretest scores ranging from 27 cm to 35 cm, while posttest scores ranged from 39 cm to 52 cm. The slow rhythm group demonstrated pretest values between 26 cm and 34 cm, with posttest scores ranging from 33 cm to 51 cm. The data indicate improvements in vertical jump performance in both groups after the six-week training intervention.

Based on the data above, a normality test was performed. The normality test was conducted to determine whether the data obtained from the research results were normally distributed. The data in question were the pretest and posttest scores for vertical jump ability. This test was based on the Kolmogorov-Smirnov statistical test. The criteria used were: if the significance value was <0.05, the data were not normally distributed. Conversely, if the significance value was >0.05, the data were normally distributed.

Group & Measurement	Statistic	df	Sig. (p)
Slow Rhythm – Pretest	0.950	15	0.521
Slow Rhythm – Posttest	0.933	15	0.301
Fast Rhythm – Pretest	0.950	15	0.521
Fast Rhythm – Posttest	0.882	15	0.050

Table 2. Shapiro–Wilk Normality Test Results

All p-values ≥ 0.05, indicating that the data are normally distributed and meet the assumptions for parametric testing (paired and independent samples t-test).

Group	Mean Difference (cm)	t	df	Sig. (2-tailed)
Slow Rhythm	-12.800	-15.227	14	0.000
Fast Rhythm	-13.333	-11.730	14	0.000

Table 3. Paired Sample t-Test Results for Fast and Slow Rhythm Groups

According to the table above, it can be seen that the calculated t value for slow rhythm is -15.227 in the t test, the plus minus sign is not considered so that the value of 15.227 > 1.761, so it can be concluded that Ho is rejected and Ha is accepted, meaning that the Slow Rhythm Double Leg Hop Progression Training has a significant effect on the Explosive Power of Leg Muscles in Volleyball Athletes of the Impeesa Morowali Utara Club.

Then in the table it is also found that the t value for Fast Rhythm is -11.730 in the t test, the plus minus sign is not considered so that the value of 11.730> 1.761, so it can be concluded that Ho is rejected and Ha is accepted, meaning that the Fast Rhythm Double Leg Hop Progression Exercise has an effect on the Explosive Power of Leg Muscles in Volleyball Athletes of the Impeesa Morowali Utara Club.

Based on the comparison, it is known that the significant value of the two training methods is 0.00 < 0.05 according to the basis of decision-making ability in the paired samples test, so it can be concluded that the fast and slow rhythm double leg hop progression training method has a significant influence on the explosive power of the leg muscles in volleyball athletes from the North Morowali Impeesa club. To determine the difference in influence between the two exercises, an Independent Samples t-Test was used on the gain score:

Group	Mean Gaian	Sig. (2-tailed)
Fast Rhythm	13.33	0.709
Slow Rhythm	12.80	0.709

Table 4. Independent Samples Test Results

When the Sig. value is > 0.05, there is no significant difference in the effect between fast and slow cadence training. Although the mean gain of fast cadence is slightly higher (13.33 vs. 12.80), this difference is not statistically significant.

DISCUSSION

This study aims to examine the effect of fast and slow rhythm Double Leg Hop Progression training on increasing leg muscle explosive power as measured by the vertical jump test. Prior to hypothesis testing, data normality was confirmed using the Kolmogorov–Smirnov test ($p > 0.05$). The fast rhythm group improved from 27–35 cm (pretest) to 39–52 cm (posttest), with a mean increase of 13.33 cm ($t = -11.730$; $p = 0.000$). The slow rhythm group improved from 26–34 cm to 33–51 cm, with a mean increase of 12.80 cm ($t = -15.227$; $p = 0.000$). Levene's Test showed homogeneous variance ($F = 2.247$; $p = 0.145$). Independent samples t-test indicated no significant difference between groups ($p = 0.709$), although descriptively the fast rhythm group showed slightly greater improvement.

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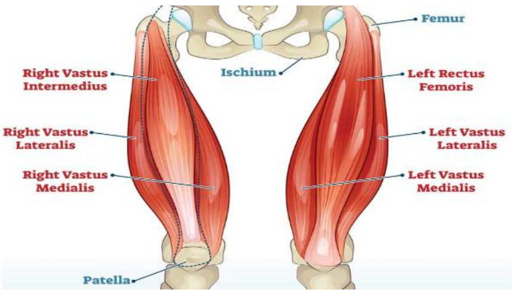

Figure 1. Thigh Muscle Anatomy
Source: (Kissam., 2020)

Double Leg Hop Progression activates major lower-limb muscles including the quadriceps, hamstrings, gluteus maximus, and gastrocnemius. From a biomechanical standpoint, rhythm manipulation affects ground contact time (GCT), tendon stiffness, and rate of force development (RFD). Fast rhythm execution minimizes GCT, enhancing musculotendinous stiffness and reactive strength through rapid stretch–shortening cycle (SSC) utilization. Increased tendon stiffness improves elastic energy return and jump efficiency (Pereira et al., 2023; Slimani et al., 2021).

Conversely, slow rhythm execution prolongs the eccentric phase, increasing time under tension and potentially enhancing force production and RFD. According to the force–velocity compensation theory, power can be improved either by increasing force output (slower tempo emphasis) or by enhancing contraction velocity (faster tempo emphasis). Recent findings show that both reactive-focused and force-oriented plyometric strategies can produce comparable improvements in vertical jump performance (Ramírez-Campillo et al., 2020; Arazi et al., 2022; Moran et al., 2021).

This explains why slow rhythm training was statistically as effective as fast rhythm training. Although neuromuscular adaptations may differ stiffness dominant versus force dominant mechanisms the overall outcome in jump height was similar. For coaches, rhythm selection can be tailored to athlete profiles: fast cadence for athletes needing improved reactivity and reduced GCT; slow cadence for athletes requiring greater eccentric control and force production. Periodizing both rhythms within a training cycle may optimize explosive adaptations while reducing overuse risk.

CONCLUSION

This study aims to analyze the effect of double leg hop progression training with fast and slow rhythms on the explosive power of volleyball athletes' leg muscles. The participants were intermediate-level male volleyball athletes (age 18–22 years) with more than two years of structured training experience at the North Morowali Impeesa Club. Based on the results, double leg hop progression training, whether performed with fast or slow rhythms, was effective in increasing leg muscle explosive power. These findings indicate that plyometric training with a progressive bilateral jumping pattern produces positive neuromuscular adaptations that enhance vertical jump performance in athletes with a moderate training background.

The study also concluded that there was no significant difference between fast- and slow-cadence double leg hop progression training in improving explosive leg muscle power. Manipulation of rhythm in this exercise did not significantly alter the explosive adaptation profile in intermediate-level volleyball athletes. Both cadences appear to stimulate comparable improvements, likely through different but compensatory neuromuscular mechanisms related to force production and stretch–shortening cycle efficiency.

The findings should be interpreted within the context of the six-week intervention and the moderate training intensity applied. Different outcomes might emerge if the training duration were extended, the intensity increased, or if the program were applied to elite or novice athletes

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with different neuromuscular characteristics. Double leg hop progression can therefore be recommended as an effective plyometric method for improving explosive leg muscle power, while rhythm variation may be adjusted according to program design without substantially affecting overall adaptation in athletes of similar proficiency levels.

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