

# Plyometric Stair Jump and Reaction Box Jump to Improve the Frequency of Straight-forward Kicks in *Pencak Silat* Athletes

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**Abstract** *Pencak Silat* basic technique mastery, either in art or fighting criteria, must be supported by ultimate physical condition. Straight-forward kick is one of the attacking modes that would be effective if supported by good leg muscle power. The objective of the study was to describe the plyometric training effectiveness on the straight-forward kick frequency. It was quasi-experiment research in which the samples were 30 junior male athletes of *Pencak Silat*. The 10-second straight-forward kick speed test was utilized as the instrument to determine the kick frequency. The researchers utilized paired t-test samples and One Way Anova with a significant score of  $p < 0.05$  to analyze the data. The research finding showed a significant effect from two plyometric training to the straight-forward kicks. No significant difference was found between the plyometric stair jump training and the box jump reaction. Further research is expected to describe the same training for both sexes at the adolescence level, so a comprehensive result could be used as guidance to train junior *Pencak Silat* athletes.

**Keywords** Plyometric, Straight-forward Kick, *Pencak Silat*

## 1. Introduction

*Pencak silat*, as one of Indonesia's original sports, reflects Indonesia's noble values or character. As formulated by IPSI and BAKIN in 1975, *Pencak Silat* is an Indonesian culture that aims at maintaining and defending the existence (independence) and the environment truthfulness to attain harmony and improve the quality of the faith in God [1]. As a sport, *Pencak Silat* improves physical quality and strengthens character since childhood [2]. The common characteristic of the Indonesian *Pencak Silat* is utilizing all parts of the body for the self-defend does not need a particular weapon because anything can be used as a weapon, such as wood, hammer, sand, umbrella, broom, or shawl. Moreover, *Pencak Silat* grew harmoniously with the environment, with courteous manners, characters, religion and beliefs [3]. The specific characteristics are calm, relaxed, alertness, utilizing agility, flexibility, speed, timing to the right target, quick response to eliminate the opponent, does not depend on strength and power, utilizing the principle of "body weight", position movement by changing the body weight transfer, utilizing every attack and power of the opponent, minimizing the power and economical [3].

The growth of *Pencak Silat* is high across Indonesia [4]. Moreover, the Minister of Youth and Sports of the Republic of Indonesia has established *Pencak Silat* as one of the fourteen Indonesian featured sports in the Olympics and Paralympics. It affects the development process (including the training process) that must be based on sports science. Physical condition is one of the supporting indicators of the ultimate athlete's performance during training or competition [5]. It includes cardiovascular endurance, strength, flexibility, speed, and power [6]. Considering the characteristic of *Pencak silat*, which consists of art and fighting criteria [7], the athlete of *Pencak silat* must have good physical condition [5] to perform all *silat* techniques optimally, such as punch, kick, sweep or slam. Based on previous findings, if the physical condition is not trained sustainably and systematically, there will be a significant decline [8]. Therefore, a systematic and sustainable training process is a must to maintain and improve performance.

There is much previous research concerning *Pencak silat*, such as training methods to improve the capacity of cardiovascular endurance of the *Pencak silat* athlete [9], to improve core strength muscle, and dynamic balance [10]. Besides that, there is also research related to the leg muscle power effect on cycle kick performance [11], the leg muscle power effect on straight kick skill [12], and the training method that has a significant effect on *Pencak silat* kicking skill [13].

Considering that leg muscle power has a positive and strong correlation to kick performance in *Pencak silat*, it is important to study the plyometric training method in improving the frequency of straight-forward kicks. In conducting straight forward kick, the *Pencak silat* athlete must use power with strong and fast movement characteristics to produce a maximum kick. Plyometric training generally requires functions such as body weight and earth gravity [14]. Plyometric training is also called special training that aims at enhancing the combination of maximum and explosive power [15]. The forms of plyometric training are stair jump and reaction box jump. The plyometric stair jump is a training jump to the stair sequentially, explosive, and conducted in the condition of high joint flexibility when landing [16]. The plyometric reaction box jump is a form of plyometric training by doing an explosive jump to a wooden box after receiving a sound or visual stimulus [16].

Although some researchers have reported the effect of

plyometric training on the physical condition component, especially muscle power, there is no study about the effect of plyometric training on the straight-forward kick by the junior athlete of *Pencak silat*. Similar studies have been conducted previously on volley, karate, football, basketball, and taekwondo. Therefore, this study was conducted to determine the effectiveness of plyometric stair jump and plyometric reaction box jump training on the straight-forward kick frequency of the junior athlete of *Pencak silat*.

The study's urgency affects the training methods selection used by the coach of *Pencak silat* to improve the frequency of straight-forward kicks by using both training methods.

## 2. Materials and Methods

### 2.1. Participants

This study involved 30 male-junior *Pencak silat* athletes from the Satria Muda Indonesia Bali martial art school (age =  $15.3 \pm 2.0$  years). The researchers selected those samples through a random sampling technique.

### 2.2. Research Design

This study can be classified as a quasi-experimental research that followed a pre-test-post-test group design (Table 1). The training was conducted within eight weeks (3 times a week = 24 training). Before the training, the stair jumps group and reaction box jump group were tested by fast kicking as many as possible in 10 seconds. Afterwards, they were trained for 24 weeks (Table 2 and Table 3). In the 25<sup>th</sup> week, both groups were tested again to perform fast kicking as many as possible in 10 seconds with a reliability score of 0.87 and content validity by face validity [17].

Table 1. Pre-test-post-test group design

Sample	Pre Test	Treatment	Post Test
N	O <sub>1</sub>	X	O <sub>2</sub>
N	O <sub>3</sub>	X	O <sub>4</sub>

Notes: N = Random Sampling; X = Treatment in the experimental group; O<sub>1</sub> = stair jump group pre-test; O<sub>2</sub> = stair jump group post-test; O<sub>3</sub> = reaction box jump group pre-test; O<sub>4</sub> = reaction box jump group post-test

**Table 2.** Training Program of Plyometric Stair Jump

Week	Day	Repetition	Set	Intensity (%)	HR-Training	HR-Recovery
I	1	5	3	70	140 – 150	110 – 120
	2	5	4			
	3	5	5			
II	4	6	3	75	150 – 160	110 – 120
	5	6	4			
	6	6	5			
III	7	7	3	80	160 – 170	110 – 120
	8	7	4			
	9	7	5			
IV	10	6	3	85	170 – 180	110 – 120
	11	6	4			
	12	6	5			
V	13	6	3	75	150 – 160	110 – 120
	14	6	4			
	15	6	5			
VI	16	7	3	80	160 – 170	110 – 120
	17	7	4			
	18	7	5			
VII	19	8	3	85	170 – 180	110 – 120
	20	8	4			
	21	8	5			
VIII	22	7	3	80	170 – 180	110 – 120
	23	7	4			
	24	7	5			

**Table 3.** Training Program of Plyometric Reaction Box Jump

Week	Day	Repetition	Set	Intensity (%)	HR-Training	HR-Recovery
I	1	5	3	70	140 – 150	110 – 120
	2	5	4			
	3	5	5			
II	4	6	3	75	150 – 160	110 – 120
	5	6	4			
	6	6	5			
III	7	7	3	80	160 – 170	110 – 120
	8	7	4			
	9	7	5			
IV	10	6	3	85	170 – 180	110 – 120
	11	6	4			
	12	6	5			
V	13	6	3	75	150 – 160	110 – 120
	14	6	4			
	15	6	5			
VI	16	7	3	80	160 – 170	110 – 120
	17	7	4			
	18	7	5			
VII	19	8	3	85	170 – 180	110 – 120
	20	8	4			
	21	8	5			
VIII	22	7	3	80	170 – 180	110 – 120
	23	7	4			
	24	7	5			

## 2.5. Statistical Analysis

Considering the effect of plyometric stair jump training or reaction jump box training that has been given (significantly affecting or not) so the authors used paired sample t-test with a significant level of  $p < 0.05$ . This test was conducted after the samples were tested after the normality test by using the Kolmogorov-Smirnov test and Shapiro-Wilk test. The researchers applied Levene's Test of Equality of Error Variances to test the data

homogeneity. Afterwards, to describe the significant value differences between the two training models, the authors utilized the One Way Anova test.

## 3. Result

The general description of the research findings showed the frequency distribution, comparison of the mean score, and deviation standard of the plyometric stair jump

training and plyometric reaction box jump training to the respective groups.

### 3.1. Description of Pre-test and Post-test Frequency of the Straight-forward Kick on the Plyometric Stair Jump Training Group

The general description of the result of the pre-test and post-test consisted of frequency distribution, distribution of mean score ( $\bar{X}$ ), and deviation standard based on the plyometric stair jump training method. The calculation of the mean score, deviation standard, and variance are shown in Table 4.

**Table 4.** Recapitulation of the straight-forward kick frequency of the plyometric stair jump group

Statistics	A1	A2
Mean Score	20.20	23.13
Median	20.00	23.00
Deviation standard	3.075	3.226
Variance	9.457	10.410
Minimum Score	16	17
Maximum Score	25	28
Range	9	11
Total	303	347

Note: A1 = Pre-test of straight forward kick frequency; A2 = Post-test of straight forward kick frequency

### 3.2. Description of Pre-test and Post-test Frequency of the Straight Forward Kick on the Plyometric Reaction Box Jump Training Group

The general description of the result of the pre-test and post-test consisted of frequency distribution, distribution of mean score ( $\bar{X}$ ), and deviation standard based on the plyometric reaction box jump training method. The calculation of the mean score, deviation standard, and variance are shown in Table 5.

### 3.3. Normality Test

The normality test was intended to test the normality of the collected data. It was conducted by using the Kolmogorov-Smirnov test and the Shapiro-Wilk test. The testing criteria were that the data had normal distribution if the significant values were more than 0.05. Otherwise, it was not normally distributed. The result of the

normality test is shown in Table 6. Based on Table 6, both Kolmogorov-Smirnov and Shapiro-Wilk test results show that straight-forward kick frequency data were from a normal distribution.

### 3.4. Homogeneity Test

The homogeneity test was conducted to describe the homogeneity of the variance. The homogeneity test of the straight-forward kick frequency utilized Levene's Test of Equality of Error Variances. If the significant level is higher than 0.05, the variance is considered homogenous. Based on table 7, it can be said that the variance between the plyometric stair jump group and the reaction box jump group is homogenous.

### 3.5. Hypothetical Test

When the data have been proven normally distributed and homogenous, the following step was testing the effect of plyometric stair jump and plyometric reaction box jump training on the straight-forward kick frequency by utilizing a T-test (paired sample test). Table 8 shows that there was a significant effect on the plyometric stair jump training group (0.000) or plyometric reaction box jump (0.000). Afterwards, One Way ANOVA analysis was conducted to describe the difference of significant results between the plyometric stair jump and plyometric reaction box jump training. Based on Table 9, it can be seen that the result of the analysis was  $F = 10.442$ , which means that there was a significant difference between the plyometric stair jump and plyometric reaction box jump training to the straight-forward kick frequency.

**Table 5.** Recapitulation of the straight-forward kick frequency of the plyometric reaction box jump group

Statistics	A1	A2
Mean Score	21.87	23.53
Median	23.00	24.00
Deviation standard	2.503	2.973
Variance	6.267	8.838
Minimum Score	18	18
Maximum Score	25	29
Range	7	11
Total	328	353

**Table 6.** The result of the Data Normality Test

	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
	Statistics	df	Sig.	Statistics	df	Sig.
Plyometric stair jump	0.208	15	0.081	0.932	15	0.293
Plyometric reaction box jump	0.192	15	0.141	0.926	15	0.235

**Table 7.** Homogeneity Test Result

Based on	Levene Statistic	df1	df2	Sig.
Mean	0.315	1	28	0.579
Median	0.255	1	28	0.618
Median and with adjusted df	0.255	1	27.917	0.618
trimmed mean	0.318	1	28	0.577

**Table 8.** The result of the T-test (Paired Sample Test)

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Deviation Std.	Error Mean Std.	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Plyometric stair jump-Pretest -Post-test	-2.933	1.033	0.267	-3.505	-2.361	-11.000	14	0.000
Pair 2	Plyometric reaction box jump-Pretest -Post-test	-1.667	1.113	0.287	-2.283	-1.050	-5.801	14	0.000

**Table 9.** The result of the F-test

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	12.033	1	12.033	10.442	0.003
Within Groups	32.267	28	1.152		
Total	44.300	29			

## 4. Discussion

This study aimed to describe the effectiveness of plyometric stair jump training and plyometric reaction box jump training on the straight-forward kick frequency of junior *Pencak silat* athletes. Based on the finding of this study (table 8), plyometric stair jumps training and plyometric reaction box jump training significantly affect the improvement of straight-forward kick frequency in *Pencak silat*. The characteristic of plyometric training is resistance training that uses body weight as the weight that focuses on the utilization of fast muscle contraction period after the muscle experience fast eccentric mode [18]. Many research findings have reported that plyometric training could improve muscle power, such as in junior volleyball athletes [19] and football athletes, especially in improving muscular power and leg strength [20]. The advantage of plyometric training for junior athletes is improving sports performance, being prepared to join the next training or competition, strengthening the bones, and being safe [21]. In other words, plyometric training is safe for junior athletes and could improve muscular power (one of them) from the physical perspective, directly supporting the technical performance of kicking in *Pencak silat*, which of them is straight-forward.

Other research also reported that plyometric training

significantly affects the *momtong dollyo Chagi* Kick of junior taekwondo athletes [21]. There was also an improvement in kicking performance in *Pencak silat* after conducting plyometric training [13]. It means that with the quality of leg muscle power, the kicking performance in martial art sports, including *Pencak silat*, will positively and strongly correlate. Biomechanically, straight-forward kick is done by using one leg (left or right), the kicking position is in front of the body, the body position faces to the front, and the leg swings from below to the up-front [22]. The muscles involved or contracted during the kick are rectus femoris, vastus lateralis, and medialis [23]. Based on the involved movement and muscles in the process of a straight-forward kick in *Pencak silat*, it is appropriate to use a plyometric training model to improve the frequency speed of the kick. The limitation of this research is that there is no strong control on both plyometric training groups, and there is no study on the training experiences of the samples. Second, plyometric exercises are given only one model, namely the jumping movement. So that further research is expected to implement this into a set of plyometric exercises consisting of throwing a medicine ball or dumbbell, push up with hand clap, or using other resistance tools in jumping. This approach (the plyometric set method) will be even more effective for increasing speed, strength or muscle power.

## 5. Conclusions

Based on the findings of this research, it can be concluded that plyometric stair jumps and reaction box jump training are effective methods to improve straight-forward kick frequency of the junior athletes of *Pencak silat*. The researchers or coach may further know about the data concerning the effect of these training methods on different gender. In the adolescence period, hormone development in boys and girls affect performance.

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