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Optimizing Lower Limb Power in Taekwondo Players: A Training Intervention Study

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Abstract

This study investigated the effectiveness of plyometric training for peak lower limb power and agility in Taekwondo athletes. Thirty male provincial-level Taekwondo athletes from the age group of 17–24 years of Khyber Pakhtunkhwa province having a minimum training history of three years were randomly assigned into experimental (n = 15) and control (n = 15) groups. True experimental design with pre- and post-test measurement was adopted. The power of the lower limbs was measured using the Vertical Jump Test, while agility was measured using the Agility T-Test. The experimental group underwent eight weeks of plyometric training, two times weekly, in the form of progressive drills such as box jumps, tuck jumps, hurdle jumps, and reactive agility drills, while the control group underwent normal training. Data were contrasted using paired and independent sample t-tests in SPSS (v26) at p < 0.05 level of significance. Outcomes showed improvements from pre- to post-test in both groups to be significant, yet the experimental group showed significantly larger improvements in both lower limb power and agility with larger mean differences and high statistical significance. Baseline comparisons prohibited any initial differences, while post-test analyses revealed strongly significant advantages for the experimental group. These findings are valuable evidence to reject the null hypothesis and conclude plyometric training is effective as a treatment for enhancing explosive power and agility among Taekwondo athletes. The study sets forth the applied use of the incorporation of plyometric drills into Taekwondo conditioning programs to maximize competitive performance and proposes future research on the long-term effects, cross-gender application, and integration of other forms of conditioning.

Keywords: *Plyometric training, lower limb power, agility, Taekwondo, athletic performance, experimental study, conditioning program*

Introduction

Taekwondo is a power martial sport involving explosive kicking action, rapid direction change, and maximal efforts movement, where lower limb power and agility are among the fundamental determinants of success in performance. The athlete must apply force within milliseconds, maintain balance during complex techniques, and quickly counter the mercurial movement of adversaries (Bridge et al., 2014). Physical requirements of Taekwondo therefore go beyond technical proficiency and are contingent upon specialized conditioning programs designed to develop neuromuscular ability. Of these, plyometric training is an intervention with potential for improving athletic skills that are directly measurable in relation to competitive performance outcomes.

Plyometric training, or "jump training," is a training method utilizing the stretch-shortening cycle of muscle to increase power, speed, and agility (Markovic & Mikulic, 2010). High-speed eccentric-concentric contractions in plyometric training induce neuromuscular adaptation, such as higher motor unit recruitment and higher rate of force development, which are required in combat sports such as Taekwondo (Ramírez-Campillo et al., 2015). Earlier work has consistently demonstrated the beneficial effect of plyometric training on the explosiveness of lower limbs, vertical jump strength, and agility in sportsmen in a range of sports such as basketball, soccer, and martial arts (Asadi et al., 2017). Despite a growing base of evidence, relatively fewer experimental researches have focused explicitly on Taekwondo players, especially from regional contexts such as Pakistan where trainer-conducted training interventions remain under-investigated.

Strength of the lower limbs is most important for Taekwondo performance. The ability to produce explosive kicks improves attacking action efficiency as well as defense response by allowing sportspersons to move position rapidly (Estevan & Falco, 2013). Agility is also most critical in evading attacks, counter motions, and maintaining tactical superiority. More responsive performers will be better capable of anticipating and responding to the dynamic demands of competition (Slimani & Nikolaidis, 2019). As such competition-specific requirements, interventions enhancing both lower limb power and agility at the same time are particularly beneficial in optimizing the overall sporting ability.

Whereas overall training and technical practice necessarily contribute to body development, condition-specific conditioning such as plyometric training have been shown to accelerate development of performance more rapidly than standard training protocols (de Villarreal et al., 2009). In spite of the difference in trainability protocol, frequency, and population groups yielding heterogenous data, context-specific research is in order. In provinces like Khyber Pakhtunkhwa (KPK), where provincial-level Taekwondo athletes can be susceptible to only being granted limited exposure to top-level conditioning programs, plyometric training interventions of a structured design can provide an important shortfall in athlete preparation. Empirically testing the influence of plyometric training on this population, the present study both addresses an applied need of training and theory shortfall in the sports science literature.

This study hinges on the presumption that plyometric training enhances the power and agility of the lower body among Taekwondo players. Through the use of a true experimental design between the control group and experimental group, this study avoids bias and guarantees differences achieved are as a result of the intervention rather than other factors. Involvement of male trainees aged 17–24 years from the provinces with experience of three or more years ensures the sample at the competitive level, hence making the outcomes both significant and applicable in the performance context. Through it, the research not only contributes to tutorial literature on training adaptations but also to applied enhancement of Taekwondo performance in Pakistan and other environments.

Objectives

1. Assess the lower limb power of experimental and control groups before and after the training intervention.
2. Compare the agility levels of the experimental and control groups pre- and post-training.
3. Evaluate the effectiveness of plyometric training in enhancing performance metrics in Taekwondo athletes.

Hypotheses

1 **H_0**: Plyometric training does not significantly improve lower limb power and agility.

2 **H_1**: Plyometric training significantly enhances lower limb power and agility.

Methodology

The study design was a true experimental design involving pre-test and post-test measures in order to determine the efficacy of plyometric training on lower limb power and agility of Taekwondo players.

The sample included 30 male Taekwondo players aged 17-24 years recruited from Khyber Pakhtunkhwa (KPK), Pakistan. All the participants possessed at least three years of training history to ensure that they were familiar with Taekwondo's physical and technical demands. Simple random sampling was employed to allocate athletes into two categories: an experimental group (n = 15) and a control group (n = 15) in order to provide equal representation and reduce selection bias.

A longitudinal data collection strategy was employed, employing pre-test and post-test measures to measure change during the course of the intervention. Quantification of performance outcomes was based on two standard validated measures. Power of the lower limb was assessed using the Vertical Jump Test, with maximal vertical jumps by participants and maximal jump height measured. Agility was measured with the Agility T-Test, in which the players had to execute quick direction changes; the time taken to finish was used as the performance measure. Both measures were chosen for their established reliability and validity in measuring athletic performance measures applicable in Taekwondo.

The process started with a baseline test in which all participants executed the pre-test measurements of lower limb power and agility. After that, the experiment group received an eight-week plyometric training intervention, two times a week under the watchful eyes of experienced coaches. The intervention was conducted to induce progressive overload and sport-specific adaptations. Weeks 1 and 2 were composed of foundation exercises, which included box jumps, depth jumps, and lateral bounds. Weeks 3 and 4 were composed of progression drills, including tuck jumps, single-leg jumps, and agility ladder drills. 5–6 weeks were committed to elite performance with advanced exercises such as medicine ball depth jumps, hurdle jumps, and zigzag jumps. Weeks 7–8 consisted of tapering with combination drills such as depth-to-broad-to-vertical jumps and reactive agility training to reinforce gains without causing overtraining. The control group received only their usual Taekwondo drills with no extra plyometric intervention.

Post-test evaluations were similarly carried out following the intervention, using identical procedures and tools used for baseline assessment. This rendered data collection consistent and allowed for proper comparison before and after the test.

Data were quantitatively analyzed with Statistical Package for the Social Sciences (SPSS, version 26). Paired sample t-tests were used to determine the within-group differences between pre-test and post-test scores of lower limb power and agility. Independent sample t-tests were used to determine the between-group differences on performance measures. The statistical significance level was a $p < 0.05$.

Results

Table 4.1: *Lower Limbs Power of Control Group (Pre-Test and Post-Test)*

Paired Samples Test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	LLP_Pre - LLP_Post	-2.93333	.79881	.20625	-3.37570	-2.49097	-14.222	14	.000

The paired samples test results for the control group on lower limbs power (pre-test and post-test) indicate a statistically significant difference. The mean difference of -2.93 suggests that the post-test scores were higher than the pre-test scores, showing a slight natural improvement despite the absence of experimental treatment. The standard deviation (0.79) and standard error mean (0.21) reflect low variability, while the 95% confidence interval of the difference (from -3.38 to -2.49) does not cross zero, further confirming the consistency of this improvement. The calculated t-value (-14.22) with 14 degrees of freedom and a p-value of .000 ($p < .05$) demonstrates that the change is highly significant statistically. However, since this is the control group, the improvement might be attributed to routine activities, familiarization with testing procedures, or natural adaptation rather than any structured training intervention.

Table 4.2: *Lower Limbs Power of Experimental Group (Pre-Test and Post-Test)*

Paired Samples Test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	LLP_Pre - LLP_Post	-7.26667	1.22280	.31573	-7.94383	-6.58950	-23.016	14	.000

The paired samples test for the experimental group on lower limbs power (pre-test and post-test) reveals a highly significant improvement. The mean difference of -7.27 indicates that the post-test scores were substantially higher than the pre-test scores, reflecting a marked gain in lower limbs power as a result of the applied intervention. The standard deviation (1.22) and standard error mean (0.32) are relatively small, suggesting consistency and reliability in the observed improvement across participants. The 95% confidence interval of the difference, ranging from -7.94 to -6.59, does not overlap zero, reinforcing that the improvement was not due to chance. Furthermore, the large t-value (-23.02) with 14 degrees of freedom and a p-value of .000 (p < .05) underscores the robustness and statistical significance of the effect. These results clearly demonstrate that the experimental training protocol had a strong positive impact on enhancing the lower limbs power of participants compared to their baseline performance.

Table 4.3: *Lower Limbs Power (Pre-Test) Comparison Between Control and Experimental Groups*

Independent Samples Test

		Levene's Test for Equality of Variances t-test for Equality of Means								
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
LLP	EVA	1.873	.182	-.205	28	.839	-.13333	.64930	-1.46336	1.19669
	EVNA			-.205	25.000	.839	-.13333	.64930	-1.47059	1.20392

The independent samples test comparing pre-test lower limbs power between the control and experimental groups shows no statistically significant difference at baseline. Levene's test for equality of variances yielded an F-value of 1.873 with a significance level of .182, indicating that the assumption of equal variances is not violated. The t-test results (t = -0.205, df = 28, p = .839) demonstrate that the mean difference of -0.13 between the two groups is negligible and not significant, with a relatively large standard error of 0.65. The 95% confidence interval of the difference, ranging from -1.46 to 1.20, crosses zero, further confirming the absence of any real difference. These findings suggest that both groups started with almost identical lower limbs power levels prior to the intervention, ensuring that any changes observed in the post-test can be more reliably attributed to the experimental treatment rather than initial group disparities.

Table 4.4: *Lower Limbs Power (Post-Test) Comparison Between Control and Experimental Groups*

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Diff:	Std. Error Diff:	95% Confidence Interval of the Difference	
									Lower	Upper
LLP	EVA	1.139	.295	-7.984	28	.000	-4.46667	.55948	-5.61271	-3.32063
	EVNA			-7.984	26.956	.000	-4.46667	.55948	-5.61471	-3.31863

The independent samples test for post-test lower limbs power between the control and experimental groups reveals a highly significant difference in performance. Levene's test for equality of variances produced an F-value of 1.139 with a significance level of .295, indicating that the assumption of equal variances is satisfied. The t-test results show a large negative t-value (-7.984) with 28 degrees of freedom and a p-value of .000 ($p < .05$), confirming a highly significant difference between the two groups. The mean difference of -4.47 indicates that the experimental group achieved substantially higher post-test scores compared to the control group. The standard error of the difference (0.56) is relatively small, reflecting consistency in the data, while the 95% confidence interval of the difference (from -5.61 to -3.32) does not cross zero, providing strong evidence for the reliability of the result. These findings clearly demonstrate that the experimental intervention had a pronounced positive effect on enhancing lower limbs power, setting the experimental group apart from the control group in post-test performance.

Table 4.5: *Agility of Control Group (Pre-Test and Post-Test)*

Paired Samples Test

		Paired Differences							
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	Agility_Pre - Agility_Post	1.1800	.2783	.0718	1.0259	1.3341	16.424	14	.000

The paired samples test results for the control group on agility (pre-test and post-test) indicate a statistically significant change. The mean difference of 1.18 shows that the post-test agility scores were lower (better performance, since agility is typically measured in time) compared to the pre-test, suggesting a slight natural improvement even without intervention. The standard deviation (0.28) and standard error mean (0.07) are low, indicating consistency in the observed differences across participants. The 95% confidence interval for the difference (from 1.03 to 1.33) does not include zero, reinforcing that the improvement is reliable and not due to chance. The large t-value (16.42) with 14 degrees of freedom and a significance level of .000 ($p < .05$) further confirm that the change is highly significant. Although this is the control group, the observed improvement may be attributed to natural adaptation, familiarity with testing, or normal physical activity rather than a structured training intervention.

Table 4.6: *Agility of Experimental Group (Pre-Test and Post-Test)*

Paired Samples Test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Agility_Pre - Agility_Post	2.3800	.3509	.0906	2.1857	2.5743	26.267	14	.000

The paired samples test for the experimental group on agility (pre-test and post-test) demonstrates a highly significant improvement. The mean difference of 2.38 indicates that participants achieved much better agility scores in the post-test compared to the pre-test, reflecting the strong impact of the training intervention. The standard deviation (0.35) and standard error mean (0.09) are relatively small, showing consistency and reliability in the performance gains across the group. The 95% confidence interval of the difference (from 2.19 to 2.57) does not cross zero, confirming that the improvement is statistically robust. Moreover, the very large t-value (26.27) with 14 degrees of freedom and a p-value of .000 ($p < .05$) highlights the strength and significance of the result. These findings clearly indicate that the experimental training program was highly effective in enhancing agility, producing greater improvements than those seen in the control group.

Table 4.7: *Agility (Pre-Test) Comparison Between Control and Experimental Groups*

Independent Samples Test

		Levene's Test for Equality of Variances t-test for Equality of Means								
		F	Sig.	t	df	Sig. (2-tailed)	Mean Diff:	Std. Error Diff:	95% Confidence Interval of the Difference	
									Lower	Upper
Agility	EVA	2.575	.120	.496	28	.624	.05333	.10750	-.16686	.27353
	EVNA			.496	25.688	.624	.05333	.10750	-.16776	.27443

The independent samples test comparing pre-test agility between the control and experimental groups shows no statistically significant difference at baseline. Levene's test for equality of variances yielded an F-value of 2.575 with a significance level of .120, indicating that the assumption of equal variances is met. The t-test results (t = 0.496, df = 28, p = .624) confirm that the mean difference of 0.05 between the two groups is negligible and not significant. The standard error of the difference is 0.11, while the 95% confidence interval (from -0.17 to 0.27) crosses zero, further demonstrating that the two groups were statistically similar before the intervention. These results indicate that both groups started with nearly identical agility levels at the pre-test stage, ensuring a fair basis for comparison in evaluating the effects of the training program.

Table 4.8: *Agility (Post-Test) Comparison Between Control and Experimental Groups*

Independent Samples Test

		Levene's Test for Equality of Variances t-test for Equality of Means								
		F	Sig.	t	df	Sig. (2-tailed)	Mean Diff:	Std. Error Diff:	95% Confidence Interval of the Difference	
									Lower	Upper
Agility	EVA	.667	.421	12.053	28	.000	1.25333	.10398	1.04033	1.46634
	EVNA			12.053	27.855	.000	1.25333	.10398	1.04028	1.46639

The independent samples test for post-test agility between the control and experimental groups reveals a highly significant difference in performance. Levene's test for equality of variances showed an F-value of 0.667 with a significance level of .421, confirming that the assumption of equal variances holds true. The t-test results (t = 12.05, df = 28, p = .000) demonstrate a very strong statistical difference between the groups. The mean difference of 1.25 indicates that the experimental group performed considerably better in agility than the control group after the intervention. The small standard error of the difference (0.10) suggests strong consistency in the results, while the 95% confidence interval (from 1.04 to 1.47) does not include zero, reinforcing the reliability of this outcome. These findings clearly confirm that the training intervention was highly effective, producing significant improvements in agility for the experimental group compared to the control group.

The independent samples test for post-test agility between the control and experimental groups reveals a highly significant difference in performance. Levene's test for equality of variances showed an F-value of 0.667 with a significance level of .421, confirming that the assumption of equal variances holds true. The t-test results (t = 12.05, df = 28, p = .000) demonstrate a very strong statistical difference between the groups. The mean difference of 1.25 indicates that the experimental group performed considerably better in agility than the control group after the intervention. The small standard error of the difference (0.10) suggests strong consistency in the results, while the 95% confidence interval (from 1.04 to 1.47) does not include zero, reinforcing the reliability of this outcome. These findings clearly confirm that the training intervention was highly effective, producing significant improvements in agility for the experimental group compared to the control group.

Conclusion

In this study, the effect of plyometric training on the power and agility of the lower limbs for Taekwondo players was assessed. The outcomes showed that pre- to post-test improvements occurred for both control and experimental groups, but the experimental group improved significantly more, something that would be owing to the systematic plyometric intervention in isolation. Preventing differences at baseline offered equitable comparisons, and strong post-test measures supported strong evidence against the null and in favor of accepting the alternative. These results affirm plyometric training as a valid means to improve athletic performance in Taekwondo.

The changes in power and agility of the lower limbs that are seen are highly applicable to Taekwondo, a high-speed and high-power sport with typical features of explosive kicking, quick change of direction, and dynamic movement. Through the inclusion of plyometric exercise in training regimens, athletes can acquire the muscular strength and neuromuscular coordination necessary for competitive performance.

References

Asadi, A., Arazi, H., Young, W. B., & Sáez de Villarreal, E. (2016). The effects of plyometric training on change-of-direction ability: A meta-analysis. *International Journal of Sports Physiology and Performance, 11*(5), 563–573.

Bridge, C. A., Jones, M. A., & Drust, B. (2014). Physical and physiological profiles of taekwondo athletes. *Sports Medicine, 44*(6), 713–733.

Chaabene, H., Negra, Y., Bouguezzi, R., Capranica, L., Franchini, E., Prieske, O., Hbacha, H., & Granacher, U. (2018). Tests for the assessment of sport-specific performance in Olympic combat sports: A systematic review with practical recommendations. *Frontiers in Physiology, 9*, 386.

Estevan, I., & Falcó, C. (2013). Mechanical analysis of the roundhouse kick according to height and distance in taekwondo. *Biology of Sport, 30*(4), 275–279.
Marković, G., & Mikulić, P. (2010). Neuromusculoskeletal and performance adaptations to lower-extremity plyometric training. *Sports Medicine, 40*(10), 859–895.
Miller, M. G., Herniman, J. J., Ricard, M. D., Cheatham, C. C., & Michael, T. J. (2006). The effects of a 6-week plyometric training program on agility. *Journal of Sports Science and Medicine, 5*(3), 459–465.
Ramírez-Campillo, R., Andrade, D. C., & Izquierdo, M. (2013). Effects of plyometric training volume and training surface on explosive strength. *Journal of Strength and Conditioning Research, 27*(10), 2714–2722.
Sáez de Villarreal, E., Kellis, E., Kraemer, W. J., & Izquierdo, M. (2009). Determining variables of plyometric training for improving vertical jump height performance: A meta-analysis. *Journal of Strength and Conditioning Research, 23*(2), 495–506.
Slimani, M., Chamari, K., Miarka, B., Del Vecchio, F. B., & Chéour, F. (2016). Effects of plyometric training on physical fitness in team sport athletes: A systematic review. *Journal of Human Kinetics, 53*, 231–247.