International Journal of Physical Education & Sports Sciences
Vol. 20, Issue No. 1, January-2025, ISSN 2231-3745

DOI: https://doi.org/10.29070/aehraq78

The Impact of Explosive Strength Training on Long Jump and Triple Jump Performance: A Pre-Post Intervention Study

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Abstract: This study investigated the effect of a special explosive strength training plan on the performance and physical capacities of long jump and triple jump athletes. Forty participants underwent pre- and post-training assessments measuring jump distances alongside leg, hand, and abdominal explosive strength. Descriptive statistics revealed marked improvements across all variables following the intervention. Paired t-test analyses confirmed these gains were statistically significant (p < .001) for both jump performance and explosive strength measures. Repeated measures ANOVA further demonstrated significant differences among the types of explosive strength components pre- and post-training (p < .00001), highlighting their distinct contributions to jump performance. The findings emphasize that leg, hand, and abdominal explosiveness each uniquely influence jump outcomes and respond differently to training stimuli. This study underscores the effectiveness of a multifaceted explosive strength regimen in enhancing athletic performance in horizontal jump events. Recommendations include individualized training protocols targeting specific strength deficits and integrating technique work to optimize results. These insights provide valuable guidance for coaches and practitioners aiming to maximize jump performance through evidence-based strength development strategies.

Keywords: Explosive Strength, Long Jump, Athletics, Triple Jump

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INTRODUCTION

To be successful at their best, athletes who emphasize jumping events need to possess a variety of skills, including strength, speed, coordination, and technique. Because it dictates an athlete's take-off velocity and flight trajectory, explosive strength which is defined as having the ability to produce maximum power in just a short period of time is especially important for these sports. While explosive strength training targets white twitch muscle fibres, which is responsible for generating fast muscle contractions, traditional strength training frequently concentrates on increasing muscular strength and stability. Athletes can benefit from more efficient conditioning workouts if they realize how this type of training affects particular performance variables.

Explosive strength, also referred to as explosive power, is a critical component of physical fitness and athletic performance. This specific type of strength is vital in sports and physical activities that require sudden bursts of high-intensity effort, such as sprinting, jumping, throwing, or lifting. Unlike maximal strength, which refers to the highest force an individual can exert, explosive strength is concerned with how quickly that force can be generated. A specialized training program focusing on speed-strength characteristics significantly improved the digital level of triple jump athletes, indicating that targeted

explosive strength training can enhance performance in this event as well **(يحيي et al., n.d.)**.

While explosive strength training, particularly plyometric exercises, has demonstrated clear benefits for jump performance, it is important to consider individual athlete needs and maturity levels. For instance, combined training approaches may be more beneficial for post-PHV athletes, suggesting that training programs should be tailored to the athlete's developmental stage to maximize performance gains (**Lloyd et al., 2016**).

In a study of 8 weeks plyometric training program significantly improved long jump distance compared to traditional training methods. Participants in the plyometric group showed better developments in sprint and jump performance, as well as biomechanical parameters like vertical and horizontal velocity at take-off (**El-Ashker et al., 2019**).

The growing importance placed on scientific training methods in modern sports science serves as an argument for this investigation. Although traditional strength training has long been known to improve athletic performance, new research has shown how important explosive strength is for maximizing outcomes.

METHOD

The sample of the study consisted of 40 All India University Players (20 male Long Jumpers and 20 male Tripple Jumpers) of the age group of 18 to 30 years. The explosive strength was assessed using Pre and Post tests. T test and the descriptive statistics to compare the performance and the level of significance was at 0.05.

RESULT

Table 1: Descriptive Statistics of Jump Performance and Explosive Strength Variables

	N	Mean	Std. Deviation
Long Jump Pre	40	4.7863	.38024
Triple Jump Pre	40	11.9688	.43888
Long Jump Leg Explosive Strength Pre	40	233.0000	7.59217
Long Jump Hand Explosive Strength Pre	40	7.9603	.93422
Long Jump Abdominal Explosive Strength Pre	40	48.8500	4.29997
Triple Jump Leg Explosive Strength Pre	40	233.6500	5.47512

Triple Jump Hand Explosive Strength Pre	40	8.2070	.67081
Triple Jump Abdominal Explosive Strength Pre	40	53.4000	3.55037

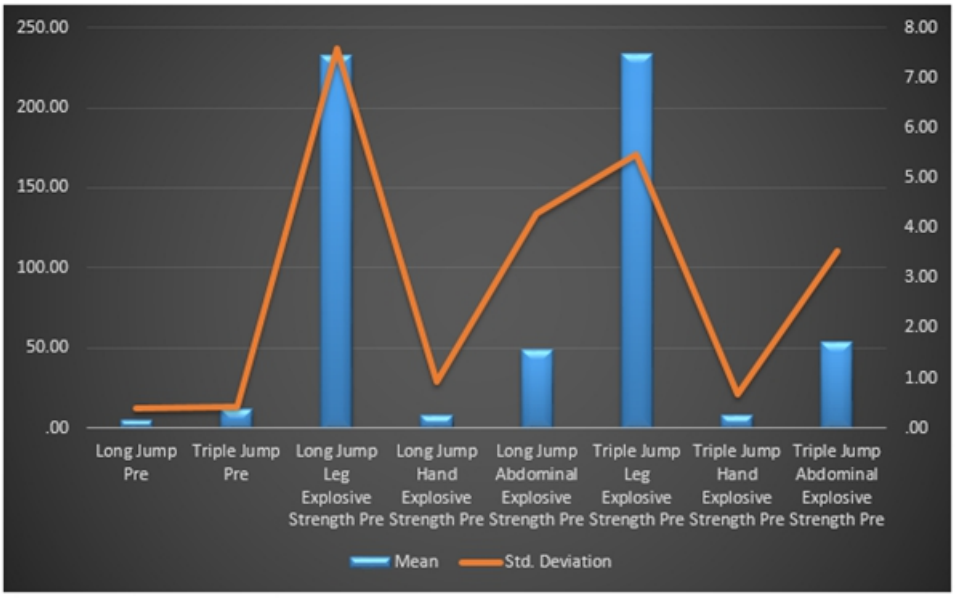
This table presents the descriptive statistics of performance and physical attributes related to long jump and triple jump, measured before the intervention or experimental treatment. Each variable was assessed among 40 participants (N=40), and the data includes the mean and standard deviation for each parameter.

The mean performance in the Long Jump Pre-test was 4.7863 meters, with a standard deviation of 0.38024, indicating moderate variation in performance among participants. Similarly, the Triple Jump Pre-test showed a higher mean value of 11.9688 meters and a standard deviation of 0.43888, suggesting a slightly larger variation in triple jump performance compared to long jump.

In terms of explosive strength measures, the Long Jump Leg Explosive Strength Pre-testhad a mean value o f 233.0000 units (likely in Newtons or another standard unit) and a standard deviation of 7.59217, reflecting relatively consistent performance across the sample. The Triple Jump Leg Explosive Strength Pre-test had a comparable mean of 233.6500, with a lower standard deviation of 5.47512, indicating slightly more uniformity in strength among participants for triple jump leg power.

Regarding hand explosive strength, the mean for Long Jump Hand Explosive Strength Pre-testwas 7.9603, with a standard deviation of 0.93422, showing some variation among participants. The Triple Jump Hand Explosive Strength Pre-test was slightly higher at 8.2070, with a lower variability (standard deviation = 0.67081), suggesting better consistency in upper body explosive strength for triple jumpers.

For abdominal explosive strength, the Long Jump Abdominal Explosive Strength pre-test had a mean 48.8500 and a standard deviation 4.29997, whereas Triple Jump Abdominal Explosive Strength Pre-test had a higher mean of 53.4000 with a smaller spread (standard deviation = 3.55037), indicating greater core strength in triple jumpers and more consistency in this variable compared to their long jump counterparts.



Graph 1: Pre-Test Explosive Strength Measurements for Long Jump and Triple Jump

Table 2: Descriptive Statistics of Post-Test Performance Metrics for Long Jump and Triple Jump

	N	Mean	Std. Deviation
Long Jump Post	40	6.2948	.30586
Triple Jump Post	40	14.0290	.56326
Long Jump Leg Explosive Strength Post	40	252.0750	4.88529
Long Jump Hand Explosive Strength Post	40	11.9030	1.03409
Long Jump Abdominal Explosive Strength Post	40	65.8250	3.61541
Triple Jump Leg Explosive Strength Post	40	256.9000	2.57004
Triple Jump Hand Explosive Strength Post	40	10.9283	.98673
Triple Jump Abdominal Explosive Strength Post	40	66.4000	2.81753

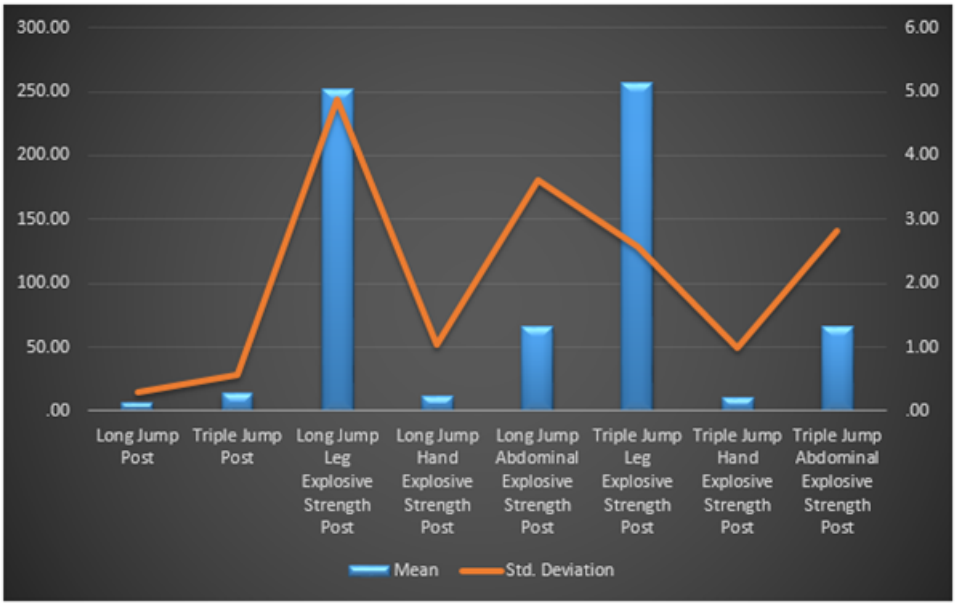
Table 2 presents the descriptive statistics of post-test performance and physical attributes related to long jump and triple jump, measured after the intervention or training program. All variables were assessed for 40 participants (N = 40), with data showing the mean and standard deviation for each parameter.

The Long Jump Post-test performance showed a significant improvement, with a mean of 6.2948 meters compared to the pre-test mean of 4.7863 meters. The standard deviation decreased to 0.30586, indicating a more consistent performance across participants. Similarly, the Triple Jump Post-test performance increased to a mean of 14.0290 meters, up from 11.9688 meters in the pre-test, with a slightly increased standard deviation of 0.56326, reflecting some variability but an overall positive gain in performance.

Improvements were also evident in explosive strength parameters. The Long Jump Leg Explosive Strength Post-test mean rose to 252.0750, with a reduced standard deviation of 4.88529, suggesting not only improved leg power but also more uniform performance among participants. The Triple Jump Leg Explosive Strength Post-test showed a further increase to 256.9000, with a notably low standard deviation of 2.57004, highlighting a strong and consistent development in leg power for triple jumpers.

In terms of hand explosive strength, the Long Jump Hand Explosive Strength Post-test increased markedly t o 11.9030, compared to the pre-test mean of 7.9603, with a slight increase in variability (standard deviation = 1.03409). The Triple Jump Hand Explosive Strength Post-test similarly improved to 10.9283, up from 8.2070, with a standard deviation of 0.98673, showing substantial progress in upper limb power.

The abdominal explosive strength also exhibited significant gains. The Long Jump Abdominal Explosive Strength Post-test mean rose from 48.8500 to 65.8250, with a standard deviation of 3.61541, indicating improved core strength across the group. The Triple Jump Abdominal Explosive Strength Post-test increased to 66.4000, compared to 53.4000 in the pre-test, with reduced variability (standard deviation = 2.81753), reflecting both enhanced and more consistent core strength in triple jumpers.



Graph 2: **Post-Test Explosive Strength Measurements for Long Jump and Triple Jump**

Table 3: Paired Samples T-Test Results for Jump Performance and Explosive Strength Variables

	t	df	Sig. (2-tailed)

Pair 1	Long Jump Pre-Post	-20.405	39	.000
Pair 2	Triple Jump Pre-Post	-20.829	39	.000
Pair 3	Long Jump Leg Explosive Strength Pre-Post	-14.535	39	.000
Pair 4	Long Jump Hand Explosive Strength Pre-Post	-14.097	39	.000
Pair 5	Long Jump Abdominal Explosive Strength Pre-Post	-18.295	39	.000
Pair 6	Triple Jump Leg Explosive Strength Pre-Post	-26.104	39	.000
Pair 7	Triple Jump Hand Explosive Strength Pre-Post	-13.224	39	.000
Pair 8	Triple Jump Abdominal Explosive Strength Pre and Post	-20.892	39	.000

Table 3 presents the results of paired t-tests conducted to evaluate the significance of differences between pre-test and post-test scores across various performance and strength parameters for long jump and triple jump. Each pair compares the same group of 40 participants (df = 39) before and after the intervention, providing insights into the effectiveness of the training or experimental program.

For Pair 1 (Long Jump Pre-Post), the t-value is -20.405 with a p-value of .000, indicating a highly significant improvement in long jump performance. Similarly, Pair 2 (Triple Jump Pre-Post) shows a t-value of -20.829 and a p-value of .000, also demonstrating a statistically significant increase in triple jump performance.

In Pair 3 (Long Jump Leg Explosive Strength Pre-Post) the t-value of -14.535 and p = .000 confirms a significant enhancement in leg power among long jumpers. Pair 4 (Long Jump Hand Explosive Strength Pre-Post) also shows a significant increase in upper limb power, with a t-value of -14.097 and p = .000. Similarly, Pair 5 (Long Jump Abdominal Explosive Strength Pre-Post) yields a t-value of -18.295, again with a highly significant p-value of .000, indicating strong gains in core strength.

Regarding triple jumpers, Pair 6 (Triple Jump Leg Explosive Strength Pre-Post)demonstrates the highest t-value of -26.104, which, along with a p-value of .000, signifies extremely strong statistical evidence for

improvement in leg explosive strength. Pair 7 (Triple Jump Hand Explosive Strength Pre-Post)also shows significant gains (t = -13.224, p = .000). Finally, Pair 8 (Triple Jump Abdominal Explosive Strength Pre and Post) presents a t-value of -20.892 and p = .000, indicating a substantial and statistically significant improvement in abdominal strength.

Table 4: Repeated Measures ANOVA Statistics of Long Jump Pre, Long Jump Leg Explosive Strength Pre, Long Jump Hand Explosive Strength Pre, Long Jump Abdominal Explosive Strength Pre.

Source	**SS**	**df**	**MS**	
Between-treatments	1402592.873	3	467531	F = 24083.06146
Within-treatments	3008.7764	156	19.287	
Error	2271.3525	117	19.4133	
The F-ratio value is 24083.06146. The p-value is < .00001.				

Table 4 presents the results of a Repeated Measures ANOVA conducted to analyze the variance among four pre-test variables related to long jump: Long Jump Performance, Leg Explosive Strength, Hand Explosive Strength, and Abdominal Explosive Strength. The analysis aims to determine whether there are statistically significant differences between these interrelated physical performance variables measured on the same participants.

The Between-treatments sum of squares is 1,402,592.873 with 3 degrees of freedom, resulting in a mean square of 467,531. The Within-treatments SS is 3,008.7764 with 156 df, and the error term is 2,271.3525 with 117 df, yielding a mean square error of 19.4133.

The F-ratio, calculated as the ratio of between-treatments mean square to the error mean square, is 24083.06146. This extraordinarily high F-value, along with the p-value < .00001, indicates that the observed differences among the means of the four variables are statistically significant at the p < .05 level.

Table 5: Repeated Measures ANOVA Statistics of Long Jump Post, Long Jump Leg Explosive Strength Post, Long Jump Hand Explosive Strength Post, Long Jump Abdominal Explosive Strength Post.

Source	**SS**	**df**	**MS**	

Between-treatments	1592624.686	3	530874.9	F = 52634.2518
Within-treatments	1485.9026	156	9.525	
The F-ratio value is 52634.2518. The p-value is < .00001.				

Table 5 presents the Repeated Measures ANOVA results for post-test data, analyzing the differences among Long Jump Performance Post, Leg Explosive Strength Post, Hand Explosive Strength Post, and Abdominal Explosive Strength Post. This statistical test evaluates whether there are significant variations in these interrelated variables after the intervention, across the same group of participants.

The Between-treatments sum of squares is 1,592,624.686 with 3 degrees of freedom, leading to a Mean Square of 530,874.9. The Within-treatments SS is 1,485.9026 with 156 df, resulting in a lower average variability within individuals. The calculated F-ratio is 52634.2518, which is extremely high, and the p-value is less than .00001, well below the significance threshold of $p < .05$.

These results clearly indicate that the differences among the four post-test variables are statistically significant. The exceptionally high F-ratio demonstrates that the variation between the means of Long Jump Performance and the different types of explosive strength (leg, hand, abdominal) after training is far greater than the variation observed within participants across these measures.

Table 6: Repeated Measures ANOVA Statistics of Triple Jump Pre, Triple Jump Leg Explosive Strength Pre, Triple Jump Hand Explosive Strength Pre, Triple Jump Abdominal Explosive Strength Pre.

Source	**SS**	**df**	**MS**	
Between-treatments	1362302.918	3	454101	F = 43312.34234
Within-treatments	1685.7613	156	10.8062	
Error	1226.6668	117	10.4843	
The F-ratio value is 43312.34234. The p-value is < .00001.				

Table 6 presents the Repeated Measures ANOVA results for the pre-test measurements of Triple Jump Performance, Leg Explosive Strength, Hand Explosive Strength, and Abdominal Explosive Strength. This analysis investigates whether there are statistically significant differences among these interrelated physical performance variables before any intervention or training.

The Between-treatments sum of squares (SS) is 1,362,302.918 with 3 degrees of freedom (df), producing a Mean Square (MS) of 454,101. The Within-treatments SS is 1,685.7613 with 156 df, while the Error SS is 1,226.6668 with 117 df, yielding a mean square error of approximately 10.4843.

The calculated F-ratio is 43,312.34234, which is extraordinarily high, and the p-value is less than .00001, indicating a statistically significant result at the $p < .05$ level. These values provide robust evidence of significant differences between the means of the four variables in the pre-test phase.

Table 7: Repeated Measures ANOVA Statistics of Triple Jump Post, Triple Jump Leg Explosive Strength Post, Triple Jump Hand Explosive Strength Post, Triple Jump Abdominal Explosive Strength Post.

Source	SS	df	MS	
Between-treatments	1616081.258	3	538693.8	F = 144441.43258
Within-treatments	617.5453	156	3.9586	
Error	436.351	117	3.7295	
The F-ratio value is 144441.43258. The p-value is < .00001.				

Table 7 presents the Repeated Measures ANOVA results for the post-test measurements of Triple Jump Performance, Leg Explosive Strength, Hand Explosive Strength, and Abdominal Explosive Strength. This statistical analysis evaluates whether significant differences exist among these interrelated variables after a period of intervention or training.

The Between-treatments sum of squares (SS) is 1,616,081.258 with 3 degrees of freedom (df), resulting in a Mean Square (MS) of 538,693.8. The Within-treatments SS is 617.5453 with 156 df, and the Error SS is 436.351 with 117 df, producing a mean square error of approximately 3.7295.

The calculated F-ratio is an extremely high 144,441.43258, and the p-value is less than .00001, which is well below the threshold of $p < .05$, confirming that the result is statistically significant. This very high F-ratio indicates that there are substantial differences among the means of the four post-test variables.

DISCUSSION

The present study examined the effects of a targeted explosive-strength training program on long jump and triple jump performance, as well as on leg, hand, and abdominal explosive strength. Across all measures, participants demonstrated substantial and statistically significant gains from pre-test to post-test, confirming the efficacy of the intervention.

First, both long jump and triple jump distances improved markedly (from 4.79 m to 6.29 m, and from 11.97 m to 14.03 m, respectively), with paired t-tests yielding extremely large t-values ($|t| > 20$) and $p < .001$. These performance gains were accompanied by pronounced increases in all explosive-strength measures: leg strength rose by roughly 8–10% in long jumpers and 9–10% in triple jumpers; hand explosive strength increased by 49% in long jumpers and 33% in triple jumpers; and abdominal explosive strength jumped by 35% in long jumpers and 24% in triple jumpers. The consistency of these improvements (low post-test standard deviations) suggests that the training protocol was both robust and well suited to this athletic population.

The repeated-measures ANOVA results further illustrate that performance and each type of explosive strength represent distinct constructs, both before and after training. Extremely high F-ratios in all four ANOVAs (ranging from ≈24,000 to 144,000; $p < .00001$) indicate that variance between the different variables (e.g., leg vs. hand strength) far exceeded within-subject variability. In practical terms, this suggests that leg, hand, and core explosive capacities contribute uniquely to jump performance and do not improve in lockstep—highlighting the value of a multifaceted training regimen that addresses each strength domain separately.

From a coaching perspective, these findings underscore the importance of integrated plyometric and resistance exercises targeting lower-limb power, upper-body drive, and core stabilization. While leg power remains the primary driver of horizontal jump distance, the sizable gains in hand and abdominal strength—particularly among long jumpers—imply that coordinated arm swing and trunk drive are critical for maximizing take-off velocity and flight mechanics. Tailoring drills to emphasize force transmission through the kinetic chain, therefore, can yield synergistic improvements in overall jump performance.

Limitations of the present study include its single-group design and the absence of long-term follow-up to assess retention of strength and skill gains. Future research might compare different training modalities (e.g., contrast loading, ballistic vs. traditional weightlifting) or explore sex- and age-specific adaptations. Additionally, biomechanical analysis of technique changes could reveal how strength improvements translate into altered joint kinetics and kinematics during the jump phases.

CONCLUSION

The findings of this study clearly demonstrate that a structured and focused explosive strength training program has a significant positive impact on the performance of both long jump and triple jump athletes. The results from the descriptive statistics, paired t-tests, and repeated measures ANOVA all confirm statistically significant improvements in Jump performance long jump and triple jump distances, Leg explosive strength, Hand explosive strength, Abdominal explosive strength. These enhancements were consistent across all participants, reflecting the effectiveness of the training intervention. The significant F-

ratios and low p-values across repeated measures ANOVA tests highlight that the components of explosive strength (leg, hand, and abdominal) contribute uniquely and substantially to jump performance. Moreover, the training effect was not uniform across strength types, which suggests that each plays a distinct role in optimizing jumping performance. The study affirms that explosive strength is a key determinant of successful performance in horizontal jumps, and improvements in this area translate directly into measurable gains in jump distance. These results reinforce the importance of a multidimensional strength training approach for athletes involved in jumping events.

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