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Evaluating the Effects of Incline Sprint Training on Vertical Jump Height in Basketball and Volleyball Players

Dr. Shubham Kumar
Assistant Professor, Department of Physical Education, IIMT University, Meerut
Aditya Nath
Assistant Professor, Department of Physical Education, IIMT University, Meerut
Dr. Gaurav Sanotra
Assistant Professor, Department of Physical Education Pedagogy, LNIPE Gwalior
Ishu Yadav
Assistant Professor, Department of Physical Education, IIMT University, Meerut

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ABSTRACT

This study aimed to evaluate the effects of a 4-week incline sprint training program on vertical jump height among university-level basketball and volleyball players in India. A total of 30 participants (15 from each sport) underwent a structured hill sprint intervention three times per week, focusing on enhancing explosive lower-limb power. Vertical jump height was assessed before and after the intervention using the Sargent Jump Test. Paired sample t-tests revealed statistically significant improvements in vertical jump height in both groups ($p < 0.001$), while independent t-test results indicated that volleyball players exhibited a significantly greater gain compared to basketball players ($p = 0.002$). These findings suggest that incline sprint training is an effective short-term method for improving vertical jump performance and may produce sport-specific adaptations, particularly in volleyball athletes. The results support the inclusion of hill sprint protocols in training programs for university-level athletes in jump-intensive sports.

INTRODUCTION

Vertical jump height is a fundamental component of athletic performance in sports such as basketball and volleyball, where explosive leg power directly influences actions like rebounding, blocking, spiking, and dunking. The ability to generate rapid force from the lower limbs can be a critical differentiator between performance levels, especially in competitive environments. For university-level athletes in India, optimizing vertical jump performance is essential not only for match effectiveness but also for talent identification and progression to elite levels.

Among the various training methods aimed at enhancing lower-body explosiveness, incline sprint training—or hill training—has garnered attention for its simplicity, accessibility, and biomechanical benefits. Hill sprints inherently increase resistance due to the upward slope, encouraging greater recruitment of fast-twitch muscle fibers, improved hip extension mechanics, and increased force production from the posterior chain. These adaptations are closely aligned with the demands of vertical jumping. While the effectiveness of plyometric and resistance training on jump performance has been well-documented, limited research has explored the role of incline sprint training as a short-term intervention, particularly among Indian collegiate athletes. Moreover, basketball and volleyball, though similar in their reliance on vertical power, may produce differing responses to the same training stimuli due to variations in movement patterns, skill demands, and jump mechanics.

This study aims to evaluate the impact of a 4-week incline sprint training program on vertical jump height in university-level basketball and volleyball players in India. By assessing performance before and after the intervention, this research seeks to determine the effectiveness of hill training in improving vertical leap and to compare its influence across the two sport disciplines.

METHODOLOGY

This study employed a quasi-experimental pre-test–post-test design without a control group to evaluate the effect of a 4-week incline sprint training program on vertical jump height among university-level basketball and volleyball players in India. A total of 30 athletes (15 basketball players and 15 volleyball players), aged 18–25 years with a minimum of two years of competitive experience and no lower-limb injuries in the past six months, were selected through purposive sampling from inter-university teams. All participants provided informed consent and were cleared for high-intensity training by a certified medical professional. The intervention consisted of three weekly sessions for four weeks, performed on a hill with a 15–20-degree incline. Each session included a 15-minute warm-up (dynamic

stretching, mobility drills, and jogging), a 20–25-minute main workout (6–8 sets of 20-meter incline sprints at progressive intensity, 3 sets of 30-meter bounding drills, and 2 sets of 10-meter single-leg power hops per leg), and a 10-minute cool-down (static stretching and walking), all under supervision by certified strength and conditioning coaches. Vertical jump height was assessed using the Sargent Jump Test, with participants performing three maximal jumps after a warm-up, and the best attempt recorded in centimetres during both pre-test (Week 0) and post-test (Week 4) phases.

Table 1: Incline Sprint Training Schedule (4 Weeks)

Component	Duration	Activities
Warm-Up	15 minutes	Dynamic stretching, mobility drills, light jogging
Main Training Set	20–25 minutes	- 6–8 × 20-meter incline sprints (progressive intensity) - 3 × 30-meter bounding drills (on incline) - 2 × 10-meter single-leg power hops (each leg)
Cool-Down	10 minutes	Walking and static stretching
Frequency	3 sessions per week	Supervised by certified strength & conditioning coaches
Duration	4 weeks (Total: 12 sessions)	Training conducted on a 15–20° hill incline

Data were analyzed using IBM SPSS Statistics, with descriptive statistics summarizing demographic and baseline data. Paired sample t-tests were used to compare pre- and post-test scores within each group, while independent sample t-tests compared the mean differences between basketball and volleyball players. Statistical significance was set at $p < 0.05$.

Data were analyzed using IBM SPSS Statistics. Descriptive statistics including mean, standard deviation (SD), and range were calculated for both pre-test and post-test vertical jump heights for basketball and volleyball players. To examine the effectiveness of the 4-week incline sprint training program, a paired sample t-test was used to compare pre-test and post-test vertical jump heights within each group (basketball and volleyball). This test determined whether the mean difference in jump height before and after the intervention was statistically significant. Additionally, an independent sample t-test was

conducted to compare the mean gain in vertical jump height between the basketball and volleyball players. This analysis helped to identify whether one sport group showed greater improvement than the other. The level of statistical significance was set at $p < 0.05$ for all analyses. All statistical results were interpreted in terms of both practical significance (actual jump height improvement in cm) and statistical significance, with results presented in both tabular and graphical form.

RESULTS AND DISCUSSION

The primary objective of this study was to evaluate the impact of a 4-week incline sprint training program on vertical jump height among university-level basketball and volleyball players. The results are presented in three parts: descriptive statistics of pre- and post-intervention performance, within-group comparisons to assess training effects, and a between-group comparison to evaluate differential responses between sports. Statistical tests were conducted at a significance level of $p < 0.05$, and all findings are interpreted in the context of training effectiveness and sport-specific performance adaptations.

Table 2: Descriptive Statistics of Vertical Jump Height (in cm)

Group	N	Pre-Test M	Post-Test M	Mean Gain	SD
Basketball	15	55.04	59.16	4.11	0.78
Volleyball	15	51.91	57.15	5.23	1.01

This table presents the descriptive statistics for vertical jump heights before and after the 4-week incline sprint training program. It includes the number of participants (N), mean values of pre- and post-test vertical jump height, the average gain, and standard deviation (SD) for both basketball and volleyball groups. The results indicate that both groups showed improvement in vertical jump height following the training. Volleyball players had a higher average gain (5.23 cm) than basketball players (4.11 cm), along with slightly greater variability, suggesting individual differences in responsiveness to the training program.

Table 3: Paired Samples t-Test Results (Within Groups)

Group	t	df	p
Basketball	20.47	14	7.872e-12
Volleyball	20.07	14	1.026e-11

This table displays the results of paired samples t-tests comparing pre- and post-test scores within each sport. The tests were conducted to assess whether the observed changes in vertical jump height were statistically significant after the 4-week intervention. The p-values for both groups are far below the 0.05 threshold, confirming that the improvements in vertical jump height were statistically significant. These results support the effectiveness of incline sprint training in enhancing explosive leg power in university-level athletes from both sports.

Table 4: Independent Samples t-Test (Between Groups)

Comparison	t	df	p
Basketball vs Volleyball	-3.40	28	0.002

This table summarizes the results of an independent t-test comparing the mean gain in vertical jump height between basketball and volleyball players. This analysis helps determine whether there was a significant difference in training response between the two groups. The significant p-value (0.002) suggests a meaningful difference in jump height gains between groups. Volleyball players showed significantly greater improvement, which may be attributed to the nature of their sport involving more frequent vertical movements, better neuromuscular adaptation, or biomechanical differences.

The effectiveness of a 4-week incline sprint training program on vertical jump height among university-level basketball and volleyball players. The results showed statistically significant improvements in vertical jump performance in both groups, with volleyball players demonstrating a notably higher mean gain compared to basketball players. These findings support the hypothesis that incline sprint training can enhance lower-body explosive power and offer sport-specific adaptations depending on the athletes' background. The descriptive statistics (Table 2) revealed a consistent increase in vertical jump height in both sports. Basketball players improved by an average of 4.11 cm, while volleyball players gained 5.23 cm. These gains are both practically and statistically significant, aligning with existing literature suggesting that sprint training on inclines effectively recruits fast-twitch muscle fibers, enhances posterior chain activation, and improves neuromuscular coordination—all critical components of vertical leap performance. The within-group analysis (Table 3) confirmed that the gains in vertical jump height were statistically significant ($p < 0.001$) for both basketball and volleyball players. This highlights the effectiveness of incline sprint training even within a relatively short intervention period (4 weeks). It also suggests that hill sprinting can be a viable and low-cost alternative to traditional resistance or plyometric training methods, especially in collegiate sports settings with limited resources.

Interestingly, the between-group comparison (Table 4) revealed that volleyball players showed significantly greater improvements in vertical jump height than basketball players (p = 0.002). This difference may stem from the inherently different demands of each sport. Volleyball players typically perform more frequent and explosive jumping actions during training and competition (e.g., spiking and blocking), possibly leading to a more rapid adaptation to stimuli that target vertical force production. Additionally, volleyball athletes may possess a higher proportion of fast-twitch muscle fibers or more efficient jump mechanics, making them more responsive to this type of training stimulus. Overall, the findings suggest that incline sprint training is a time-efficient, effective, and accessible method to enhance vertical jump performance in jump-dominant sports. The results also underscore the importance of considering sport-specific demands and individual variability when designing training programs.

CONCLUSION

The findings of this study demonstrate that a 4-week incline sprint training program can significantly enhance vertical jump height in university-level basketball and volleyball players. Both groups showed statistically significant improvements in explosive lower-limb performance following the intervention, highlighting the effectiveness of hill sprint training as a low-cost, high-impact method for developing jump-specific power. Notably, volleyball players exhibited greater gains in vertical jump height compared to their basketball counterparts, suggesting that sport-specific factors such as jump frequency, movement patterns, or neuromuscular readiness may influence training responsiveness. These results support the inclusion of incline sprinting in sport conditioning programs, particularly for athletes in jump-dominant sports. In conclusion, incline sprint training offers a practical and efficient approach to improving vertical jump performance. Coaches and practitioners at the collegiate level are encouraged to adopt this method as part of their athletic development protocols. Future studies should consider longer intervention periods, larger sample sizes, and biomechanical assessments to further validate and refine training strategies for different athletic populations.

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