

## Effect of Different joints Velocity during Approach Run on High Jumping Performance: A Kinematic Study

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**Abstract:** This study was structured to detect whether the joints velocity during approach run has an impact on the jump height (performance). For the purpose of this study twelve male high jumpers who perform Fosbury-flop technique were recruited from the 70th All India Inter University Athletic Championship, Jawaharlal Nehru Stadium, Chennai, 2009. The mean age, height and body mass of high jumpers were 23.5 years ( $\pm 2.28$  years), 179.90 cm ( $\pm 4.43$  cm) and 66.78 kg ( $\pm 4.78$  kg), respectively. Before data acquisition subjects were asked to go for complete warm-up and practice the Fosbury-flop technique. When subjects warmed-up they were asked to perform Fosbury-flop high jump technique. Each subjects jumps at an interval given by the experts of the event. For collecting the videographic data, a Sony DCR SX40E camcorder in a field setting operating at a nominal frame of 60 Hz and with a shutter speed of 1/2000 second was used. To acquire kinematical data during the competition the camcorder mounted at a height of 5 feet was placed at 10 meters away, perpendicular to the approach area. All subjects were performed three jumps, all the jump performances were recorded and downloaded in the personal computer and only successful jump performance of each subject was selected for further analysis. The digitization of the obtained data was done with the help of Silicon Coach Pro7 motion analysis software. The kinematical variables for the study were taken as ankle, knee, hip, shoulder and elbow joints velocity. All statistical procedures were conducted using the SPSS 16.0 Version software. A level of significance was set at 0.05. The correlation-coefficient was used to establish a relationship between biomechanical variables and jumping height (performance) of Fosbury-flop high jumpers. The results of the study revealed that there was significant relationship exist between ankle, hip, shoulder and elbow joint velocity with the jump height (performance) and insignificant relationship existed between knee joint velocity and jump height (performance). On the basis of the results it is concluded that during the approach run the velocity of the different joints affect the jump height (performance of the high jumpers).

**Key words:** Biomechanics • Inter University • Fosbury-flop • Segmental joints and Velocity

### INTRODUCTION

High jump competitions are commonly won or lost by only one or two percent differences in the performance capabilities of the competitors. In high jumping there is a need to generate appropriate velocity of the different joints in the approach run in order to clear the bar

successfully. It is known that the velocity at approach run phase is a major determinant of performance outcome in high jumping and it is thought that the limbs will make a greater contribution to this velocity the more vigorously they are used. [1]. The purpose of the run-up is to set the appropriate conditions for the beginning of the take-off phase [1].

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The approach (run-up) in the high jump consists of 8-12 steps, not taking into account the rather various preliminary phase [2]. It is a general principle that the higher the approach velocity (may be up to 8.73 m/sec. cf Zhukov and Yufrikov, [3] the greater the radius. As it is possible to control the direction of the run only during the support phases, the impulse curve itself naturally, is affected only during the support phases [4].

The run-up serves as a preparation for the take-off phase, the most important part of the jump. The bar clearance technique is less important. Most bar clearance problems actually originate in the run-up. Most jumpers who use the Fosbury flop technique have a curved approach run. The typical length of the run-up for experienced jumpers is about 10 strides.

The first part of the run-up usually follows a straight line, perpendicular to the plane of the standards and the last four or five strides follow a curve. One of the main purposes of the curve is to make the jumper lean away from the bar at the start of the take-off phase. In the early part of the run-up the athlete should follow a gradual progression in which each stride is a little bit longer and faster than the previous one.

### Methodology

**Participants:** A total of twelve high jumpers were selected as the subjects for the study from 70th All India Inter University Athletic Championship, Jawaharlal Nehru Stadium, Chennai, 2009. The mean age, height and body mass of intervarsity players were 23.5 years ( $\pm 2.28$  years), 179.90 cm ( $\pm 4.43$  cm) and 66.78 kg ( $\pm 4.78$  kg), respectively.

**Equipments and Facilities:** Biomechanical analysis requires specific tools and equipments to capture, edit and analyze the data. The experimental apparatus used in this research work were camcorder (Sony DCR SX40E), tripod, measuring tap, STHVCD55 Software, Silicon Coach Pro-7 (motion analysis software) and computer system.

**Procedure for Data Collection:** Two-dimensional coordinate data from one side of the body were obtained with a high speed Sony DCR SX40E camcorder operating at 1/2000 Hz with a frame rate of 60 frames per second was used to capture the biomechanical data. The camcorder was placed on a rigid tripod and mounted at the height of 5 feet on the right angle i.e. perpendicular to the run-up area at a distance of 10 meters. Before data acquisition subjects were asked to go for complete warm-up and

perform some trials of jumps. After warming up all the subjects have to perform three jumps, all the jumps were recorded and the best valid jump for each athlete was selected for further analysis.

**Data Analysis:** The selected video footages were downloaded, slashed and edited by using the downloaded version of STHVCD55 software. The Silicon Coach Pro7 Motion Analysis Software was used for digitization, smoothing and analysis. The biomechanical parameters which were analyzed, i.e. different joints (ankle, knee, hip, shoulder and elbow) velocity.

**Statistical Analysis:** The acquired data on the selected biomechanical variables were sequentially arranged, tabulated and subjected to appropriate descriptive statistical analysis.

## RESULTS

The results of this empirical investigation is presented in the preceding tables and graphs.

The relationship between different joints velocity and jump height (performance) of the Fosbury-flop high jumpers presented in the above mentioned table 2 which depicted that there were significant relationship existed between ankle, hip, shoulder and elbow joints velocity with the jump height (performance), since calculated r values of these joints velocity were more than tab r value (0.576) further insignificant relationship was found between knee joint velocity and jump height (performance).

Table 1: Indicating Mean and Standard Deviation of Performance and different Joints velocity during Approach Run of Fosbury-flop High Jumpers

	Mean	S D
Performance	2.015	0.122
Ankle	7.099	0.569
Knee	6.955	0.547
Hip	7.083	0.467
Shoulder	6.998	0.553
Elbow	7.050	0.474

Table 2: Indicating Relationship between different Joints Linear Velocity and Jump Height (Performance) of Fosbury-flop High Jumpers

	Ankle	Knee	Hip	Shoulder	Elbow
Performance	0.844*	0.509	0.676*	0.858*	0.784*

\*Significant at 0.05 level of significance Tab. r 0.576

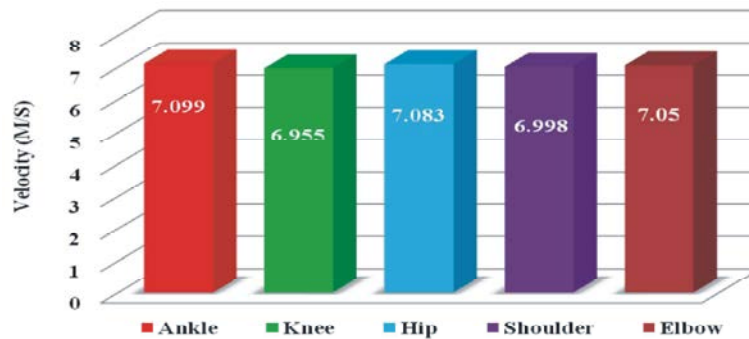


Fig. 1: Showing Mean of different Joints Velocity during Approach Run of Fosbury-flop High Jumpers

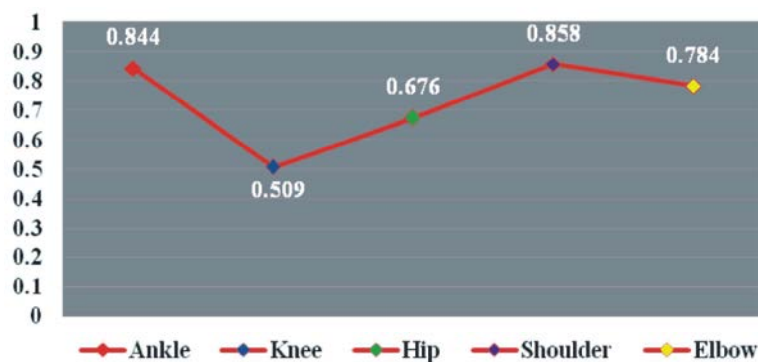


Fig. 2: Showing Relationship of different Joints Velocity with performance

## DISCUSSION

The aim of the study was to see that the velocity of different joints during approach run affect the performance or not. The result of the study showed that there was significant relationship exist between ankle, hip, shoulder and elbow joints velocity with the performance. It means the velocity of these joints during approach run affect the performance of a Fosbury-flop high jumper. Different researchers support these findings [5-9]. They found that as a high jumper increases approach run velocity, the height of the jump improve and said that increasing approach velocity is important for achieving the maximum height. The results of the approach run demonstrate the fastest run-ups ever recorded. When comparing the findings of present study to the earlier studies [9-11], it seems clear that nowadays approach run velocity is increasing. These findings are well in agreement with the findings of Isolehto, Virmavirta, Kyrolainen and Komi [12]. We also found the insignificant relationship between knee joint velocity and jump height (performance).

## CONCLUSIONS

On the basis of the findings we can conclude that during the approach run the velocity of the different joints affect the jump height of a jumper. So approach run velocity is most important factor for enhancing the Fosbury-flop high jumping performance. As much as the approach run velocity the jump height will be high.

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