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KINEMATIC ANALYSIS OF HORIZONTAL VELOCITY AT TOUCHDOWN AND TAKE OFF WITH THE PERFORMANCE OF INDIAN LONG JUMP ATHLETES

Rajan Bhatia[1] and Dr. Ratnesh Singh[2]
[1]Research Scholar, Department of Physical Education, Guru Ghasidas University, Bilaspur (C.G.), India.
[2]Associate Professor, Department of Physical Education, Guru Ghasidas University, Bilaspur (C.G.), India.

ABSTRACT:
The purpose of the present study was to investigate the relationships between the kinematic variables i.e., Horizontal Velocity at touchdown and takeoff with the performance of Indian long jump athletes. Total five long jumpers were selected as a sample: Indian elite male long jumpers who had represented the country at International level were selected as a sample on the basis of performance in preceding competition. The jumpers with the age ranging between 17 to 25 years were selected for the study. The kinematic variables Horizontal velocity, 3rd to take-off Stride (take-off) (take-off leg), 2nd to take-off Stride (touchdown) (take-off leg) 2nd to take-off Stride (Take-off), Penultimate (touchdown), Penultimate (take-off), Take-off Stride (touchdown), Take-off Stride (take-off), Touchdown takeoff board, Final Takeoff from takeoff board and performance of long jump athletes. The Kinematic Analysis of long jump athletes mean, standard deviation and Karl Pearson's product moment coefficient correlation were employed with the help of statistical package of SPSS. The level of significance was set at 0.05. The outcome of the study showed significant relationship between the performance and 2nd to take-off Stride touch down (-.916) of Indian Long Jump athletes.*

KEYWORDS: *Kinematic, Horizontal Velocity, Long Jump, etc*

INTRODUCTION

The long jump is a track and field event in which athletes combine speed, strength and agility in an attempt to leap as far as possible from a take-off point. Along with the triple jump, the two events that measure jumping for distance as a group are referred to as the "horizontal jumps". The long jump is a formerly commonly called the "broad jump". The long jump is the only known jumping event of Ancient Greece's original Olympics' pentathlon events. The long jump has been part of modern Olympic competition since the inception of the games in 1896. The basic technique used in long jumping has remained unchanged since the beginning of modern athletics in the mid-nineteenth century. The athlete sprints down a runway, jumps up from a wooden take off board, and flies through the air before landing in a pit of sand. A successful long jumper must, therefore, be a fast sprinter, have strong legs for jumping, and be sufficiently coordinated to perform the moderately complex take-off, flight, and landing manoeuvres. The objectives in each phase of the jump are the same regardless of the athlete's gender or ability. Hay Thorson and Kippenhan, 1999)

Just before touchdown the athlete pre-tenses the muscles of the take-off leg. The subsequent bending of the leg during the take-off is due to the force of landing, and is not a deliberate yielding of the ankle, knee, and hip joints. Flexion of the takeoff leg is unavoidable and is limited by the eccentric strength of the athlete's leg muscles. Maximally activating the muscles of the take-off leg keeps the leg as straight as possible during the take-off. This enable athlete's COM to pivot up over the foot, generating vertical velocity via a purely mechanical mechanism. Over 60 per cent of the athlete's final vertical velocity is achieved by the instant of maximum knee flexion, which indicates that the pivot mechanism is the single most important mechanism acting to create vertical velocity during the take-off. The knee extension phase makes only a minor contribution to the generation of vertical velocity, and the rapid plantar flexion of the ankle joint towards the end of the take-off contributes very little to upward velocity. Long jumpers spend a lot of time on exercises to strengthen the muscles of their take-off leg. Greater eccentric muscular leg strength gives the athlete a greater ability to resist flexion of the take-off leg, which enhances the mechanical pivot mechanism during the take-off and hence produces a greater take-off velocity. The stretch-shorten cycle, where the concentric phase of a muscle contraction is facilitated by a rapid eccentric phase, does not play a significant role in the long jump take-off. Rather, fast eccentric actions early in the take-off enable the muscles to exert large forces and thus generate large gains in vertical velocity. In the long jump takeoff the instant of maximum knee flexion is a poor indicator of when the extensor muscles of the take-off leg change from eccentric activity to concentric activity. In long jumping, the gluteus maximusis active isometrically at first and then concentrically; the hamstrings are active concentrically throughout the take-off; rectus femoris acts either isometrically at first then eccentrically or eccentrically throughout the take-off; and the vasti, soleus, and gastrocnemius act eccentrically at first and then concentrically. The explosive extension of the hip, knee, and ankle joints during the last half of the take-off is accompanied by a vigorous swinging of the arms and free leg. These actions place the athlete's COM higher and farther ahead of the takeoff line at the instant of take-off, and are also believed to enhance the athlete's take-off velocity. Some athletes use a double-arm swing to increase the take-off velocity, but it is difficult to switch smoothly without loss of running velocity from a normal asynchronous sprint arm action during the runup to a double-arm swing at take-off. (Lees, Fowler and Derby 1993).

It is well known that take-off angles in the long jump are substantially less than the 45˚ angle that is usually proposed as the optimum for a projectile in free flight. Video measurements of world-class long jumpers consistently give International Journal of Yoga, Physiotherapy and Physical Education 233 take-off angles of around 21˚. The notion that the optimum take-off angle is 45˚ is based on the assumption that the take- off velocity is constant for all choices of take-off angle. However, in the long jump, as in most other sports projectile events, this assumption is not valid. The take-off velocity that a long jumper is able to generate is substantially greater at low take-off angles than at high take-off angles and so the optimum take off angle is shifted to below 45˚. (Linthorne, Guzman and Bridgett 2005).

OBJECTIVE:

The Problem entitled as "kinematic analysis of Horizontal Velocity at touchdown and takeoff with the performance of Indian long jump athletes".

METHOD AND PROCEDURE

Selection of subjects

Total five long jumpers were select as a sample: Indian elite male long jumpers who had represented the country at International level were selected as a sample on the basis of performance in preceding competition. The age of all the subjects ranged between 17-25 year.

Selection of variables

Horizontal velocity: 3rd to take-off Stride (take-off) (take-off leg), 2nd to take-off Stride (touchdown) (take-off leg) 2nd to take-off Stride (Take-off), Penultimate (touchdown), Penultimate (take-off), Take-off Stride (touchdown), Take-off Stride (take-off), Touchdown takeoff board, Final Takeoff from takeoff board.

Administration of the test

Five Indian elite male long jumpers who had represented the country at International level were selected as a sample. All the selected subjects were asked to perform the long jump with their full potential and accurate technique. The jumpers were well directed, informed and prepared for the study. Six chances were given to every jumper. They were asked to perform the long jump in the natural way as they actually perform. It was ascertained that subjects possess reasonable level of technique. Players were video graphed with systematic filming method as required. Motion capture technique was used in this study. To recorded the video of the long jumpers, while they performing the jump, digital video camera (250 fps) was used by a professional photographer. The performance of the subject was recorded with stroboscopic effect from approach to landing. Digital Video camera was placed 6 meter away at the perpendicular to the plane of motion.

Criterion Measure

The criterion measure for this study was the performance of the jumper. Total of six attempts were given to each subject. The performance of each jump was judged accurately and performance was recorded. The selected Kinematic variables such as Horizontal velocity: 3rd to take-off Stride (take-off) (take-off leg), 2nd to take-off Stride (touchdown) (take-off leg) 2nd to take-off Stride (Take-off), Penultimate (touchdown), Penultimate (take-off), Take-off Stride (touchdown), Take-off Stride (take-off), Touchdown takeoff board, Final Takeoff from takeoff board.

Filming Protocol

Motion capture technique was used in this study. To recorded the video of the long jumpers, while they performing the jump digital video camera (250 fps) was used by a professional photographer. After obtaining the recorded video, the video was analyzed through Kinovea software version 0.8.27 First video was digitized through Cann Camera. After the procedure of digitizing, the video was calibrated. The calibrated video gives us the results through makers, stroboscopic effect

Statistical Techniques

Karl Pearson's product moment coefficient correlation statistical technique was calculated between selected kinematical variables with performance of male long jumpers. In order to check the significance, level of significance was set at 0.05.

Table-1
Descriptive Statistics of horizontal velocity at touchdown and takeoff points of last four strides and final takeoff of Indian long jump athletes

Sl. No.	Horizontal velocity	Mean	SD
1	3rd to take-off Stride (take-off)	9.87	.53
2	2nd to take-off Stride (touchdown)	10.6	1.35
3	2nd to take-off Stride (Take-off)	10.74	1.76
4	Penultimate (touchdown)	9.80	.98
5	Penultimate (take-off)	9.56	.93
6	Take-off Stride (touchdown)	9.49	1.03
7	Take-off Stride (take-off)	10.13	.65
8	Touchdown takeoff board	8.49	.65
9	Final Takeoff from takeoff board	9.41	1.86

Table -1 shows that the mean value of angle of 2nd to take-off Stride (touchdown) was 10.74, whereas the standard deviation (SD) of angle of hip joint of long jumpers was 1.76 respectively. At the time of calculation of relationship was found between Horizontal velocity and 2nd to take-off Stride (Take-off) with performance of long jumpers.

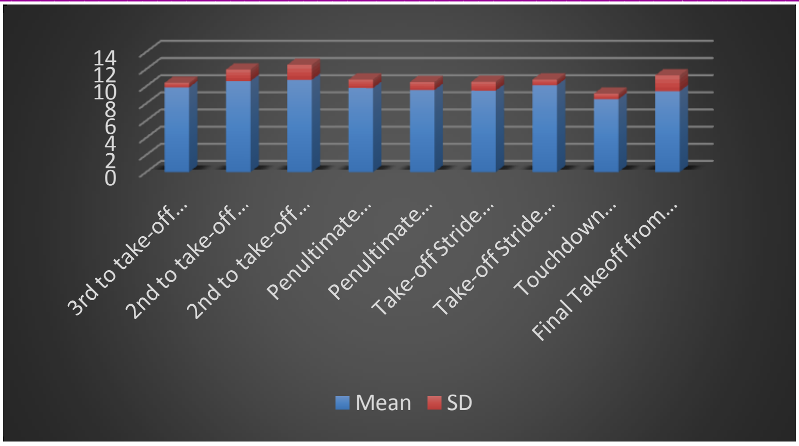

Fig 1

Table-2
Correlation Coefficient of kinematic analysis of Horizontal Velocity at touchdown and takeoff with the performance of Indian long jump athletes

Sl. No.	Horizontal velocity	Mean	SD	Coefficients of correlation	r
1	3rd to take-off Stride (take-off)	9.87	.53	.400	.504
2	2nd to take-off Stride (touch down)	10.6	1.35	-.916*	.029
3	2nd to take-off Stride (Take-off)	10.74	1.76	.259	.674
4	Penultimate (touch down)	9.80	.98	.798	.106
5	Penultimate (take-off)	9.56	.93	.402	.502
6	Take-off Stride (touch down)	9.49	1.03	-.203	.743
7	Take-off Stride (take-off)	10.13	.65	-.842	.074
8	Touchdown takeoff board	8.49	.65	.735	.157
9	Final Takeoff from takeoff board	9.41	1.86	.878	.050

'r'0.05(2) = -.916* Significant at .05 level of significance

the r value was -.916*The data does suggest that there is significant relationship between Horizontal velocity 2nd to take-off Stride (Take-off) of long jumpers with performance.

DISCUSSION OF THE FINDINGS

1. The results of the study notify that there is significant relationship between Horizontal velocity 2nd to take-off Stride (Take-off) of long jumpers with performance. Lakhwinder Singh, (2018) Relationship of kinematic analysis and performance of long jump athletes supported the present study.
2. The result of the study informs that there is significant relationship between Horizontal velocity 2nd to take-off Stride (Take-off) of long jumpers with performance. Ter-Ovanessian (1993) "Biomechanical Analysis of the World Record Long Jump" supported the present study.

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