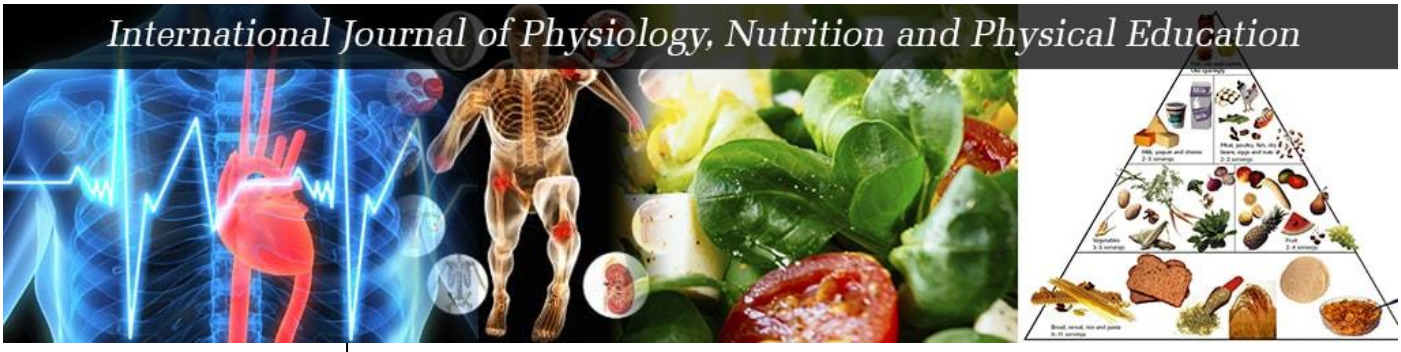

ISSN: 2456-0057
IJPNPE 2019; 4(2): 149-151

www.journalofsports.com
Received: 19-05-2019
Accepted: 21-06-2019

Santhosh R
PhD Scholar, LNCPE, Trivandrum, Kerala, India

Dr. SJ Shabu
Assistant Professor, Govt. Teacher Education College, Thykadu, Trivandrum, Kerala, India

Correspondence
Santhosh R
PhD Scholar, LNCPE, Trivandrum, Kerala, India

Kinematic analysis on selected biomechanical parameters of hop phase in tipple jump

Santhosh R and Dr. SJ Shabu

Abstract
The purpose of the study was to find out the relationship among the selected kinematic variables of hop phase of triple jump. For the purpose of the study 20 interuniversity triple jumpers were selected and their trials were recorded using digital cameras (Sony A7S2, lens: 24-105mm, 120 FPS). Each athlete's best legal trials were analyzed for the study. The analysis on each attempt was done using Kinovea motion analysis software. The data pertaining to the selected biomechanical variables of hop phase of triple jump were tested using Descriptive statistics, and Pearson's Product Moment Correlation. The level of significance was set at 0.05 for testing the hypothesis. The kinematic analysis of selected biomechanical variables of hop phase in triple jump revealed that distance of hop has significant relationship with the selected biomechanical variables like Average Velocity, Takeoff Velocity, Horizontal Velocity, Loss of Horizontal Velocity and Maximum Height of CG.

Keywords: Kinematics analysis, triple jump

Introduction
The hop phase is a crucial element in determining the ultimate distance of a triple jump. The definition of the word hop implies certain tendencies that describe the mechanics of this phase. The hop initiates with the athlete jumping from the mark on his/her takeoff leg, and landing on the runway with the takeoff leg. As the jumper takes off from the ground on a designated leg, the movement includes a backward recovery of the same leg. It then swings forward a second time, so that the jumper lands on the same foot. During the hop the athlete performs a leg change so that the take-off leg is in front again for the step. It turns out to be more of a "cycling'' movement. The take-off angle in the hop is considerably lower than in the long jump (12 -15° as opposed to 19 - 23°). The jumper must endeavor to stanch as little as possible in the take-off that means he/she must try to pull the take-off foot as close as possible under the body. The objective of the hop phase is to go forward and up, not upward and forward as in the long jump. This is accomplished by keeping the body upright and rotating the heel of the hop leg up under the buttocks and then extending it as far forward as possible. Considering the mechanical importance of hop phase the researcher made an attempt to find out the relationship among the selected kinematic variables of hop phase of triple jump.

Materials and methods
Twenty National level Triple Jumpers of age group 18-25 years were randomly selected as the subjects for the study. Distance, Flight Time, Average Velocity, Takeoff Velocity, Angle of Takeoff, Horizontal Velocity, Loss of Horizontal Velocity, Vertical Velocity, Duration of Support Phase, Minimal Knee Angle at Touch Down, Inclination Angle at Touch Down, Trunk Angle at Touch Down, Trunk Angle at Takeoff, and Maximum Height of CG at Takeoff were selected as the variables for the study. **T**heir trials were recorded using digital cameras (Sony A7S2, lens: 24-105mm, 120 FPS). The performance distance comprises of 25metres had been analyzed and divided the total distance in to 3 zones (9m, 8m, 9m). A 0.5m overlap occurred between zones 1and 2 and between zones 2 and 3. Each zone was covered by a single camera and an additional camera was used to record the total area in order to capture the whole sequence Camera (1), camera (2) and camera (3) covering the first second and third zones were positioned at the midpoint of each zones to the left side of the runway at a distance of 10

meter from the left edge near the approach path. The camera lens was oriented perpendicular to the plane of motion (sagittal) at a height of 1.35 meters which was approximately equal to one half of the height of the athlete when he was in the air after the take off. Each attempt was captured and saved in to a computer in AVI format. The analysis on each attempt was done using Kinovea motion analysis software. All the kinematics variables of hop phase were measured using Kinovea motion analysis software. The data pertaining to the selected biomechanical variables of hop phase of triple jump phase was tested using Descriptive statistics, and Pearson's Product Moment Correlation. The level of significance was set at .05 for testing the hypotheses.

Results of the study

The Kinematic variables of hop phase in triple jump of the research subjects are presented in Table 1.

Table 1: Analysis of the variables of Hop phase in Triple Jump

Variable	Mean	Std. Deviation	N
Distance	5.453	0.405	20
Flight Time	0.539	0.051	20
Average Velocity	10.199	1.128	20
Takeoff Velocity	8.840	0.410	20
Angle of Takeoff	12.850	2.519	20
Horizontal Velocity	8.613	0.388	20
Loss of Horizontal Velocity	1.569	0.388	20
Vertical Velocity	1.969	0.409	20
Duration of Support Phase	0.131	0.007	20
Minimal Knee Angle at Touch Down	134.850	2.907	20
Inclination Angle at Touch Down	15.800	2.441	20
Trunk Angle at Touch Down	87.200	7.488	20
Trunk Angle at Takeoff	87.300	7.087	20
Max: Height of CG at Takeoff	1.166	0.048	20

The research group had a mean distance of 5.45m with a standard deviation of 0.41m in the hop phase.

The mean flight time and standard deviation of hop phase were recorded as 0.54s and 0.05s respectively. The results for the mean average velocity and standard deviation of hop phase of the research subjects were 10.20m/s and 1.13m/s respectively. The mean takeoff velocity and standard deviation of hop phase of the research subjects were recorded as 8.84 m/s and 0.41 m/s respectively. The results of the mean angle of take off and standard deviation of hop phase were 12.85 degree and 2.52 degree respectively. The research group had a mean horizontal velocity of 8.61m/s with a standard deviation of 0.39m/s in the hop phase.. The mean loss of horizontal velocity and standard deviation of hop phase of the research subjects were 1.57 m/s and 0.39 m/s respectively. The mean vertical velocity and standard deviation of hop phase of the research subjects were recorded as 1.97 m/s and 0.41 m/s respectively. The values for the mean duration of support phase and standard deviation of hop phase were 0.13 s and 0.007 s respectively. The research group had a mean minimal knee angle at touchdown of 134.85 degree with a standard deviation of 2.91 degree in the hop phase. The mean inclination angle and standard deviation of hop were recorded as 15.80 degree and 2.44 degree respectively. The mean trunk angle at touchdown and standard deviation of hop phase of the research subjects were 87.20 degree and 7.49 degree respectively. The results of mean trunk angle at takeoff and standard deviation of hop phase of the research subjects were 87.30 degree and 7.09 degree respectively. The mean maximum height of CG and standard deviation of hop phase were 1.17 m and 0.05 m respectively.

Table 2: Correlation analysis between dependent variables

Variable		Correlation Coefficient	Sig.
Distance of Hop Phase	Flight Time	0.137	0.565
	Average Velocity	0.544**	0.013
	Takeoff Velocity	0.873**	0.000
	Angle of Takeoff	0.160	0.501
	Horizontal Velocity	0.876**	0.000
	Loss of Horizontal Velocity	-0.880**	0.000
	Vertical Velocity	0.348	0.133
	Duration of Support Phase	0.015	0.949
	Minimal Knee Angle at Touch Down	0.326	0.160
	Inclination Angle at Touch Down	-0.107	0.652
	Trunk Angle at Touch Down	0.069	0.771
	Trunk Angle at Takeoff	0.234	0.320
	Max: Height of CG at Takeoff	0.580**	0.007

The analysis of correlation coefficient between the distance of hop phase and the selected kinematic variables indicated that the distance has a positive relationship with Flight Time (r = 0.137, p = 0.565), Average Velocity (r = 0.544, p = 0.013), Take off Velocity (r = 0.873, p = 0.000), Angle of Takeoff (r = 0.160, p = 0.501), Horizontal Velocity (r = 0.876, p = 0.000), Vertical Velocity (r = 0.348, p = 0.133), Duration of Support phase (r = 0.015, p = 0.949), Minimal Knee Angle at Touchdown (r = 0.326, p = 0.160), Trunk Angle at Touchdown (r = 0.069, p = 0.771), Trunk Angle at Takeoff (r = 0.234, p = 0.320), Maximum Height of CG (r = 0.580, p = 0.007) and negative relationship with Loss of Horizontal

Velocity (r = -0.880, p = 0.000), and Inclination Angle at Touchdown (r = -0.107, p = 0.652).

Conclusions

1. Average Velocity has a positive relationship with the distance of hop phase. As the hop phase shows larger phase distance and moderate flight time, hop average velocity perceives higher. Larger phase distance of Hop is inveigled by the consequential variables such as Angle of Takeoff, Maximum Height of Center of Gravity at Takeoff, Take off Velocity, Duration of Support phase, Horizontal Velocity and Vertical Velocity, contributes to an optimal trajectory which consecutively influences the hop phase distance
2. Take off velocity has got a significant relationship with the hop phase distance. The Horizontal Velocity achieved along the approach run is transferred at the time of take off and the athlete takes off with a moderate Angle of Takeoff which enhances the Take off Velocity of the Hop phase. Another decisive factor which persuaded the Take off Velocity of the hop phases is the Duration of Support phase and Maximum Height of CG at Takeoff.
3. Horizontal Velocity significantly correlates with the hop phase distance. The athlete acquired maximum Horizontal Velocity along the approach run, transferred after an active foot placement at the time of take off converted to an elevated Take off Velocity results to a maximum Horizontal Velocity during the Hop phase. Angle of Take off and the Vertical Velocity are the two dominant parameters influences the horizontal velocity at the time of take off. As the Angle of Take off increases the Vertical Velocity also increase which may hamper the Horizontal Velocity. Since the hop phase shows optimum angle of take off and vertical velocity the Horizontal Velocity at the hop phase perceives the highest which enhances the hop phase distance.
4. Loss of Horizontal velocity has got a negative relationship with the hop phase distance. Once the athlete prepares for the takeoff, the whole momentum achieved during the approach run has been transferred which in turn results in greater Loss in the Horizontal Velocity of Hop phase. Active Take off is influenced by the variables Duration of support phase, Horizontal Velocity and Maximum Height of CG at Take off which contributes minimum Loss of Horizontal Velocity successively enhances the performances.
5. Maximum Height of CG at Takeoff has a positive relationship with the hop phase distance. During the Hop phase, the athlete takes off at a high Take off Velocity with a moderate Angle of Takeoff and moderate flight curve in order to maintain the Horizontal velocity achieved during the runway in the successive phases. Therefore, the Maximum Height of Center of Gravity at Take off is moderate which results in an increased hop phase distance

References

1. Allen SJ, King MA, Yeadon MR. Optimisation of phase ratio in the Triple jump using computer simulation, Human Movement Science. 2016; 46:167-176.
2. Brfidgette LA, Linthorne MP. Changes in long jump takeoff technique with increasing run-up speed. Journal of Sports Science. 2006; 24:889-897.
3. Hay JG. Citius, Altius, longius (faster, higher, longer): the biomechanics of jumping for distance. Journal of Biomechanics. 1993; 26:7-21.
4. Miladinov O, Bonov P. Individual approach in improving the technique of triple jump for women, New Studies in Athletics. 2004; 19:27-36.
5. Miller JA, Hay JG. Kinematics of a world record and other world- class performance in the triple jump. International Journal of Sports Biomechanics. 1986; 2:272-288.