Influence Of Block Phase Mechanics On 100-Meter Sprint Performance: A Study Of Hip Angle, Knee Angle, And First-Step Distance

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ARTICLE INFO	ABSTRACT
	The study's goal was to determine how stride length, stride angle, and flight time related to block phase 100-meter sprint performance. Ten collegiate sprinters were chosen for this purpose from among Jammu's colleges and sports clubs.Three Y1 cameras with an f/2.8 aperture lens and a 140-degree field of view were used to record the subjects while they ran a 100-meter sprint on a synthetic track at 60 frames per second and 1080p. Each of the three cameras was positioned 0.94 meters above the ground and seven meters away from the plane of motion. One hundredth of a second was used to measure the 100-meter sprint performance. KINOVEA software was used to analyze the recorded footage in order to determine the first leg's distance from the start line (meters), hip angle (degrees), and knee angle (degrees). To determine the impact of the first leg's distance from the start line (meters), hip angle (degrees), and knee angle (degrees) on 100-meter sprint performance, the gathered data was analyzed using Pearson product moment correlation. The level of significance was set at 0.05 in each instance. It was determined that the 100-meter sprint performance was significantly correlated with the first leg's distance from the start line, hip angle, and knee angle. **Keywords-** Hip angle, knee angle, sprinting, kinematics, explosive strength, tibial condyle, meatarsal head.

Introduction

One of the most well-liked and competitive track events is the 100-meter sprint, where even little technical variations can have an impact on the outcome. The block phase is the most crucial of all the sprinting phases as it determines the runner's starting velocity and affects the race's early acceleration. The sprinter may produce more horizontal force and get greater momentum at the start of the run with a powerful and well-executed block start (Mann & Sprague, 1980). Research in sprint biomechanics has shown that proper body angles and effective force application during the start are key factors for better sprint performance (Morin et al., 2012; Nagahara et al., 2014). The distance of the first step from the start line, the hip angle, and the knee angle are some crucial kinematic factors during the block phase. When it comes to propelling the body forward, the hip angle during block clearance is crucial. An athlete may accelerate more effectively and generate more horizontal velocity when their hips are properly extended (Bezodis et al., 2010; Čoh et al., 2017).In a similar vein, the sprinter's ability to exert power against the starting blocks is influenced by the angle of their front and back legs. A stronger push-off and improved utilization of muscular strength are the outcomes of proper knee placement (Harland & Steele, 1997).

The first leg's distance from the starting line is another crucial consideration. This distance demonstrates the athlete's ability to properly translate explosive energy into forward motion. An excessively lengthy or short initial stride might disrupt the rhythm of acceleration and decrease efficiency (Mero et al., 2006).

Thus, the current study is to investigate the link between 100-meter sprint performance and hip angle, knee angle, and first-step distance during the block phase. Coaches and athletes may find the results useful in enhancing sprint performance and beginning technique.

Methodology

The purpose of this study was to examine the influence of the first leg's distance from the start line , hip angle , and knee angle on 100-meter sprint performance. Ten university-level sprinters from different institutions and sports teams in Jammu participated in the study.

Block Phase
Three YI cameras with f/2.8 aperture lenses, a 140-degree field of view, 1080p resolution, and 60 frames per second recording capacity were used to capture sprint performance. The cameras were placed 7 meters away from the running lane and positioned at a height of 0.94 meters. Video recording was conducted between the 60-meter and 80-meter sections of the 100-meter sprint to analyze top speed phase mechanics. Sprint time for 100 meters was measured using a stopwatch with an accuracy of 1/100 second.
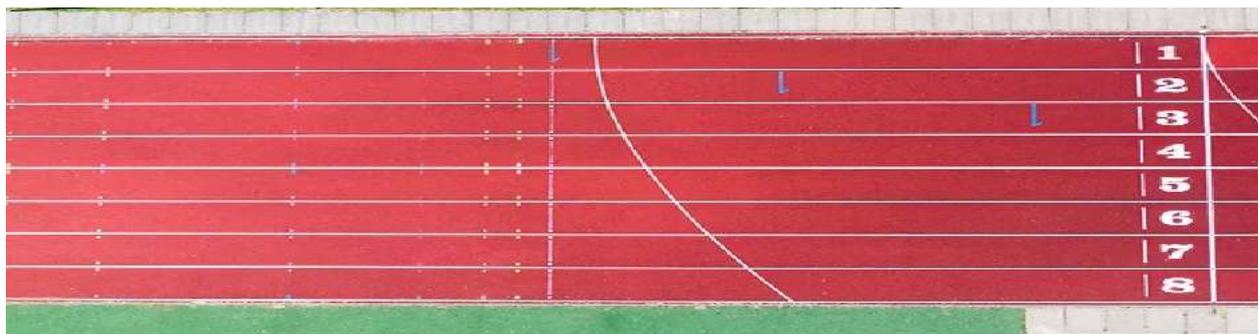
Knee Angle
Knee angle was assessed using the angle tool when the sprinters were in set position. Angle between the thigh and tibial condyle line was measured.

Hip Angle
Hip angle was assessed using the angle tool when the sprinters were in set position in block phase. Angle between the trunk and femoral condyle line was measured.

Distance between the start line and first leg

Distance between the start line and first leg was assessed using the distance when the sprinters were in set position in block phase. Start line to second metatarsal head of first leg distance was measured.

Statistical analysis was performed using the Pearson product-moment correlation coefficient to examine the relationships between hip angle, knee angle, distance of first leg from start line , and 100-meter sprint performance. The level of significance was set at 0.05 for all analyses.

Results and Discussion

S.No	Variables	N	Min	Max	Mean	S.D

Dependent Variable

S.No	Variables	N	Min	Max	Mean	S.D
1.	100 Meters Sprint Performance (secs)	10	10.96 secs	13.58 secs	11.76 secs	1.07

Independent Variables In Block Phase

S.No	Variables	N	Min	Max	Mean	S.D
2.	Hip Angle (degrees)	10	53.90	58.30	55.60	2.07
3.	Knee Angle (degrees)	10	112.40	118.80	114.70	2.40
4.	Distance of first leg from start line (meters)	10	0.26	0.36	0.31	0.04

Interpretive analysis of Dependent Variable

The 100 meters sprinting performance had minimum and maximum value of 10.96 secs and 13.58 secs respectively.The mean and standard deviation were 11.76 secs 1.07 respectively.

Interpretive analysis of independent variables in Block phase in 100-meter sprint

The minimum and maximum **hip angle** was 53.90 degrees and 58.30 degrees respectively. The mean and standard deviation were 55.60 degrees and 2.07 respectively.

The 100m sprinters minimum and maximum **knee angle** was 112.40 degrees and 118.80 degrees respectively. The mean and standard deviation were 114.70 degrees and 2.40 respectively.

The minimum and maximum **distance of first leg from start line** was 0.26 meters and 0.36 meters seconds respectively. The mean and standard deviation were 0.31 and 0.04 seconds respectively.

Pearson's correlation analysis

Pearson's product moment correlation was used to find out the relationship between selected dependent variable and independent variables in 100m sprint.

Independent Variables in Top Speed Phase

Variables	r value
Hip Angle	- 0.886
Knee Angle	- 0.583
Distance of first leg from start line	- 0.932

Interpretive results of 100m sprinting performance and Block phase variables

From the table, it was deducted that the 100m sprinting performance had significant strong negative correlation with hip angle (r= -0.886), moderate negative correlation with knee angle (r= -0.583) and very strong negative correlation with distance of first leg from start line (r= -0.932).

Conclusion

The hip angle had a significant negative correlation witht the 100 meters performance, the knee angle moderate negative correlation with the 100 meters performance and distance of first leg from start line had a very strong negative correlation with the 100 meters sprint performance.

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