Kinematical Analysis of First Step Length at Varied Angles of Block in Athletics

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Abstract
The purpose of the study was to compare the varied angles of block in relation to first step length in sprint start. Eight male (national / inter university level) sprinters were selected from Sub Centre Sports Authority of India, Lucknow and Banaras Hindu University Varanasi who’s age ranged between 17 to 30 years. The data were analyzed using, analysis of variance (ANOVA) test was applied. Insignificant difference was found at varied angles of block in athletics in relation to First step length.

Keyword: Biomechanics, Linear kinematics, Block Angle 45/45, 45/60, 60/75, 75/90

INTRODUCTION
Performance in the 100 m sprint is influenced by a multitude of factors including starting strategy, stride length, stride frequency, physiological demands, biomechanics, neural influences, muscle composition, anthropometrics, and track and environmental conditions. The sprint start, the accelerative phase of the race, depends greatly on muscular power. Three considerations of the sprint start are reaction time (time to initiate response to the sound of the starting gun), movement time (onset of response until end of movement) and response time. Maximal velocity running is a result of stride length and stride frequency. While stride length can be greatly limited by an individual’s size and joint flexibility, stride frequency can be affected by muscle composition, neuromuscular development, and training. Although 100 m sprint world record times have progressed drastically, there is limited evidence for how technology has contributed to such improvement. As such, human physiology and physique combine to be the most influential determinants of improved sprint performance. (Aditi S. Majumdar and Robert A. Robergs) (2006)

METHODOLOGY
Eight male (National / Inter university level) sprinters were selected from Sub Centre Sports Authority of India, Lucknow and Banaras Hindu University Varanasi who’s age ranged between 17 to 30 years. According to availability of two Casio EX-F1 high speed cameras were used, which have frequency from 60 to 300 frames per second (f/s). The data were recorded from sagittal plane and frontal plane. The data was analyzed by Silicon coach-pro7 motion analysis software.
### Table-1: Descriptive Statistics at Varied Angles of Block in Athletics in Relation to First Step Length

<table>
<thead>
<tr>
<th>Angle</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>95% Confidence Interval for Mean</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>45/45</td>
<td>1.4063</td>
<td>.27055</td>
<td>.09565</td>
<td>Lower Bound: 1.1801 Upper Bound: 1.6324</td>
<td>1.08</td>
<td>1.86</td>
</tr>
<tr>
<td>45/60</td>
<td>1.4638</td>
<td>.18150</td>
<td>.06417</td>
<td>Lower Bound: 1.3120 Upper Bound: 1.6155</td>
<td>1.28</td>
<td>1.72</td>
</tr>
<tr>
<td>60/75</td>
<td>1.3113</td>
<td>.16287</td>
<td>.05758</td>
<td>Lower Bound: 1.1751 Upper Bound: 1.4474</td>
<td>1.05</td>
<td>1.59</td>
</tr>
<tr>
<td>75/90</td>
<td>1.4600</td>
<td>.25939</td>
<td>.09171</td>
<td>Lower Bound: 1.2431 Upper Bound: 1.6769</td>
<td>1.11</td>
<td>1.88</td>
</tr>
<tr>
<td>Total</td>
<td>1.4103</td>
<td>.22150</td>
<td>.03916</td>
<td>Lower Bound: 1.3305 Upper Bound: 1.4902</td>
<td>1.05</td>
<td>1.88</td>
</tr>
</tbody>
</table>

### Table-2: Analysis of Variance of Mean at varied Angles of Block in Athletics in Relation to First Step Length

<table>
<thead>
<tr>
<th>Source of Variable</th>
<th>Sum of Squares</th>
<th>Degree of Freedom</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>.121</td>
<td>3</td>
<td>.040</td>
<td>.808</td>
</tr>
<tr>
<td>Within Groups</td>
<td>1.400</td>
<td>28</td>
<td>.050</td>
<td></td>
</tr>
</tbody>
</table>

* Significant at 0.05 level, Tabulated F-value required to be significant at (3, 28) = 2.95

Table- 2 revealed that insignificant difference was found at varied angles of block in athletics in relation to First step length, as obtained F-ratio was (.808), which was less than the tabulated value of (2.95), at 0.05 level with (3, 28) degree of freedom.

**Graph-1: Graphical Representation of Comparison of Means of Sprinters at Varied Angles of Block in Athletics in Relation to First Step Length**

First step length was found greater at 45 to 60 degree of block at varied angles of block in athletics.
DISCUSSION AND FINDINGS
Insignificant difference was found with first step length at varied angles of block in athletics. First step length was found (1.463 meter) greater at 45/60 degree of block and second best step length was found (1.46 meter) at 75/90 degree of block In athletics.

First step length was found optimal on 45/60 and 75/90 degree of block angle due to equal distributed there body weight medium block spacing were used by all the athlete so that at 75/90 degree block oblique is high so the at the time of drive the front knee forward for maintaining the COM so that the length of first step was found also well on 75/90 degree of block.

45/60 radian oblique angle on the block allowed the athletes to apply their foot force perpendicularly against the block for a longer time period. An increase in the runners’ explosive impulse coming out of the blocks produced longer block clearance times, and slightly higher maximal velocities during the accelerative phase (steps 2, 3, and 4). Although the angled block did not produce greater velocities during the first step, it did facilitate an effective transition to form running with slightly higher velocities which were non-significantly different in the latter steps measured. According to research conducted by Stevenson (1997), a longer stride resulted in a higher linear velocity at take-off, but hindered block clearance time. The present study found that the angled starting block produced slightly longer step lengths which resulted in higher linear velocities but slower block clearance times. Overall, 45/60 degree block angle was found better step length in comparison of other block angle. Although, these slight differences may appear to be insignificant, they may be beneficial for coaches and athletes, in sprinting events where the margin of winning or losing is measured in milliseconds.

Although this suggests a longer first step length will lead to enhanced sprint performance, a number of confounding variables, including stance type, anthropometrical variable training factor block spacing, and center of mass, may have contributed to the data variability. Rather than a longer or shorter first step being most beneficial, an optimal first step length is key for enhanced performance, which is individualized.

References


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