Relationship Between Leg Length and First Step Length with 100 Meter Sprinting Performance

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Abstract

The purpose of the study was to find out the relationship between leg length and first step length and 100 meter sprinting performance. For this purpose, 13 university level sprinters were selected from different colleges in Chennai. The subjects were captured in start acceleration of 100 meters sprint on mud track using one Y1 camera f/2.8 aperture lens with 155 degrees of view, resolution at 1080p and 60fps. Camera was mounted at a height of 0.43 meters with the distance of seven meters from plane of motion and leg length was measured with measuring tape in centimetres. The performance of 100 meter sprint was measured using stopwatch. The captured video was analyzed with KINOVEA software to find out the first step length. The collected data were analysed with Pearson product moment correlation to find the relationship between leg length and first step length with 100 meter sprint performance. In all cases, level of significance was fixed at 0.05. It was concluded that leg length and first step length had significant correlation with 100 meter sprint performance.

Keywords: Leg Length, First Step Length and Sprinting Performance.

Introduction

In 100 meters sprint, an athlete's goal is to cover the distance in the least possible time. The sprinter has to react quickly (reflex speed), accelerate as fast and for as long as possible (power), reach the highest possible running speed (maximum velocity), maintain this for as long as possible (maximum speed endurance) and minimize the loss of velocity caused by fatigue (sub-maximal speed endurance).

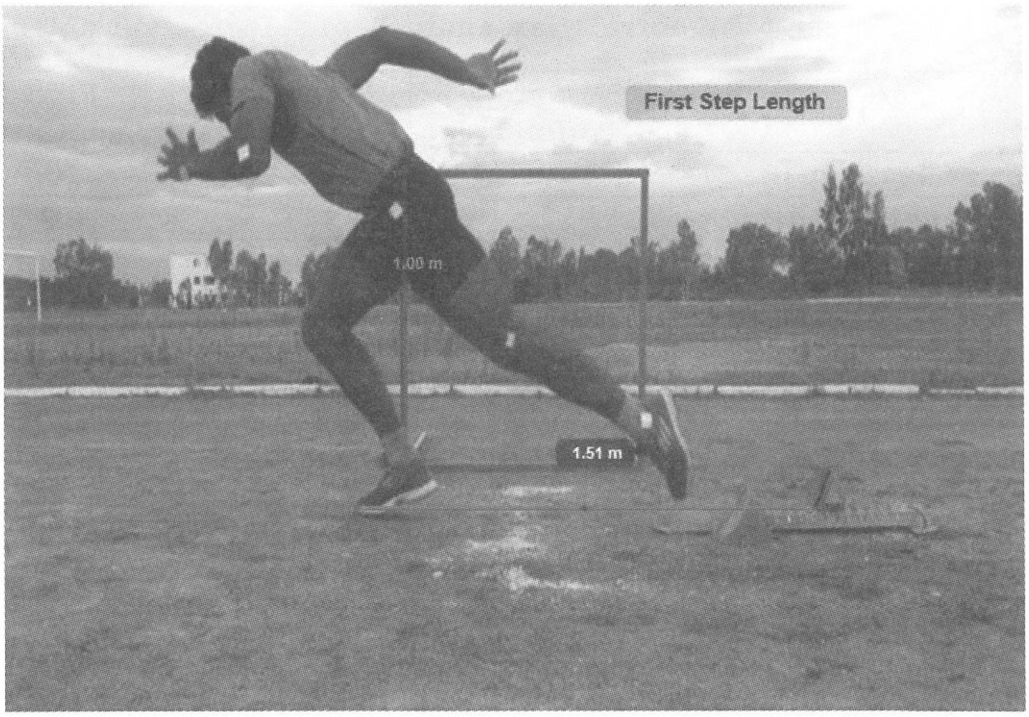
Abe, Fukashiro, Harada, & Kawamoto (2001) concluded that longer fascicle length is associated with greater sprinting performance in sprinters, but there is no gender difference in fascicle length for elite sprinters. Chelly and Denis (2001) conveyed that sprint performance undoubtedly involves muscle power; the stiffness of the leg also determines sprint performance while running at maximal velocity. Losos (1990) observed relationship between forelimb and tail length and ecology probably is a spurious result of the correlation between these variables and height, limb length. Further, because the evolutions of jumping and sprinting ability are closely linked, the ability to adapt to certain microhabitats may be limited.

According to Uth (2005), Coh et al. (2001), and Coh (2007) the anthropometric characteristics typical of sprinters in part might have an influence on relative muscle strength and step length. Especially in sprinters the presence of long lower extremities is found to be advantageous in achieving top performance (Vucetic et al., 2008). This is not consistent with the understanding that SL cannot only be defined by leg length. Mann and Sprague (1980) along with Simonsen et al. (1985) recognized other factors besides leg length including the force of the extensor muscles of the ankle and knee joints since they produce the push off impulse in the contact phase. Ciacci, Merni, Bartolomei, & Di Michele (2017) suggest that the start kinematics is only partially affected by the sex of sprinters, whereas a bigger role is played by their performance level.

After reviewing these researches it was evident that anthropometrical variables may have contributed to the step length and higher velocity of the sprinters, and also faster sprinters had the centre of mass (CM) closer to the ground and a more flexed front knee in the "set" position, longer pushing phase duration, lower vertical velocity of the CM at block clearing, and longer contact times and shorter flight times in the first two steps (Simone Ciacci, Franco Merni, Sandro Bartolomei & Rocco Di Michele, 2016). Hence this study focuses on the relationship of leg length and first step length with sprinting performance.

Methodology

The purpose of the study was to find out the relationship between leg length and first step length and 100 meter sprinting performance. For this purpose, 13 university level sprinters were selected from different colleges in Chennai. The subjects were captured in start acceleration of 100 meters sprint on mud track using one Y1 camera f/2.8 aperture lens with 155 degrees of view, resolution at 1080p and 60fps. Camera was mounted at a height of 0.43 meters with the distance of seven meters from plane of motion. The first step length was measured from starting block to Calcaneus at the same height above the plantar surface of the foot of leading leg and leg length was measured with measuring tape in centimetres. The performance of 100 meter sprint was measured using stopwatch. The captured video was analysed with KINOVEA software to find out the first step length.



The collected data were analysed with Pearson product moment correlation to find the relationship between leg length and first step length with 100 meter sprint performance. In all cases, level of significance was fixed at 0.05.

Results

Table I

Descriptive statistics of the selected variables

S. No.	Variables	N	Minimum	Maximum	Mean	Std. Deviation (±)
Dependent variable						
1.	Sprint Performance (Seconds)	13	11.37	13.61	12.32	0.57
Independent variables						
2.	Leg Length (centimetres)	13	79.85	88.5	84.53	2.29
3.	First Step Length (Meters)		1.32	1.61	1.49	0.09

Table – I shows that the mean value of sprint performance, leg length and first step length was 12.32, 84.53 and 1.49 with standard deviation of ±0.57, ±2.29, and ±0.09 respectively. The minimum values of sprint performance, leg length and first step length was 11.37, 19.85 and 1.32, and maximum values were 13.61, 88.5 and 1.61 respectively.

Table II

Showing the correlation analysis of selected variables

	Sprint Performance	Leg Length (Centimetres)	First Step Length (Meters)
Sprint Performance	*	**- 0.671***	**0.866**
Leg Length (Centimetres)		*	**- 0.573***
First Step Length (Meters)			*

Table 'r' value with df 11 = 0.553 at 0.05 level of confidence

It was evident from the Table – II that the sprinting performance was highly correlated with first step length (0.866) and negatively correlated with leg length (- 0.671). Leg length was correlated with first step length (- 0.573).

Figure I

Scatter plot for selected independent variables

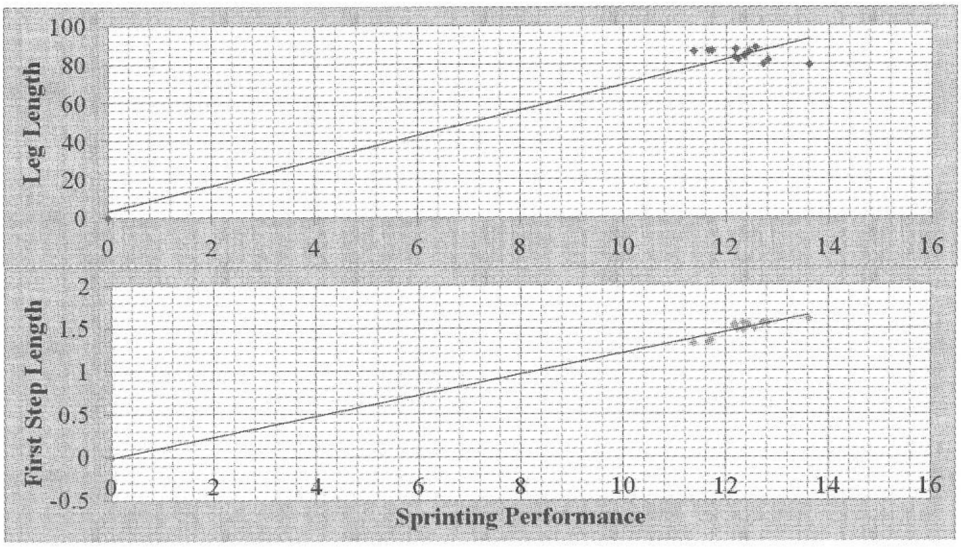


Table III

Showing 't' test analysis of correlation value

	Leg Length (Centimetres)	First Step Length (Meters)
'r' Value	-0.672	0.866
Number of Subjects	13	13
't' Value	3.01	5.75

Table 't' Value with df 11 = 2.20 at 0.05 level of confidence

From the table III it was found that the 't' value of leg length was 3.01 it was higher than the table value of 2.20. Hence there is sufficient evidence to conclude that there was a significant correlation between leg length and sprint performance.

It was also found that the 't' value of first step length was 5.75 it was higher than the table value of 2.20. Hence there is sufficient evidence to conclude that there was a significant correlation between first step length and sprint performance.

Discussions

From the results it was proved that leg length was negatively correlated with sprinting performance and first step length was positively correlated with sprinting performance. First step length and leg length also correlated negatively.

The result of the study also resembling the study of van Coppenolle et al. 1989 suggested average horizontal block acceleration is potentially a more useful measure of performance than block velocity, one athlete may exhibit a higher block velocity, and another could have a higher acceleration due to a shorter push phase duration. Hence he first step length was most contributed for the block velocity which contributed for the performance. Simone Ciacci, Franco Merni, Sandro Bartolomei & Rocco Di Michele (2016) conveyed that faster sprinters showed the centre of mass (CM) closer to the ground and a more flexed front knee in the "set" position, longer pushing phase duration, lower vertical velocity of the CM at block clearing, and longer contact times and shorter flight times in the first two steps. According to Uth (2005), Coh et al. (2001), and Coh (2007) the anthropometric characteristics part might have an influence on relative muscle strength and step length. Especially in sprinters the presence of long lower extremities is found to be advantageous in achieving top performance (Vucetic et al., 2008).

Conclusion

It was concluded that leg length and first step length was highly contributed to the sprinting performance.

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