



## Kinematic Comparison of Barefoot and Shod Running in Acceleration Phase of 100M Sprint

### KEYWORDS

Running, Barefoot, kinematic Analysis

#### Tapas Bapari

Research Scholar, Department of Physical Education, University of Kalyani

#### Dr. Nita Bandyopadhyay

Department of Physical Education, University of Kalyani

#### Prof. Sudarsan Bhowmick

Professor, Department of Physical Education, University of Kalyani

### ABSTRACT

Once upon a time players of all games and sports ran barefoot. After some time players of most of the games and sports run with different shoes. The purpose of present study was to compare the responsible mechanical factors for the performance of with shoe and without shoe running. Fifteen male athletes and fifteen male non-athlete were selected as subjects. The selected mechanical parameters were (a) Stride Length (b) Stride Frequency (c) Horizontal Velocity (d) Stride Time (e) Flight Time (f) Contact Time (g) Upper Body Inclination (h) Push Leg Inclination (i) Swing Leg Knee Angle (j) Push Leg Knee Angle (k) Front Arm Elbow Angle (l) Back Arm Elbow Angle. The movement of running were recorded by video camera and the parameters were analyzed by freeze frame technique. Results revealed that there were statistically significant difference between running with shoe and without shoe in contact time, Horizontal velocity and knee angle of swing leg. In all the cases running with shoe provides better performance. For Non Athlete group statistically significant difference appears only in Knee Angle of Push Leg. With shoe even the Non Athlete can push the ground with higher angle. Without shoe the subjects bend the push leg more at knee, which is bad for running performance. For other selected parameters there appears no significant difference.

### Introduction:

Running is a method of terrestrial locomotion allowing humans and other animals to move rapidly on foot. Running is a type of gait characterized by an aerial phase in which all feet are above the ground. The term running can refer to any of a variety of speeds ranging from jogging to sprinting. Jogging is running slowly and sprinting is running fast.

Since the beginning of civilization humans have traditionally run barefoot. Then different games and sports have involved in social life. Games and sports are movement activities where changes of position take place very fast. So players of most of the games and sports run from one place to another. The main purpose of this run is to change their position as soon as possible. Once upon a time players of all games and sports ran barefoot. Throughout most of human history, running was performed while barefoot or in thin-soled shoes such as moccasins. Historians believe that the runners of Ancient Greece ran barefoot.

### Results:

**Table-1: Descriptive statistics of selected kinematic parameters of Athlete group for running with shoe and without shoe in acceleration phase**

Parameter		Mean Value	S.D	Mean Difference	df	T Value	Remarks
Stride Length(cm)	Running with Shoe	123.043	+_7.729	3.733	28	1.183	Not significant
	Running without shoe	119.311	+_9.464				
Stride Frequency(no/sec)	Running with Shoe	3.460	+_0.173	0.039	28	0.564	Not significant
	Running without shoe	3.421	+_0.208				
Horizontal Velocity(Cm/sec)	Running with Shoe	424.849	+_19.528	18.320	28	2.801	significant
	Running without shoe	406.908	+_16.277				
Stride Time(Sec)	Running with Shoe	0.290	+_0.014	0.003	28	0.663	Not significant
	Running without shoe	0.293	+_0.018				
Flight Time(Sec)	Running with Shoe	0.075	+_0.012	0.008	28	1.998	Not significant
	Running without shoe	0.067	+_0.010				

After some time technology has been developed in all fields. Like all other fields technology has developed in sports and games and from that time players of most of the games and sports run with different shoes.

Present study was to analyze the responsible mechanical factors for performance of running.

### Methodology:

Fifteen male athletes and fifteen male non-athletes were selected as subject for the present study. Athletes participated in State level athletic meet and University Athletic meet. The selected mechanical factors were (a) Stride Length (b) Stride Frequency (c) Horizontal Velocity (d) Stride Time (e) Flight Time (f) Contact Time (g) Upper Body Inclination (h) Push Leg Inclination (i) Swing Leg Knee Angle (j) Push Leg Knee Angle (k) Front Arm Elbow Angle (l) Back Arm Elbow Angle. These were the criteria for measurement in this present study. The movements of the subjects for running were recorded by videographic method and data were analyzed by freeze-frame technique.

Contact Time(Sec)	Running with Shoe	0.214	+_0.014	0.012	28	2.229	significant
	Running without shoe	0.226	+_0.015				
Upper Body Inclination(0°)	Running with Shoe	36.550	+_3.940	0.167	28	0.100	Not significant
	Running without shoe	36.383	+_5.104				
Push Leg Inclination(0°)	Running with Shoe	53.617	+_2.204	0.600	28	0.776	Not significant
	Running without shoe	53.017	+_2.028				
Swing Leg Knee Angle(0°)	Running with Shoe	98.967	+_3.862	5.233	28	3.257	significant
	Running without shoe	104.200	+_4.880				
Push Leg Knee Angle(0°)	Running with Shoe	171.067	+_2.517	0.750	28	0.764	Not significant
	Running without shoe	170.317	+_2.850				
Font Arm Elbow angle(0°)	Running with Shoe	67.70	+_15.339	0.450	28	0.089	Not significant
	Running without shoe	67.25	+_12.321				
Back Arm Elbow angle(0°)	Running with Shoe	132.217	+_9.903	2.350	28	0.627	Not significant
	Running without shoe	129.867	+_10.601				

It is seen from the table that the mean values of all the parameters of athlete group in the

acceleration phase running with shoe were 123.043, 3.460, 424.849, 0.290, 0.075, 0.214, 36.550, 53.617, 98.967, 171.067, 67.70, 132.217 and sd were +\_7.729, +\_0.173, +\_19.415, +\_0.014,+\_0.012, +\_0.014, +\_3.940, +\_2.204+\_3.862, +\_2.517, +\_15.339, +\_9.903 and the mean values of running without shoe (Barefooted running) were 119.311, 3.421, 406.528, 0.293,0.067, 0.226, 36.183, 53.017, 104.200, 170.317, 67.25, 129.867 and sd were +\_9.464, +\_0.208, +\_16.277, +\_0.018, +\_0.010, +\_0.015, +\_5.104, +\_2.028, +\_4.880, +\_2.850, +\_12.321, +\_10.601 repactively. To observe the significant difference of all the parameters between running with shoe and without shoe 't' value was calculated and found to be 1.183, 0.564, 2.801, 0.663, 1.998, 2.229, 0.100, 0.776, 3.257, 0.764, 0.089, 0.627. In case of Stride Length, Stride Frequency, Stride Time, Flight Time, Upper Body Inclination, Push Leg Inclination, Font Arm Elbow Angle, Back Arm Elbow Angle the 't' value were not significant. This indicate that there were no statistically significant difference of Stride Length, Stride Frequency, Stride Time, Flight Time, Upper Body Inclination, Push Leg Inclination, Font Arm Elbow Angle, Back Arm Elbow Angle between running with shoe and without shoe in acceleration phase. But in case of Horizontal velocity, contact Time, Push Leg Inclination, Swing Leg Knee Angle the 't' value were significant. This indicate that there were statistically significant difference of Horizontal velocity, contact Time, Push Leg Inclination, Swing Leg Knee Angle between running with shoe and without shoe in acceleration phase.

**Table -2 Descriptive statistics of selected kinematic parameters of Non-Athlete group for running with shoe and without shoe in acceleration phase**

Parameter		Mean Value	S.D	Mean Difference	df	T Value	Remarks
Stride Length (cm)	Running with Shoe	119.311	+_7.033	3.733	28	1.362	Not significant
	Running without shoe	115.578	+_4.977				
Stride Frequency (no/sec)	Running with Shoe	2.981	+_0.220	0.098	28	1.269	Not significant
	Running without shoe	3.079	+_0.201				
Horizontal Velocity(Cm/sec)	Running with Shoe	354.832	+_20.694	0.213	28	0.027	Not significant
	Running without shoe	355.045	+_22.580				
Stride Time(Sec)	Running with Shoe	0.337	+_0.023	0.011	28	1.401	Not significant
	Running without shoe	0.326	+_0.020				
Flight Time(Sec)	Running with Shoe	0.067	+_0.013	0.006	28	1.407	Not significant
	Running without shoe	0.061	+_0.010				
Contact Time(Sec)	Running with Shoe	0.270	+_0.025	0.005	28	0.572	Not significant
	Running without shoe	0.265	+_0.022				
Upper Body Inclination(0°)	Running with Shoe	42.650	+_4.732	1.350	28	0.782	Not significant
	Running without shoe	41.300	+_4.729				
Push Leg Inclination(0°)	Running with Shoe	51.917	+_3.326	0.850	28	0.803	Not significant
	Running without shoe	51.067	+_2.395				
Swing Leg Knee Angle(0°)	Running with Shoe	106.583	+_5.920	0.967	28	0.392	Not significant
	Running without shoe	107.550	+_7.504				
Push Leg Knee Angle(0°)	Running with Shoe	159.283	+_2.884	3.184	28	2.834	significant
	Running without shoe	162.467	+_3.257				
Font Arm Elbow angle(0°)	Running with Shoe	84.500	+_17.675	1.000	28	0.167	Not significant
	Running without shoe	85.500	+_15.023				
Back Arm Elbow angle (0°)	Running with Shoe	126.950	+_9.857	0.383	28	0.109	Not significant
	Running without shoe	127.333	+_9.358				

It is seen from the table that the mean values of the all the parameters of Non-athlete group

in the acceleration phase running with shoe were 119.311, 2.981, 354.832, 0.337, 0.067, 0.270, 42.650, 51.917, 106.583, 159.283, 84.500, 126.950, and sd were +\_7.033, +\_0.220, +\_20.694, +\_0.023, +\_0.013, +\_0.025, +\_4.732, +\_3.326, +\_5.920, +\_2.884, +\_17.675, +\_9.857 and the mean values of running without shoe (Barefooted running) were 115.578, 3.079, 355.045, 0.326, 0.061, 0.265, 41.300, 51.067, 107.550, 162.467, 85.500, 127.333 and sd were +\_7.977, +\_0.201, +\_22.580, +\_0.020, +\_0.010, +\_0.022, +\_4.729, +\_2.395, +\_7.504, +\_3.257, +\_15.023, +\_9.358 respectively. To observe the significant difference of all the parameters between running with shoe and without shoe 't' value was calculated and found to be 1.362, 1.269, 0.027, 1.401, 1.407, 0.572, 0.782, 0.803, 0.392, 2.834, 0.167, 0.109. In case of Stride Length, Stride Frequency, Horizontal velocity, Stride Time, Flight Time, contact Time, Upper Body Inclination, Push Leg Inclination, swing Leg Knee Angle, Front Arm Elbow Angle, Back Arm Elbow Angle the 't' value were not significant. This indicate that there were no statistically significant difference of Stride Length, Stride Frequency, Horizontal velocity, Stride Time, Flight Time, contact Time, Upper Body Inclination, Push Leg Inclination, swing Leg Knee Angle, Front Arm Elbow Angle, Back Arm Elbow Angle between running with shoe and without shoe in acceleration phase. But in case of Push Leg Knee Angle the 't' value were significant. This indicate that there were statistically significant difference of Push Leg Knee Angle between running with shoe and without shoe in acceleration phase.

#### Conclusion:

On the basis of results obtained, the following conclusions were drawn:

1. For Athlete group statistically significant difference appears between running with shoe and without shoe in contact time, velocity and Knee Angle of Swing Leg. In all the cases running with shoe provides better performance.
2. For Non Athlete group statistically significant difference appears only in Knee Angle of Push Leg. With shoe even the Non Athlete can push the ground with higher angle. Without shoe the subjects bend the push leg more at knee, which is bad for running performance.
3. For other selected parameters there appears no significant difference for both Athlete and Non-Athlete groups.

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