ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

IJESRT
INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

JOINT EFFECT OF STRIDE LENGTH AND STRIDE WIDTH ON RUNNING PERFORMANCE

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DOI: 10.5281/zenodo.160901

ABSTRACT
The purpose of this study is to describe joint effect of stride length and stride width on running performance of 100m sprinters and 5000m distance runners during completion. Twenty runners (Ten100m sprinters & Ten 5000m distance) from All India Athletic Meet were selected for the study. The aged ranged from 18-25years, height ranged from 1.56-1.85 m, body weight ranged from 49 - 75 kg were of subjects. The subject's running motion was recorded using two Synchronised video cameras. One was secured to 2m behind 100m starting line for recording stride width and second was secured 18m away from first lane and 50 m from starting line in filed area for recording the stride length. Softwares MPEG, Photo Studio, SthSDVD , Coral-5 , Coral –9 , Player, and SPSS Software were used to analysed recorded data. F- Test has been applied to know the joint effect of stride length and stride width on running performance timings. The result was found that joint effect of stride length and stride width have significant effect on sprinter's running while joint effect of stride length and stride width have no significant effect on 5000m long distance running. Statistical significance was set at P< 0.05.

INTRODUCTION
A significant component of running performance of a sportsperson and prevention from injury is correct running style. Correct running style and running mechanics help to an athlete for make more efficient runner, run easier, faster and improve their running economy whereas poor running form is a cause of slow running and decrease athlete's running efficiency and also can even be the cause of many running injuries.

Running as a form of exercise which one of the other natural body movements that humans are blessed with. Every human being runs in different running style. Two major categories of athletes in running events of track and field are sprinting and distance running. Differences between these two groups are distance running concentrates on the economy of body movement whereas power and speed are associated with sprinting. During close to finish line of the any race, economy of movement gives way to speed. Nowadays, sprinting is not simply running fast and same as distance running is not simply running long. For separate of these two running categories, there are distinct variations in running technique and form.

Distance runners represent the foot-strike is often near the heel in an effort to absorb impact, and the feet are lifted no higher than necessary to complete each stride. Little vertical oscillation is found among distance runners, while arm motion is primarily for proper counterbalance (Williams and Cavanagh, 1987). Running speed is determined by two factors, the length of stride and frequency of stride. For increasing the running speed, one or both of these factors must be increased. Length of stride is dependent primarily upon leg length and the power of the stride. Leg speed (frequency) is mostly dependent upon speed and strength of muscle contraction as well as neuro-muscular coordinator in running. (Shaw, 1998)

The running speed increases when stride length remains constant and stride rate increases. Similarly, if stride rate remains constant then stride length increases resulting increase in speed (Enoka, 1994). The stride length is again related with the range of motion about a joint (quantity) and the pattern of displacement (quality). As the runner goes from a walk to a run the angular displacement around about the knee joint increases. Likewise, the range of motion around both shoulder and elbow joints also increases as a person goes from walk to a sprint (Vaughan, 1984). As the length of the race increases beyond 400m normally regarded as the longest sprint event. The athlete's stride length and stride frequency are both substantially reduced; so too are the range and vigor of most of athlete's actions. The forcefulness of the extension of the hip, knee and ankle joints during the driving phase is reduced (Hay, 1993)

To rationalize a movement as an efficient one, it is very important to investigate the movement first. Some time, it is very difficult for a human eye to analyse all the movements of various body segments and joints at the same time, so this has been potentiated by technical advances including faster cameras and marker systems which eliminate the need to hand digitize frame after frame of video. The best method to analyse or evaluate various movements is called cinematography. This is a quantitative method which is very accurate but at the same time costly and time consuming. The role of cinematography in biomechanical research involves form of recording motion to a sophisticated means of computer analysis of better efficiency. Over the years, new techniques in filming and timing have been perfected to aid the research in achieving accurate time measurements of both simple and complex locomoting patterns. (Newton and Arononcher, 1996)

However, researchers have committed their time to study the running complex motion of track events by investigative the relevant biomechanical variables. These include Stride length also contributes to the success of a runner (Cavanagh, 1987;Nummela et al., 2007). When a runner increases speed, stride length increases even with a self-selected optimal stride lengths displayed by each runner (Nummela et al., 2007). Further research can identify characteristics in stride lengthdisplayed by each group at various speeds. Mercer, Black, Branks and Hreljac (2001) have studied stride length effects on ground reaction forces during running. Aron, Robert and Aaron (2003) have studied kinematic determinants of early acceleration in field sport athletes.

Due to the complex nature of running motion, Coaches and sports scientists are taking interest to identifying the factors that affect running performance. Identifying variations in the biomechanical attributes between athletes of special talent is important, but All India athletes are rarely available in the same place and at the same time. Thus data collection during competitions is a good solution. Since athletes perform to their best during competitions, this should result in the best performance data. Such comparative studies can provide joint effect of stride length and stride width into the key biomechanical variables that potentially differentiate running performance. There is, however, a paucity of studies comparing athletes of a All India level. The main aim of the present study was to establish joint effect of stride length and stride width on running performance of sprinters as well as distance runners. It was also hoped that our findings would provide new information for technique training of sprinter and distance endurance runners.

METHODOLOGY

Twenty runners (Ten sprinters & Ten 5000m distance) from All India Athletic Meet were selected for the study. The aged from 18-25years, height ranged from 1.56-1.85 m, body weight from 49 - 75 kg were of subjects. Table-1 has shown anthropometric description of subjects. All subjects were free from any physical injury at the time of video recording. The subject's running motion was recorded using two Synchronised Panasonic F15 S-VHS video cameras in a field setting. Two video cameras were projected on rigid tripod stands. One was secured to 2m behind 100m starting line for recording Step Width (SW) and second was secured 18m away from first lane and 50 m from starting line in filed area for recording the Stride Length (SL). SL and SW are represented by elgon figures 1& 2. The locations of the cameras were chosen such that the optical axes of the cameras intersected at 90 degrees at both planes namely Sagital plane, and Frontal plane. Once positioned of the cameras was over, the zoom on the camera was adjusted in order to see that the four selected sprinter's stride of the whole motion during the 100meter sprint were recorded into video tape. The sampling rates of the video cameras were 25 frames per second. In order to eliminate the effect of blurring at the time of video recording, the shutter of the cameras was fixed with a high speed (1/1000th of a second). Softwares like MPEG, Photo Studio, SthSDVD , Coral-5 , Coral –9 , Player, and SPSS Software were used to analysed recorded data. F- test has been applied to know the joint effect of Stride Length and Stride Width on sprinter's running on performance timings. Statistical significance was set at $P< 0.05$.

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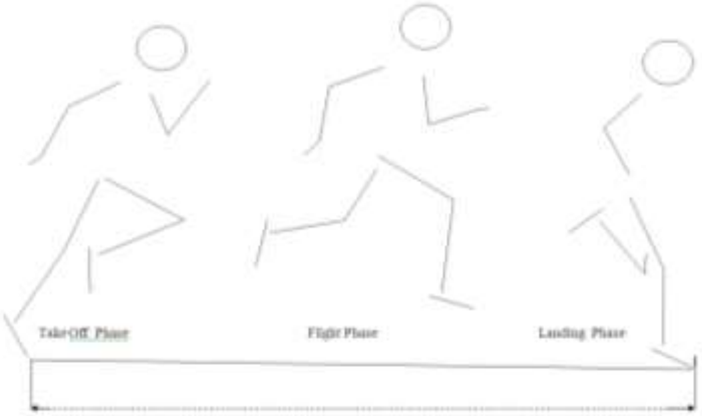

Figure-1
STRIDE LENGTH

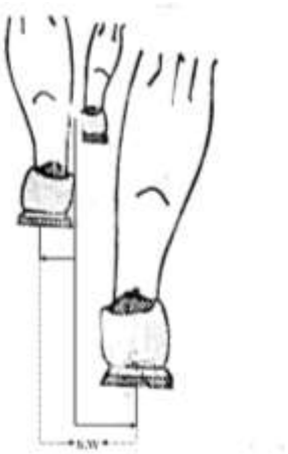

Figure - 2
Stride Width

Table –1

Anthropometric Data of the Subject

Variable	Range (Min - Max)	M	SD
Thigh Length (cm)	7.62 (38.1-45.72)	42.04	2.11
Lower Leg Length (cm)	3.81 (41.91-45.72)	43.28	1.27
Shoulder Girth (cm)	8.63 (32.01-40.64)	37.30	2.48
Leg Length (cm)	11.43 (85.09-96.52)	90.50	2.98

RESULT

For applying F-test we assume r_1=Performance timing of the subject (sec.), r_2=stride length (m) and r_3= stride width (m).

$$R^2_{1.23} = \frac{r^2_{12} + r^2_{13} - 2r_{12}r_{13}r_{23}}{1 - r^2_{23}}$$

$H_0 : \iota_{1.23} = 0$ (there is no significant)
Vs $H_1 : \iota_{1.23} > 0$ (there is significant)

Table-2

5000m long Distance running		F-Value	100m Sprint		F-Value
r_{12}	-0.20	2.17	r_{12}	-0.86	45.55
r_{23}	-0.09		r_{23}	-0.09	
r_{13}	-0.05		r_{13}	-0.05	

$F_{.05;2,08}$= 2.17

Table-2 revealed that the calculated F in 5000m long distance running is less than tabulated F. Therefore the joint effect of S.L and S.W does not play a significant role on 5000m long distance running mechanics. Since the calculated F in 100m sprint is greater than tabulated F. Therefore the joint effect of S.L and S.W play a significant role on 100m sprint running mechanics.

DISCUSSION

The result of this study indicated that the joint effect of the stride length and stride width was significant in sprint while the joint effect of the stride length and stride width was not significant in 5000m distance running. Increased speed is the characteristic of running and achieved by increased horizontal force when it is impossible to swing the leg forward before the other finishes its drive, the body is pushed hard in its forward and upward direction. The length of the stride is longer as a result of progress during non-support and of the greater angle of the driving leg. The greater angle of back ward gives an increased forward component. The body weight rides lower so supporting knee bends more as the body passes over it.

Monica and Kokubun (1998) observed that the stride length was sufficient to compensate the decreases in stride rate, thus maintaining the velocity, only when fatigue was not severe. Despite natural differences in stride length, similarities exist within groups. Sprinters have a longer stride length compared to distance runners (Armstrong et al., 1984; Bushnell & Hunter, 2007). Derrick and Hamill (1996) reported that the energy absorbed by the hip, knee and ankle during non-fatigued running was dependent on stride rate. Subjects ran at a constant speed, and changed stride rate to higher or lower rates compared to the preferred stride rate. Derrick, et al., 1996 was reported that the level of impact was lower and the energy absorbed by the lower extremity was lower during the higher stride rates. The energy absorbed by each joint was dependent on stride rate r elative to the preferred stride rate. At stride rates greater than preferred, most of the energy was absorbed by the knee and ankle. At stride rates lower than the preferred, most of the energy was absorbed by the knee.

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ISSN: 2277-9655
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