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AN ANALYSIS OF DIFFERENT RUNNING SPEED PARAMETERS WHICH INFLUENCING SPRINT RUNNING

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Abstract:

The purposeswere to study the relations of different running speed parameters and to compare them with performance. We analyzed the different factors which influences the speed performance such as stride length and stride frequency and the relation of these two factors with other physical and fitness factors such as height, weight, BMI, explosive strength, quadriceps strength, hamstring strength.16 University level trained athletes were considered as the subjects. Themanual methods were considered to measure different speed parameters. The performance of 50mtr run was recorded and each and every phase of 10mtr.run. The other parameters were measured and recorded manually. The stride frequencies were measured by the footmark of the nail and hence the stride length also.The different strength factors were measured in the gymnasium. The anthropometric measures such as the height, lower limb length and the body weightwere also measured. The result doesn't show any special relation between the different variables. Height and lower limb length influenced the stride frequency and the stride length which ultimately determine the speed performance. The stride frequency and the stride length correlated inversely with a very high significant value.Additionally the ability to strike the ground more forcefully may also be an important factor to get the more rebound force from the ground.

Key Words: Sprint Parameter, Kinematic Variables, Stride Length, Stride Frequency & Anthropometric Measures

1. Introduction

Running speed depends upon the stride frequency and stride length along with the lower limb length, body build, leg explosive strength etc. Among the said factors stride length and stride frequency are the most influential factors. Schmolinsky et al (1983) showed that the purpose of sprint training should be to increase leg explosive strength for maximum possible stride length with increase stride frequency. Gundlach (1963)investigated thoroughly regarding stride length during 100m sprint and reported that top sprinters increased their stride length up to 60m whereas poorly trained athletes increased them up to 30m. Saito et. al. (1975) reported that the sprinters exhibited slight decrease in stride length at the extreme velocity. Sprinting speed may be defined as the mutually interdependent factors of frequency and the strides length (Mann and Herman, 1985; Ae et al., 1992; Delecluse et al., 1998; Brűggemann et al., 1999; Gajer et al., 1999; Ferro et al., 2001). The speed of running increases with the increase of length or frequency of strides. The increase of both parameters simultaneously is quite difficult due to mutual dependency. Therefore an increase in one factor will result in an improvement in sprint velocity, as long as the other factor does not undergo a proportionately similar or larger decrease (Hunter at el., 2004). Frequency resultsinverselywith stride length. Therefore the increase in stride length must be directly proportional with the decrease of stride frequency, especially at the beginning of the race – the initial acceleration phase (Mackala, 2007).According to Hunter et al. (2004) and Bezodias et al. (2008), research investigating the relative importance of developing a long stride length or a high stride rate has been inconsistent across published data. Mann and Herman (1985), Ae et al. (1992) and Bezodias et al. (2008)reported that Stride Frequency was a more important contributor to the velocity increase in sprint performance, where Mero and Komi (1985), Gajer et al. (1999), Shen (2000) and Mackala (2007)informed that Stride Length was a more significant variable. Still now there are two different schools of thoughts regarding the application of those two kinematic parameters. However it is not clear also that how these two parameters and the other dependent variables are related with each other. There is no such information also how the two speed parameters change their magnitude in the full course of sprint running. Considering the said view the aim of the present study was formed and that were to find out the relationships among different speed parameterand its dependence upon different anthropometric measures and strength variables.

The purposesof this research were to study the relations of different running speed parameters and to compare them with performance of the university level boys. The different factors which influences the speed performance such as stride length and stride frequency and the relation of these two factors with other physical and fitness factors such as height, weight, BMI, explosive strength, quadriceps strength, hamstring strength etc. were taken into consideration.

2. Material and Methods:

2.1 Subjects:

The participants for this study were 16 University levelboys of age = 23.3 ± 2.93 years, body height =1.65 ± 0.05mtr. , body mass = 58.5 ± 7.4 kg., and 50mtr. performance = 7.02 ± 0.29 sec.

2.2 Criteria Measured:

- ✓ Anthropometric characteristics: body mass, body height, body mass index (BMI), lower limb length
- ✓ Kinematic parameters: stride length, stride frequency, speed performance for 50 mtr.
- ✓ Calculated factors: velocity, no. of stride in 30 mtr.
- ✓ Strength variables: explosive strength (mtr.), max. hamstring strength (Kg.), max. quadriceps strength (Kg.)

2.3 Measures and Procedures:

The data were taken in the ground of Jadavpur University, Kolkata. The subjects were the students of master of physical education who were trained athletes having some 5/6 years of training experience and were selected through purposive sampling. 50mtr. leneardistanceswas divided into 5 parts with 10mtrs each. The no. of strideswascounted by the signs of the running shoe nail and the time taken to cover each 10mtr.were recorded by stopwatch through manual system. The stride lengths were measured by the steel tape. The average stride length and the velocity were calculated.All the measures of other variables such as the explosive strength, maximum quadriceps strength and maximum hamstring strength were taken through standard test procedure in the University gymnasium.

3. Results and Discussion:

In case of finding out the results it included the calculation of mean, S.D. and co-rrelations. All the data were analyzed using the statistics package for windows Statistical Package for Social Science.

3.1 Results:

Table 1: Mean ± S.D. of different anthropometric parameters

Parameters	Mean ± S.D.
Body mass (kg.)	58.5 ± 7.4
Body height (mtr.)	1.65 ±0 .05
BMI (kg. /mtr.^{2})	20.43 ± 2.45
Lower Limb Length (mtr.)	0.79 ± 0.03

The average body height of the athlete was 1.65mtr and the average weight was 58.5 kg. On the other hand, average body mass index showed 20.43 kg/mtr^2. The average length of the lower limb was 0.79mtr. (Table1).

Table 2: Numerical values of selected kinematic parameters in the 50 m sprint:

parameters	Mean±S.D.
Time [sec.]	7.02±0.29
Velocity [mtr./sec.]	7.12 ± 0.43
Stride frequency [Hz.]	3.61 ± 0.16
Number of strides in 30mtr.	15.19 ± 1.38
Stride length [mtr.]	1.98 ± 0.16

Table 2 contains the basic kinematic parameters of the athletes. The average time taken to complete 50mtr was 7.02 sec. and the average velocity was 7.12mtr./sec. The average no. of strides taken by the athlete was 15.19 to cover 30mtr.The stride length was 1.98 mtr of course, the stride length is inextricably linked to its frequency, which was3.61Hzs.

Table 3: mean and S.D. value of selected strength parameters of the performers

Strength variables	parameter	Mean ± S.D.
Explosive strength	Vertical jump (mtr.)	.53± 0.06
Max. Hamstring strength	Hamstring pull (Kg.)	26.84± 5.15
Max. Quadriceps strength	Leg press(Kg.)	93.13± 20.57

The average value of different strength parameters are given here in the table 3.

Table 4: Co-efficient of correlation of different parameters

Factors	Stride Length	'p' value	Stride Frequency	'p' value
time	0.09	.74	-0.01	.97
Height	.36	.17	-0.40	.12
Lower Limb Length	.58	.02*	-0.58	.02*
Stride length	1.00	-	-0.97	.00001*
Explosive strength	.007	.97	-0.01	.97
Quadriceps strength	-.11	.68	0.001	.99
Hamstring strength	-0.02	.94	-0.01	.97

The positive relation of body height on the stride length is an established fact and which ultimately influence the running speed. Here the co-efficient of correlation between these two factors is .36 and which ultimately indicate the dependence of stride length on height. Although there are numerous other controlling factors such as body build, gravity, ground contact time, muscle type, power which determine the speed. The lower limb length also has some influence upon the stride length and co-efficient of correlation is also .58 which is fairly high but the relation is negative with stride frequency and both the value bears significant relationship. This is supported by the highly significant negative relationship (r = -0.97) between the stride length and stride frequency. Very weak relations were found in case of the different strength parameters.

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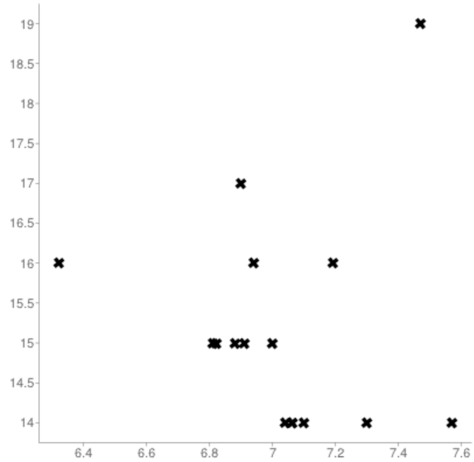
In the following sections we may concentrate ourselves to the different Scatter Plot diagram to get some idea regarding the different relationship:



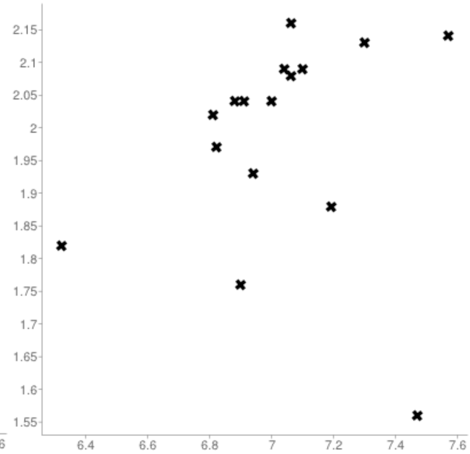
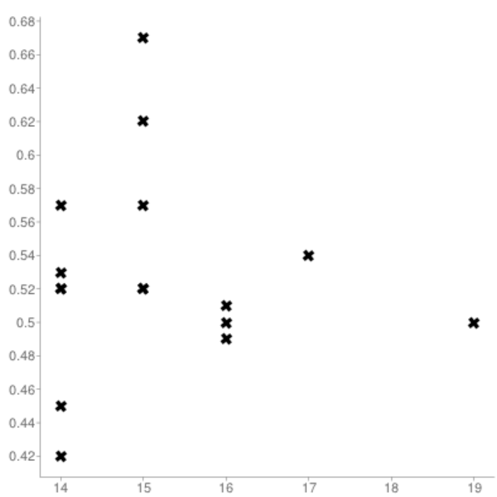
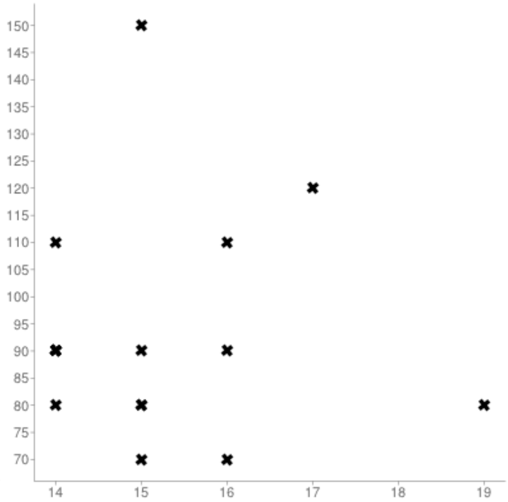


Figure 1: Scatter Plot (S.P.) diagram of Time vs Stride Length (S.L)

Figure 2: S.P. diagram of Time vs stride frequency (S.F)





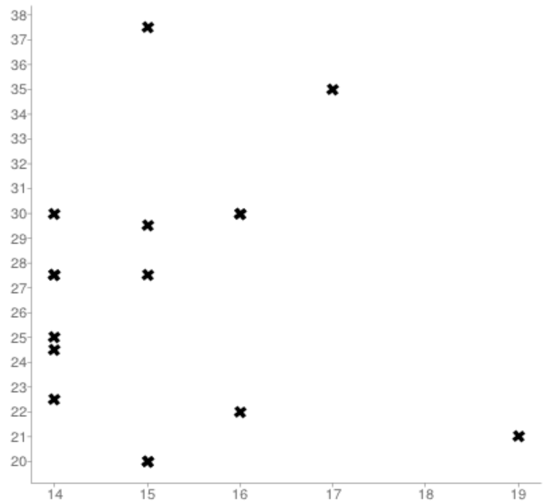
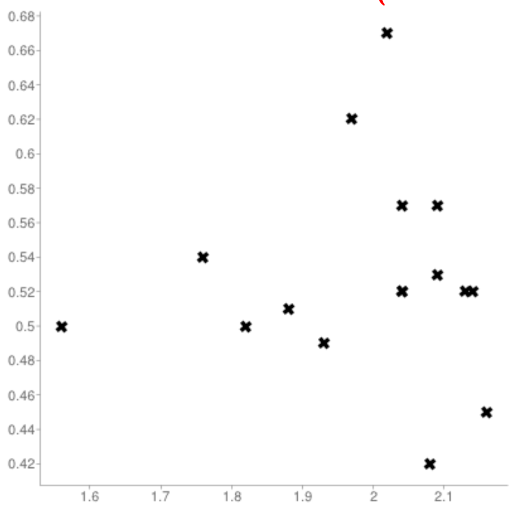
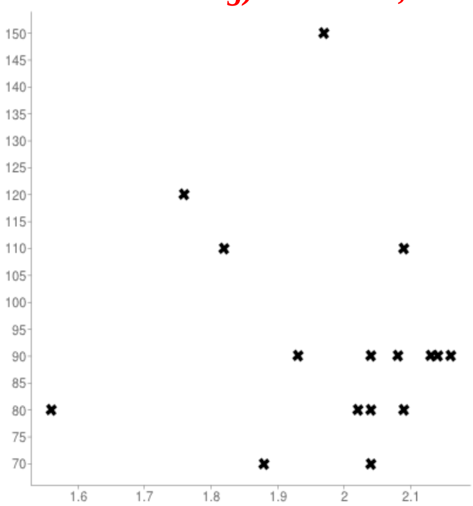


Figure 3: S.P. diagram of S.F vs exp. Strength
Figure 4: S.P. diagram of S.F vs quad. Strength
Figure 5: S.P. diagram of S.F vs hams. Strength





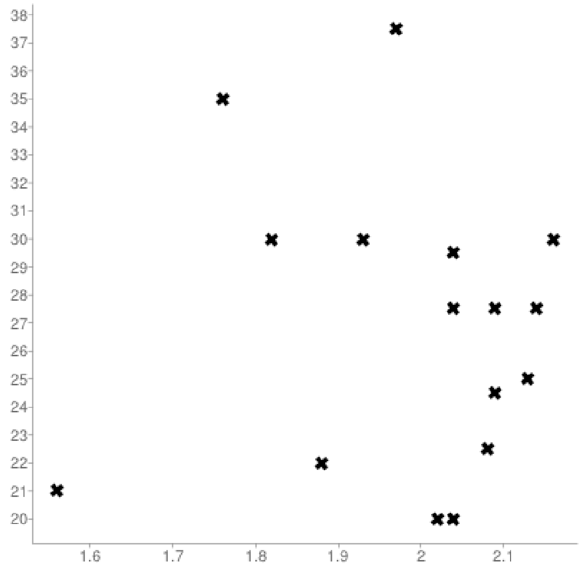
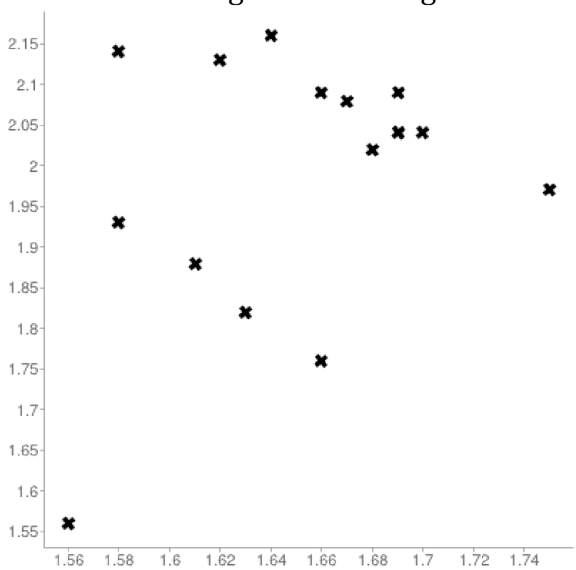


Figure 6: S.P diagram of S.L vs explosive strength
Figure 7: S.P diagram of S.L vs Quadriceps strength.
Figure 8: S.P diagram of S.L vs Hamstring strength.



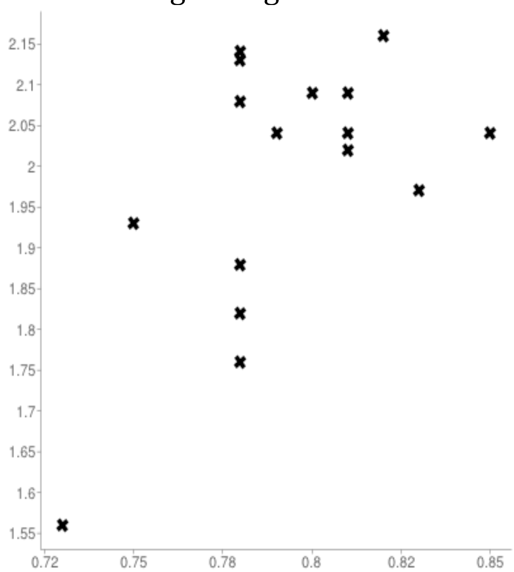


Figure 9: S.P diagram of Stride frequency vs lower limb length
Figure 10: S.P diagram of Stride Length vs Lower Limb Length

3.2 Discussion:

The purpose of this investigation was to culture the present status, compare and relate the different kinematic parameter, strength parameter and anthropometric measures with two main running speed parameters (stride length and stride frequency) of college level sprinter having long term training experience. Based on this, an attempt was made to discuss differentrelated factors which influence the sprinting performance. Rompetti (1957) and Hoffman (1967) found statistically positive significant correlation with stride length and body height and leg length.

The ability of the sprinters to achieve higher running speed depends on the striking force to the ground. According to Wey and et al. (2000), at top speed, every sprinter takes around a third of a second to pick their foot up and put it down again. Here it was app. 0.56sec (2x7.02x3/5/15.19) as from table 2. This difference occurred due to much less stride length and the different power related with lower limb such as the explosive strength, quadriceps strength and hamstring strength in college level in comparison to the international level.

Running velocity is the product of stride length and stride frequency (Luhtanen and Komi, 1978; Mero and Komi, 1985). But the time taken to cover a distance is not significantly correlated(co-efficient=0.04) with the product of stride length and stride frequency although the said very two important factors are negatively correlated(co-efficient=-0.97) with a very high level of significance. According to Ballereich (1976), the speed performance depends on these two parameters with an increase of stride length (with a decrease of number of strides and their frequency) or inversely, a decrease of stride length (with an increase in stride frequency) (Mackala, 2007). In turn, Delecluse et al. (1998) found a linear relationship between the length of the stride and speed. Here also we got such relationship but very poor with no significant level. However their research did not find a significant correlation between stride frequency and speed just like here also we got the same thing. Gajer et al. (1999), concluded on the French best sprinters that stride length was a more important factor contributing to the increase in velocity in sprint performance. Opposite to this statement, through a longitudinal case study Bezodis et al. (2008) stated that the changes in speed occurred as a consequence of changes in stride frequency. In this study the present researcher has tried to build up some relations between the three strength factors and the other two main speed parameters but no such conclusions may be drawn. Regarding these Hunter et al. (2004) stated that a longer stride length is achieved through long term development of strength and power.

So it clear that rather than the influence of the two discussed kinematic parameters i.e., stride length and stride frequency there are different factors which influenced the speed. It is very difficult to clearly identify one or two factor which influences the speed performance. The conjugate effect of different factors should be taken into consideration. It is rather important to establish the relationship between different factors which ultimately affect the speed and to find out the intensity of those relationships. As Hunter et al., (2000) rightly declared that, it is important to know how an improvement of one factor (i.e., stride length or stride rate) may affect another.

4. Conclusions:

Body height and lower limbs length are the two main anthropometric factors which influence the main two speed parameter the stride frequency and stride length. Between these two factors which one is more influential that is a matter of question. Besides these the power to strike the ground to get the rebound force for acceleration or maintain the uniform velocity depends upon the body build and strength of the lower limb. Analysis of the obtained results may be of great importance for trainers and coaches as it implies that work on stride frequency (SF) in order to reach a higher value of maximal sprinting speed should be given most weightage. Therefore, it is noteworthy that the main focus should be on the optimal interaction between stride lengths and stride frequency.

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