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Research Article

A STUDY ON EXPLOSIVE STRENGTH AS A PREDICTOR OF SPRINT RUNNING

Pallab Ray Sarkar and Asish Paul*

Department of Physical Education, Jadavpur University, Kolkata-32, W. B

A R T I C L E I N F O

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A B S T R A C T

Speed is an important component of most sports and running speed is vital in both team and individual sports. Maximal running speed is depend on running technique, stride length and rate, force capabilities, and production of power and impulse. Stride length and Stride frequency is influenced by the leg explosive strength and both are considered as the most influential factors to determine speed.The purpose of this study was to find out the relation between the explosive strength and the sprint performance for school going boys of 15^+ to 16 yrs. of age. Two teams were selected for a football match and each team comprises with 15 students. During this 30 minutes matchconsidering the resting heart rate, that has earlier taken and the maximum heart rate, 20 students were selected fromSauriBholanathVidyamandir (H.S), District PaschimMedinipur.Explosive strength was measured by Standing Broad Jump and the sprint performances were measured by 50mtr. and 100mtr. sprint. A significant moderate co-relation was found between explosive strength and sprint performance. From the present study this may be concluded that the explosive strength may be used to determine the speed in athletics.

INTRODUCTION

General Introduction

Over the years, the standing long-jump test has been adopted by a variety of academic and sports organizations, both professional and amateur, to evaluate and predict athletic success. Sprints, jumps and throws are complex motor tasks that are influenced by a number of factors, such as coordination, flexibility, muscular strength etc. Complexity is also reflected in the muscle groups that are involved in executing movements. The acceleration of the centre of mass of a sprinter is mainly determined by three external forces: the ground reaction force, gravitational force and the wind velocity. Several different methods have been used to assess strength in the investigation of its relationship to athletic performance.

Maximum running velocity in elite sprinters is achieved by optimal stride length and stride frequency in the distance between 45 (m) and 60(m). Generally, shorter contact time (CT) results in greater performances in sprinting; therefore, faster sprinters have shorter contact time than slower sprinters in each stride. More powerful sprinters have short foot contact time with the ground; longer stride length and flight time (FT) and more stride frequency which all related to muscular power. Therefore, it is thought that greater muscle power is necessary for maximum jump and sprint running. It has known that jump power is the best indicator of sprint ability [25]. Jump tests provide evaluations of lower-limb power capability and give valid assessments of muscular power. Several investigators have studied mechanical factors that influence the maximum sprinting speed. While both stride length and stride frequency increase as speed increases from a slow jog to a maximum sprint, the stride length plateaus at a moderate speed, and the stride frequency increases up until the maximum speed. Greater stride frequencies require the legs to move through the stride cycle at faster rates, and the muscles to shorten and lengthen more rapidly. This finding has directed attention on the well-known force–velocity relationship of skeletal muscle as the potential ‘‘bottleneck’’ that ultimately limits maximum sprinting speed [33]. Measurements or estimates of force–velocity parameters in vivo correlate with training-induced improvements in sprint performance distinguish between the muscles of sprint athletes and other individuals and are better predictors of sprint performance than measures of isometric strength [19].

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. Sprint training has to increase leg explosive strength for maximum possible stride length with increase stride frequency. Gundlach investigated thoroughly regarding stride length during 100 m sprint and reported that top sprinters increased their stride length up to 60m whereas poorly trained athletes increased them up to 30m. He reported that the sprinters exhibited slight

*Corresponding author: **Pallab Ray Sarkar**
Department of Physical Education, Jadavpur University, Kolkata-32, W. B

decrease in stride length at the extreme velocity. Sprinting speed may be defined as the mutually interdependent factors of frequency and the strides length[21] [8]. 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. Frequency results inversely with 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. Research investigating the relative importance of developing a long stride length or a high stride rate has been inconsistent across published data [14]. Stride Frequency is a more important contributor to the velocity increase in sprint performance, where it is known that Stride Length is a more significant variable. Still now there is two different schools of thoughts regarding the application of those two kinematic parameters [21][16].

However, body dimensions may significantly affect performance when Standing Long Jump is used for the assessment of leg muscle power in children, since taller individuals may jump longer than shorter ones with the same leg muscle power. The most important factors for this outcome are the higher centre of mass and the longer leg length in taller children, which increase the trajectory of the centre of mass and thus standing long jump performance. standing long jump performance (distance) has three parts: (a) the take-off distance, which is defined as the horizontal distance between the take-off line and the jumper's centre of mass at the instant of take-off, (b) the flight distance, which is the horizontal distance travelled by the centre of mass while airborne and (c) the landing distance, which is defined as the distance between the centre of mass and the heels of the feet at the instant of landing [20]. Both the take-off and landing distances are strongly affected by leg length, i.e. they are greater in an individual with longer legs, while the flight distance mainly depends on leg muscle power. Consequently, during physical development, children may increase standing long jump performance simply because height and leg length are increased.

Many authors have found a relationship between various measures of sprint and jump performance with regard to jump performance, It has known thata significant correlation between jump performance and 10 m sprint (r = 0.66)[3]. It hasalso found that a relationship between jump performance and maximal running velocity (r = 0.73) found a significant correlation between jump height and maximum velocity as well [4] [5]. Squat jump power output has been correlated to 5 m sprint time and 10 m running velocity. The standing long jump has also been shown to significantly correlate to 10, 20, 30, and 40 m average velocity and acceleration values [1].

Maximum muscle contraction force is necessary to achieve mechanical power in the starting speed and short sprint performance. More powerful sprint and more stride frequency, which are all related to muscular power. Therefore, it is thought that greater muscle power is necessary for maximum jump and sprint running**.** It has knownthat jump power is the best indicator of sprint ability [25]. Jump tests provide evaluations for lower-limb power capability and give valid assessments of muscular power. Contracting at a high velocity and rapid stretching of the lower-limb musculature suggest that relative explosive ability of hip and knee extensors are critical to sprint performance. Leg stiffness was calculated in vertical jump, which is correlated with the muscular power, resituated during the eccentric–concentric phase of the leg force and contact time (reactive power).

Objectives

1. To find out the explosive strength and speed of school going boys of age of 15-16 yrs.
2. To find out explosive strength as a predictor of speed performance of school going boys of age of 15-16 yrs.

Significance of the Study

As the leg explosive strength is one of the main influential factors of stride frequency then to develop the performance of sprint running it must be a regular task to think about the development of leg strength.

It may by signify as the following:

1. It provides the confidence to the athletic trainer to take care about the development of leg strength.
2. The physical education teachers and coaches may be benefited to inform their trainees about the specific qualities that should be required by each sprinter.

METHODOLOGY

Selection of the Subjects

A football match of 30 min. duration was organized. Each team comprised with 15 school football players at the age group of 15^{+}-16 yrs. Considering the execution of different fitness parameter specifically speed in the play field the primary selection were made. Then the resting heart rate and the maximum heart rate were measured and from that basic datathe best 20 students were selected for the main study.

Variables and test

1. Explosive strength measured by Standing long jump
2. Heart rate measured by heart rate monitor
3. Speed measured by 50 meter and 100 meter sprint

Design of the Study

For collecting data the measuring tape, marked jump sector, marked track, stopwatch or timing gates, markers. At first the standing long jump were tested and data recorded. Then in the marked track 50 mtr. and 100 mtr. speeds were measured. All the measurements were taken in a single day in the afternoon.The performance of the subjects only measured but never programmed to develop that.The researcher had no control over the life-style of the subjects.The researcher had no control over the food habits of the subjects.

Statistical Procedure

The dependent variables in this study were the sprinting speeds at 50m and 100 m. The independent variables were the variables collected in the horizontal tests. A Pearson product-moment coefficient of correlation was used to analyze the relationships between these variables.

RESULTS AND DISCUSSIONS

Results included the calculation of mean, S.D. and co-relations. For calculation the statistics package for windows Statistical Package for Social Science were used.

Results

Table 1 Mean ± S.D. of different selected variables

Variables	Test	Mean ± S.D.
Explosive strength	Standing long jump (in mtr.)	2.07 ± 0.23
Speed	100 mtr. (in sec.)	14.92 ± 1.16
	50 mtr. (in sec.)	7.67 ± 0.51

The average distance of standing long jump was 2.07 mtr. and the average time taken to complete 50 mtr. and 100 mtr. were 7.67 sec. and 14.92 sec. respectively.

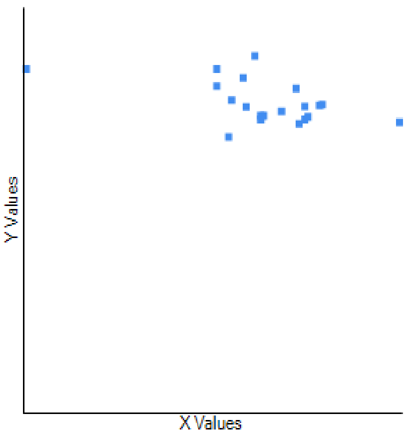
Table 2 Co-efficient of correlation ('r') between standing long jump and performance during sprint

Variables	Standing long jump	'P' value
50 meter	-0.50	0.03*
100 meter	-0.51	0.03*

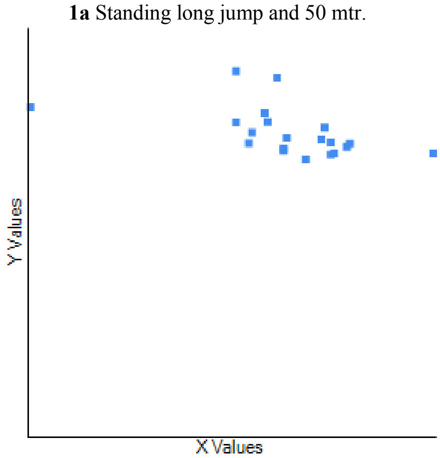
Significant at 0.05%

This table is showingsignificant negative co-relationbetween the explosive strength and performance and that co-efficient was moderate which indicated actually the positive influence of strength on performance because the decrease of time in speed actually indicated the increase of performance.

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



1a Standing long jump and 50 mtr.



1b Standing long jump and 100 mtr.

Figure 1a and 1b Scatter Plot (S.P.) diagram of co-relation

DISCUSSIONS

The results showed that explosive strength was significantly related to sprinting performance in both the distances. Sprint performance mainly influences bytwo factors 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 is very important. Based on this, an attempt was made to discuss different related factors which influenced the sprinting performance. It has known thatstatistically positive significant correlation existed with stride length and body height and leg length [11].The ability of the sprinters to achieve higher running speed depends on the striking force to the ground. Running velocity is the product of stride length and stride frequency [23].

So it clear that not only explosive strength increase rather than other influence of the two 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. It has rightly declared that, it is important to know how an improvement of one factor (i.e., stride length or stride rate) may affect another [14].

A training-induced increase in the maximal firing frequency and action potential in the muscles appears to occur in young subjects executing maximal exercises as described above [13]. The improvements observed are supposed induced by enhanced coordination, motor unit recruitment, central nervous activation and improved technical skills [24]. Furthermore, training programs that include movements that are biomechanically specific to the performance tests, may be likely to induce improvements in performance measures**,** thus, positive responses in speed and agility are supposed to be associated to specificity in the current program [9] [10].

A comparison of the slopes of the relationships representing the effects of strength and power on speed addresses the question of whether power or strength is more beneficial to improve sprint ability in youth. The comparison of the standardized effects was unclear, but the observed moderate difference provides some evidence for the argument that increasing power rather than strength is more beneficial. Recent reviews of the training response in youth have supported the contention that complex and plyometric power training induce more improvement of sprint performance in youth compared with strength training, but further studies comparing training methods across maturity groups are required.

CONCLUSION

The performance in sprint running is mainly signifies by stride length and stride frequency and those are influenced by the leg explosive strength. To measure the leg explosive strength standing long jump is a reliable and valid test. From this present study this may be concluded that the standing long jump may be used to determine the speed in athletics.

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