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KINEMATIC ANALYSIS OF SPEED PERFORMANCE AMONG SPRINT MIDDLE AND LONG DISTANCE RUNNERS

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ABSTRACT

The purpose of the study was to analyze the kinematic determinant of speed performance among sprint, middle and long distance runners. To achieve this purpose forty five male athletes consists of 15 athletes in each category who participated in the intercollegiate level competition were selected randomly as the subjects. They were tested for their speed performance and kinematic variable stride length. The running speeds of the subjects were measured through '50 meters run test' and the kinematic variable stride length was measured through video graphical analysis and the measures determined through computer based software "Silicon Coach". To test the differences among the sprint, middle and long distance runners, the analysis of variance was applied and whenever significant differences were obtained, post hoc test was made by using Schaeffer's confidence interval. The 0.05 level of confidence was fixed. The results indicated significant difference between sprint and long distance runners. However, no significant differences exist between sprint and middle distance runners, middle and long distance runners.

INTRODUCTION

Speed of movement in the proper sequence over duration of time is the ultimate object in optimum performance. As strength levels increase and all other bio-motor areas have been developed, speed becomes a resultant of the training that has been applied. As the systems are trained, all principles must be adhered to in order for efficient and economical speed development to occur. If the athlete cannot maintain proper neuromuscular coordination due to physiological energy system fatigue, then the effectiveness of speed is reduced. Development of the bio-motor abilities of work capacity, flexibility, co-ordination and strength are necessary in order to ensure that the sportsmen or athlete will be able to maintain speed in all of the sports events.

Sprinting speed is determined by the length of stride and stride frequency (speed of stride). Length of stride depends primarily upon leg length and leg power. Leg speed and frequency mostly depend upon speed of muscle contractions and neuromuscular co-ordination. Researcher demonstrated that the length of stride, rather than the rate of acceleration of the leg, is the main limitation in sprinting. It is known that length of stride can be increased by increasing leg power which is the ability to apply more force rapidly and thereby project the body faster and further with each stride. Leg speed is innate, but stride length can be improved by increasing muscular strength and mobility. Increasing either factor automatically increases a runner's sprinting speed. Though stride frequency is an inborn quality, it might be possible to improve slightly through training.

One way to increase stride length and stride frequency is to increase overall functional strength through the entire body. Improved strength levels will allow athletes to produce greater amounts of force while at the same time decreasing their ground contact time. Training the body to use the attained strength gains in a powerful fashion is the key to acceleration improvement. Power refers to the ability to generate the greatest amount of force in the shortest possible time. In a nutshell, the most powerful athletes spend less time on the ground, have longer strides, and can repeat them more rapidly than their less powerful counterparts.

Sprinting is a faultless, perfected series of finely tuned technical and motor coordinated skills. It is in the motor unit where speed begins and must be perfected. (Farlane, 1993). The importance of Speed and agility training in any regimen designed to improve athletic performance and promote overall Physical health. There are several techniques for reducing reaction times, increasing the length and frequency of strides, and promoting quick coordinated movements, all of which are essential elements of speed. The distance between two successive placements of the same foot, consisting of two step lengths; Stride length measured between successive positions of the left foot is always the same as that measured by the right foot, unless the subject is walking in a curve. Stride length is better understood in relation to the athlete's center of gravity, and the distance the center of gravity travels from take off to touch down is used to figure the actual stride length. The longer the distance the athlete's body travels while on the ground, the more time is spent, and the slower the maximum velocity. The relationship between ground and air distance for center of gravity should be long air distances relative to ground distances change length the distance the hip travels through the air in a stride. The goal is big air distance and small ground distance. Therefore, during acceleration runs and buildups, force should be applied into the ground how the athletes look at stride length, maybe by utilizing the concept of effective stride and with the goal of projecting the hips forward as far as possible.

METHODOLOGY

The purpose of the study was to analyze the kinematic determinant of stride length among sprint, middle and long distance runners. To achieve this purpose forty five players consists of 15 sprinters, 15 middle distance runners and 15 long distance runners who participated in the inter-collegiate level were selected randomly as subjects. The selected subjects were tested of their 50 meters run performance and their kinematic variable of stride length.

Camera set-up

The subject's 50 meters run was recorded by using five digital video cameras (SONY Digital Hi 8), set at a sampling rate of 25 Hz. A "household" camera was chosen because it was affordable, discreet, and readily available. High-resolution cameras, by contrast, require exacting lighting conditions and are expensive and fragile.

Five Cameras were fixed on the tripod perpendicular to the Sagittal plane at 90 degree angle so as to record the Sagittal plane movements of the subject. Each camera was fixed to record every 10 m distance at the intervals of 5m, 15m, 25m, 35m and 45m and 20 m from the inner border of the track. Cones were fixed at the starting point and finishing point and at every ten meters interval and they were numbered as cone-1, cone-2, cone-3, cone-4, cone-5 and cone-6. The cones were used to identify the relative position of the subject in each camera recordings.

Video Graph Analyzing

The 50 meters run performance recorded was video graphed and analyzed frame by frame and selected the right performance frame to measure the right foot to right foot step length by using Silicon Coach Software. On selection of the right frames, it was measured from right foot toe strike to next right foot toe strike. The distance was measured in meters with the help of silicon coach software tools.

Statistical Techniques

The descriptive data, consisting of mean, standard deviation and range on stride length was calculated. Pearson's Correlation Co-efficient was used to examine the relationship between 50 meters run performance and selected kinematic variables. To test the differences between the selected kinematic variables among the sprint, middle and long distance runners. Analysis of Variance was applied and whenever a significant difference was obtained, post hoc analysis was made by using Scheffe's confidence interval.

RESULTS AND DISCUSSION

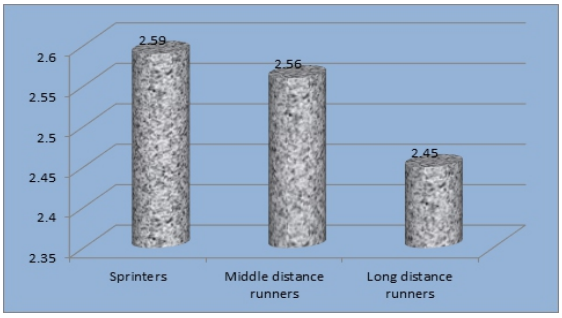
In order to analyze the kinematic determinants on the performance of speed among sprint, middle and long distance runners, the kinematic variable of stride length was measured. The descriptive data, consisting of mean, standard deviation and range on stride length is presented in Table I.

Table I: **Descriptive Data on Stride Length of Sprint, Middle and Long Distance Runners**

Players	N	Mean	SD	Range	
				Minimum	Maximum
Sprinters	15	2.59	0.13	2.38	2.81
Middle distance runners	15	2.56	0.18	2.32	2.93
Long distance runners	15	2.45	0.15	2.16	2.65

The mean and standard deviation on stride length of sprint, middle and long distance runners are 2.59 + 0.13, 2.56 + 0.18 and 2.45+ 0, 15 respectively. This proved that there was difference in the means of the players in stride length. The obtained means of the stride length among sprint, middle and long distance runners are presented through bar diagram for better understanding of the results.

Figure I: Showing the Means values of Sprint, Middle and Long Distance Runner's Stride Length during 50 M run



The obtained data was analyzed to find out whether the subjects' kinematic variable of stride length has any relationship with the speed performance of the sprint, middle and long distance runners, the obtained data were subjected to statistical treatment by using Correlation Coefficient. The obtained results between stride length and speed performance of the sprint, middle and long distance runners is presented in Table II.

Table II: Correlation Coefficient between Stride Length and Speed Performance of Sprint, Middle and Long Distance Runners

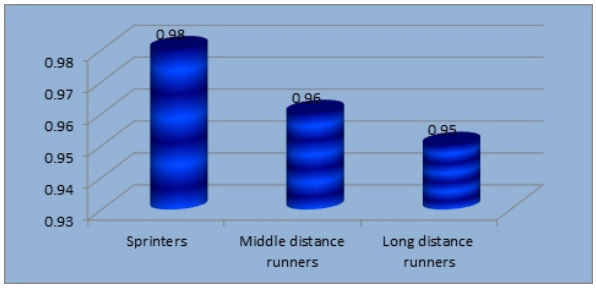
Players	Variables	N	Mean	Obtained 'r'	Required 'r'
Sprinters	Speed	15	7.11	0.98*	0.497
	Stride length	15	2.593		
Middle distance runners	Speed	15	7.44	0.96*	
	Stride length	15	2.559		
Long distance runners	Speed	15	7.29	0.95*	
	Stride length	15	2.445		

** Significant at 0.05 level.*

As per the results presented in Table II, the obtained 'r' values of 0.98, 0.96 and 0.95 are greater than the required table 'r' value of 0.497 to be significant at 0.05 level and it was found that kinematic variable of stride length is significantly related to speed of sprint, middle and long distance runners respectively.

The obtained correlation coefficient between stride length and speed performance of basketball, volleyball and football players are presented through bar diagram for better understanding of the results.

Figure II: **Showing Obtained Coefficient of Correlation between Speed Performance and Kinematic Variable Stride Length**



The results presented in Table I proved that there was difference on stride length among sprint, middle and long distance runners. To test the significance of the differences in means, ANOVA was employed and the results presented in Table III.

Table III: Comparison of Stride Length among Sprint, Middle and Long Distance Runners

Source of Variance	Sum of Squares	df	Mean Square	F
Between	0.179	2	0.089	5.03*
Within	1.012	42	0.018	

Required table F, df (2, 42) at 0.05 level 3.22.

**Significant at 0.05 level.*

The results presented in Table-III proved that there was significant difference among sprint, middle and long distance runners in stride length as the obtained F value of 5.03 was greater than the required F ratio to be significant at 0.05 level. Since significant differences were obtained, the results were further subjected to statistical analysis by using Schaeffer's post hoc analysis and the results proved in table IV.

Table IV: **Multiple Comparisons of Means on Stride Length among Sprint, Middle and Long Distance Runners**

Means of			Mean Difference	C.I.
Sprinters	Middle Distance Runners	Long Distance Runners		
2.59	2.56		0.03	0.12
2.59		2.45	0.14*	0.12
	2.56	2.45	0.11	0.12

** Significant at 0.05 level.*

The results presented in Table IV proved that there was no significant difference in means of stride length between sprint and middle distance runners (MD: 0.03); middle and long distance runners (MD: 0.11) as the obtained mean difference were less than the required confidence interval value of 0.12. There was significant difference between sprint and long distance runners (MD: 0.14) as the obtained mean difference were greater than the required confidence interval value of 0.12.

DISCUSSION

Sprinting has long been accepted as an essential training component for the competitive athletes in almost every sport. Running is a skill that most of us learn at an early age. Because no two persons are anatomically exactly the same, each person will have a slight different running style or form. However there are

certain things that all runners should pay attention in terms of running style and proper form to help make running more efficient and reduce the possibility of injuries (Prentice, 1994).

Speed and acceleration are essential components of team sports, such as the various football codes, basketball, and field hockey (Delecluse et al., 1995; Klinzing, 1984; Majdell et al., 1991). In addition, maximum- effort sprints are often too short to allow for the attainment of peak speed for athletes in these sports (Young et al., 1995). As a result, the acceleration period of a sprint effort becomes an important focus for any training program for such athletes.

It has been observed that stride rate contributed 6.9% and stride length 1.5% to the increase from maximal to supramaximal running velocity. This led to a significant correlation of 0.64 between changes in running velocity and stride rate from maximum to supramaximal velocity. Researchers have found increases in stride rate (Mero & Komi, 1986), IEMG (Komi, 1983), ground reaction forces, muscle stiffness, stored elastic energy (Ito et al., 1983, Mero & Komi (1990), and increased efficiency of muscle contraction and running skill (Mero & Komi, 1987), during supra-maximal running. This could be interpreted as having some benefits in sprint training by adapting human neuromuscular performance to a higher performance level.

CONCLUSION

Based on the results of the study, it was concluded that kinematic variable of stride length was significantly related to speed of sprint, middle and long distance runners and there was a significant difference in means of stride length between sprint and long distance runners and that there was no significant difference in means of stride length between sprint and middle distance runners and also between middle and long distance runners.

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