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A Comparative Study on Running Gait Pattern of Sprinters and Distance Runners

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Abstract: The biomechanics of running gait vary significantly between sprinters and distance runners, owing to the unique demands of their respective disciplines. Sprinting is an aggressive and intricate athletic activity that is primarily associated with power and speed, whereas distance running is concerned with efficiency and fluidity of movement. This study was formulated to determine whether sprinters and distance runners would exhibit differences in technique while running at the same speed. 20 male collegiate athletes—10 sprinters and 10 distance runners aged between 17-25 year were selected from the LNIPE. Each subject ran on treadmill at a set pace of 15 km/hr for 5 mins. Spatiotemporal variables (cadence, stride length, run cycle duration, stance phase duration, swing phase duration, propulsion speed) and pelvic kinematic variables (pelvic tilt, pelvic obliquity, and pelvic rotation) were measured using BTS G-Walk sensor. Collected data was analysed using independent t-test. The result of the study showed no significant differences (p > .05) between sprinters and distance runners for both the spatiotemporal and the pelvic kinematic variables which suggests that, despite their different training focuses and race distances, sprinters and distance runners exhibit similar gait patterns when running at the same speed.
Keywords: Running, sprinting, gait, kinematics, mechanics.

I. INTRODUCTION

Running is one of the most popular sports around the globe, both for athletes and for the general population. Running can be performed over a wide range of distances and speeds, from jogging to sprinting, the most common of which is recreational running. Sprinters and distance runners are the two main categories of athletes. The two groups compete in distinct events, leading to variations in technique and form. Sprinting is running over a short distance at the highest speed of the body in a limited period, whereas distance running is running at a slower speed for a longer duration [1] [2]. Sprinting is an aggressive athletic activity that is primarily associated with power and speed, whereas distance running exhibits a more economical and sustainable gait, focusing on conserving energy and maintaining endurance over longer durations [3].

Sprinters have a very different body type compared to distance runners. Sprinters typically have a mesomorphic body type, which is defined by muscularity and power, thus being capable of high speeds and rapid acceleration. Distance runners, on the other hand, have a more ectomorphic body type, which is leaner and contains less muscle mass. This distinction in body types is due to the different physiological demands of sprinting and long-distance running [4].

Sprinting biomechanics is heavily influenced by the interaction of stride length and stride frequency. Elite sprinters achieve incredible speeds by optimizing both parameters, with longer strides and higher frequencies resulting in superior performance. Running economy, or the energy cost of running at a given velocity, is an important determinant of distance running performance. Biomechanical factors that influence running economy include stride length, stride frequency, and vertical oscillation [5] [6]. When competing in their events, sprinters exhibit very short ground contact time, as they quickly propel themselves forward with explosive force. The running gait of sprinters is characterized by extremely high cadence, to maximize speed whereas their distance counterparts show moderate cadence, generally between 160-180 steps per minute, balancing speed and endurance.

The ideal movement pattern varies between events, as the goal shifts from economy of movement in long-distance events to speed and power in sprints. The purpose of this study was to determine whether sprinters and distance runners would exhibit differences in gait patterns while running at the same speed.

II. METHODS

A. Participants

Twenty male collegiate athletes—ten sprinters and ten distance runners aged between 17-25 year were selected from the LNIPE track and field team. Athletes who specialized in the 100m, 200m, 400m, 110m hurdle, and 400m hurdle races were classified as sprinters. Athletes who specialized in the 5000m, 10,000m, and 3000m steeplechase races were classified as distance runners.

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B. Test Administration

The selected subjects were made to run on a treadmill at a set pace of 15 km/hr (4:00 min/km) each for 5 minutes wearing the G-sensor around the S1 of the vertebral column. Spatiotemporal variables (cadence, stride length, run cycle duration, stance phase duration, swing phase duration, propulsion speed) and pelvic kinematic variables (pelvic tilt, pelvic obliquity, and pelvic rotation) were measured using BTS G-WALK System Software. Protocols used for the analysis of running gait typically incorporate a treadmill familiarization period to minimize the potential changes in gait across running modes [7]. Thus, before performing the 5-minute run at the given pace, the athletes were asked to run on the treadmill at a slower pace as per their convenience to warm up, followed by stretching.

C. Statistical Technique

Differences in the spatiotemporal and pelvic kinematic variables between groups were tested using independent t-test. The level of significance was set at 0.05.

III. RESULTS

A. Descriptive Statistics

The means and standard deviations for the data of Sprinters and Distance runners on selected variables are presented Table I.

TABLE I
DESCRIPTIVE STATISTICS OF THE SELECTED VARIABLES OF SPRINTERS AND DISTANCE RUNNERS

	Group	N	Mean	Std. Deviation	Min.	Max.
Cadence	Sprinter	10	175.97	4.45	170	184
	Distance runner	10	175.91	7.85	164	186
Stride Length	Sprinter	10	2.86	0.07	2.71	2.94
	Distance runner	10	2.86	0.13	2.69	3.08
Run Cycle Duration	Sprinter	10	0.68	0.01	0.65	0.70
	Distance runner	10	0.68	0.03	0.65	0.73
Stance Phase Duration	Sprinter	10	21.37	2.96	17.20	26.60
	Distance runner	10	22.20	2.56	18.60	26.60
Swing Phase Duration	Sprinter	10	78.63	2.96	73.40	82.80
	Distance runner	10	77.80	2.56	73.40	81.40
Propulsion Speed	Sprinter	10	0.89	0.21	0.63	1.22
	Distance runner.	10	0.86	0.15	0.66	1.10
Pelvic Tilt	Sprinter	10	8.95	2.55	5.90	13.00
	Distance runner	10	8.72	1.74	6.40	10.90
Pelvic Obliquity	Sprinter	10	9.03	2.83	5.10	14.60
	Distance runner	10	9.64	2.64	6.00	15.40
Pelvic Rotation	Sprinter	10	17.05	3.51	9.80	22.40
	Distance runner	10	15.18	4.71	8.00	26.10

B. Spatiotemporal variables

Table II presents the results of t-tests for equality of means between two groups across different spatiotemporal variables comparing sprinters and distance runners. The findings revealed no significant differences in means between sprinters and distance runners, as the p-value is greater than a predetermined significance level (0.05).

TABLE II
INDEPENDENT SAMPLE T-TEST OF SPATIO-TEMPORAL VARIABLES

	t	**df**	**Sig. (2-tailed)**	**Mean Difference**
Cadence	0.021	18	0.983	0.06
Stride Length	-0.021	18	0.984	0.001
Run Cycle Duration	-0.269	18	0.791	0.003
Stance Phase Duration	-0.670	18	0.512	0.83
Swing Phase Duration	0.670	18	0.512	0.83
Propulsion Speed	0.255	18	0.801	0.021

C. Pelvic Kinematic Variables

Table III presents the results of t-tests for equality of means between two groups across pelvic kinematic variables comparing sprinters and distance runners. The findings revealed no significant differences in means between sprinters and distance runners, as the p-value is greater than a predetermined significance level (0.05).

TABLE III
INDEPENDENT SAMPLE T-TEST OF PELVIC KINEMATIC VARIABLES

	t	df	Sig. (2-tailed)	Mean Difference
Pelvic Tilt	0.235	18	0.817	0.23
Pelvic Obliquity	-0.497	18	0.625	0.61
Pelvic Rotation	1.006	18	0.328	1.87

IV. CONCLUSIONS

Based on the findings, it is concluded that despite the different training focuses and race distances, when running at a uniform speed of 15 km/hr, sprinters and distance runners exhibit remarkably similar gait patterns in terms of spatiotemporal variables and pelvic kinematic variables. This suggests that at a controlled submaximal speed, both sprinters and distance runners exhibit similar gait patterns. This implies a level of biomechanical commonality between the two groups, demonstrating the adaptability of the human body to meet the demands of running across different disciplines. Understanding that the gait patterns overlap at a set speed provides insights that can be valuable for developing training strategies, especially in the context of cross-training and injury prevention.

To further clarify the effects of specialized training on running mechanics, future studies should examine running biomechanics at different speeds, incorporating athletes' competitive paces. This could lead to more focused methods to training and performance optimization in the sprinting and distance running disciplines. It would also improve our understanding of how speed and kind of training affect running gait.

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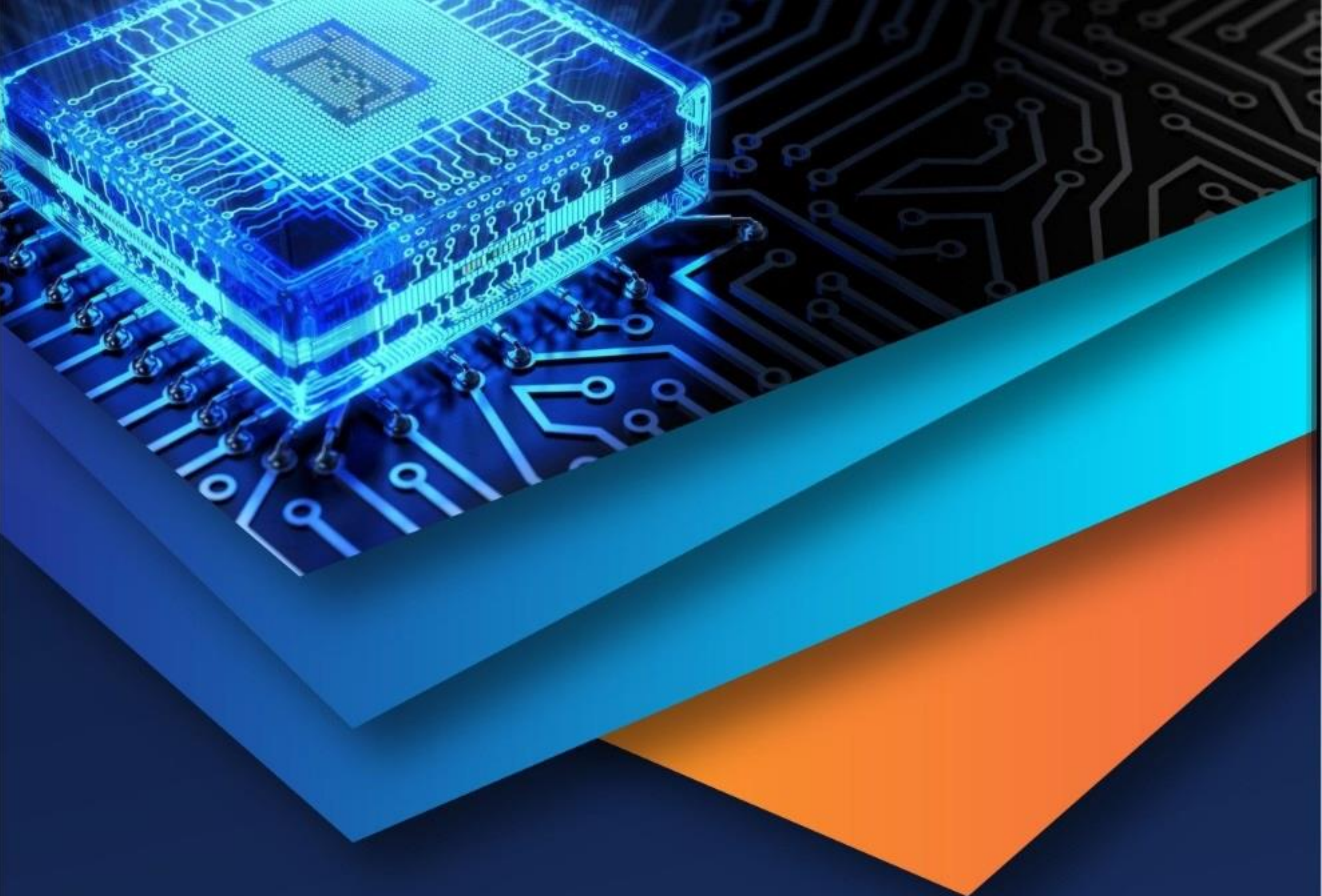

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