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RELATIONSHIP BETWEEN THE RANGE OF ARM MOVEMENT AND THE STRIDE FREQUENCY IN THE CONSTANT SPEED PHASE OF 100M. SPRINTING

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ABSTRACT

The purpose of this study was to examine the relationship between the range of arm movement and the stride frequency of university-level sprinters from West Bengal. The subjects' ages ranged from 19 to 23 years. The video graphic technique was employed to record the movement for data collection. Two Nikon 3. ccd video cameras were used in this study. The cameras were positioned 15 meters away at both the frontal right and left, with the camera height set at 1.50 meters from the ground to obtain individual videography. The subjects' performances were captured under controlled conditions. To measure the range of arm movement, the angular distance from extreme shoulder flexion to extreme shoulder hyperextension was assessed. Motion analyzer software Kinovea version 0.8.15 (copyright @2006-2011joan charman and Cenyrib) was utilized to analyze the video films. The joint point method was employed to determine the angles of the joints. The data were analyzed using Pearson's product-moment correlation coefficient to ascertain the relationship between the range of arm movement and the stride frequency. The relationship between the range of arm movement and the stride frequency is negative.

Keyword: Arm Amplitude, Stride Frequency, Kinematic

1. INTRODUCTION

Biomechanics is the sport science field that applies the laws of mechanics and physics to human performance, to gain a greater understanding of performance in athletic events through modeling, simulation, and measurement.

It is also necessary to have a good understanding of the application of physics to sport, as physical principles such as motion, resistance, momentum, and friction play a part in most sporting events.

Sport Science is a discipline that studies the application of scientific principles and techniques to improve sporting performance. Human movement (kinesiology) is a related scientific discipline that studies human movement in all contexts, including that of sport. Sport and Exercise Biomechanics is a title that encompasses the area of science concerned with the analysis of the mechanics of human movement. In other words, it is the science of explaining how and why the human body moves in the way that it does. The identification of the optimal technique for enhancing sports performance is a vital aspect of research in sports biomechanics. The analysis of body loading was to determine the safest method for performing a particular sport or exercise task, and the assessment of muscular recruitment and loading. The analysis of body limb angle to the sprinting performance is a well-established research area.

Sprinting is the act of running over a short distance at (or near) top speed. It is used in many sports that incorporate running, typically as a way of quickly reaching a target or goal, or avoiding or catching an opponent. Human physiology dictates that a runner's near-top speed cannot be maintained for more than 30-35 seconds due to the accumulation of lactic acid in muscles.

In modern day, to succeed in a sprinting event like the 100m. 200 m. 400 m, it requires a high level of skill and physical fitness. To improve 100 m performance, sportsmen require greater stride length and more stride frequency, and they have to swing their arms to generate the force. That's why the researcher took up this study to find out the relationship between the range of arm movement and stride frequency.

The objective of the study was to find out the relationship between the range of arm movement and stride frequency for better sprinting performance.

2. METHODOLOGY

2.1 Subjects

8 male sprinters who represented the Visva-Bharati athletic team, which participated in the All-India Inter-University Athletic Meet for several years, were selected from Visva-Bharati for this study. The age of the subjects was between 19 to 23 years.

2.2 Criterion Measures

* Angle of the Shoulder joint at (extreme flexion to extreme hyperextension) was measured in degrees.
* Stride frequency was measured and recorded in metres/second.

2.3 Collection of Data

The camera position was set at a distance of 15 meters at both the frontal right and frontal left, the height of the camera (lance) was fixed at a height of 1.50 meters from the ground for obtaining individual videography. For setting up the camera the studies conducted by Chanda & Mondal (2018,2019,2020), Acharyya & Mondal (2017), and Chhangte & Mondal (2023) were referred and the procedure adopted by them was employed by the researcher in the present study.

The movement of the subjects was captured by a Nikon 3.ccd when they entered the constant speed phase up to the moment, they stepped out of the constant speed phase. The distance of 50 to 70 m. was considered a constant speed phase of sprinting. Then the recorded video was analyzed by the Kinovea version 0.8.15 (copyright @2006-2011joan charman and Cenyrib) software. Individually, their all-stride frequency was measured and divided by the number of strides to obtain the average stride frequency. The average range of arm movement was measured by measuring the individual arm movement length divided by the number of full arm movements.

2.3.1 Constant Speed Phase

The constant speed phase can be sub-maximal, maximal, or supra-maximal and is characterized by both the stride length and stride frequency remaining the same over some time. This phase is generally achieved between the 60 to 80 meter mark in men and the 50 to 70 meter mark in women. In principle, the top sprinters can sustain this phase over a distance of 10 to 20 meters. The difference between elite and sub-elite sprinters is the frequency of stride, demonstrating that it is more important than the length of the stride.

2.3.2 Stride Frequency in Running

Stride frequency, often referred to as cadence, is defined as the number of strides taken per unit of time, commonly expressed in strides per minute (spm). It is a critical parameter in the biomechanics of running, influencing running efficiency, energy expenditure, and injury risk (Cavanagh & Williams, 1982). Stride frequency, in combination with stride length, determines running velocity, as given by the equation:

Velocity = Stride Length × Stride Frequency.

2.4 Statistics

Person's Product Moment correlation was employed to find out the significance of the relationship between stride frequency and the range of arm movement of 100m sprinters at 3.

3. RESULT

Person's Product Moment correlation was used to find out the relationship between the range of arm movement (shoulder joint angle) and stride frequency in sprint. The level of significance to check the relationship was set at 0.05.

TABLE 1

STRIDE FREQUENCY OF THE INDIVIDUAL SUBJECT IN THE CONSTANT SPEED PHASE (50 TO 70)

Subject	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th
1	1.45	1.87	1.99	1.95	2.03	2.16	2.08	1.91	1.99	1.7	0.37	
2	1.56	1.96	2	2.08	1.92	2.16	2.08	2.04	1.88	1.2		
3	0.36	1.68	1.44	1.7	1.8	1.84	1.84	1.72	1.84	1.48	1.84	1.2
4	1.44	1.88	2	2.2	2	2.4	1.92	2.12	1.88	0.92		
5	0.52	1.68	1.72	1.8	1.88	1.76	2	1.84	1.84	1.64	1.68	0.48
6	1.68	1.97	1.92	2.08	2.04	2.28	1.92	2.04	1.8	1.2		
7	0.48	1.88	2	1.96	2.2	2.16	2.16	2.16	1.84	2.08	1.84	
8	1.16	1.72	1.8	1.8	1.96	1.88	1.96	1.8	1.72	1.72	1.29	1.16

TABLE 2

LENGTH OF EACH RANGE OF ARM MOVEMENT OF AN INDIVIDUAL SUBJECT IN THE CONSTANT SPEED PHASE

Subject	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th
1	36	38	41	30	76	49	57	46	71	24		
2	96	68	29	29	70	54	56	30	80	45	51	
3	59	57	43	43	71	41	42	29	75	36	54	50
4	26	42	60	50	48	34	63	56	67	45		
5	83	53	45	35	70	50	52	43	72	40	51	28
6	38	25	69	43	61	48	73	30	59	40		
7	74	51	61	48	89	39	75	39	80	38		
8	53	37	38	31	83	56	61	52	80	46		

TABLE 3
COEFFICIENT CORRELATION BETWEEN AVERAGE STRIDE FREQUENCY, AVERAGE RANGE OF ARM MOVEMENT

Subjects	Average of Stride Frequency (Meter/Sec.)	Average Range of Arm Movement (Degree)	Co-efficient Correlation 'r'
1	4.74	48.45	
2	3.79	55.40	
3	4.60	50.62	
4	3.97	52.80	**-0.58043**
5	4.91	53.08	
6	3.52	54.45	
7	3.81	60.05	
8	4.44	56.25	

Table 3 shows the relationship between the range of arm movement and the stride frequency of 100m. Sprinters at the constant speed phase of sprinting, as calculated 'r' -0.58043, is lower than the tabulated 'r' value of .88 required to be significant at the 0.05 level. However, the negative value of calculated 'r' (-0.58043) shows that the relationship between the range of arm movement and the stride frequency is negative.

4. DISCUSSION

The above finding may justify that the sprinting performance of the level of present subjects has three phases: acceleration, maintenance, and deceleration. When sprinters start sprinting, they gradually accelerate at the cost of a gradual increase in stride frequency, and to control the angular momentum of the body about a vertical axis, they also increase their range of arm movement. But when they reach the constant speed phase of their run, they are no longer able to increase their speed; rather, they excel in maintaining their speed they have developed. In this phase, they neither increase nor decrease their speed; they do not excel in greater stride frequency, and to stop body rotation, greater range of arm movement. Hence significant relationship between the stride frequency and the range of arm movement in the constant speed phase was not found. However, the negative value of 'r' indicates that if the stride frequency either increases or decreases, the corresponding range of arm movement will also increase or decrease, respectively.

5. CONCLUSION

Based on the result of the study, it may be concluded that during the constant speed phase of sprinting, the stride frequency and the range of arm movement of the sprinter remain in identical conditions.

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