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An analytical study on timing of Kalyani university sprinters in 100m Race

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Abstract
Objectives: The study was conducted to analyze the 100m sprint ability in time and other kinematic variables i.e., velocity and acceleration of the Kalyani University male and female sprinters. In the present study time analysis technique was used.
Methodology: 5 male sprinters and 3 female sprinters of Kalyani University from B.P.Ed and M.P.Ed course were selected as subject. Age was ranged from 22 to 25. In the present study the only measuring criterion was the time to cover different distance zone as segmented by the researcher purposefully. 100m. running distance were divided into ten (10) equal distance zones. The kinematical variables studied were Time, Zonal time, Zonal Velocity and Zonal Acceleration. The subject was advised to give his best possible effort. Before the race the opportunity of sufficient worm-up was given to the subject. At the end of each 10m segment two time keepers were posted both side of the lane. The times were taken by manual stop watch. The average of the two times of the two timekeepers for each zone was taken as time data. Two 100m trial were taken and the best timing was taken as final data. After one hour of first trial, the second trial was taken. From the collected data, Zonal time and Zonal Velocity were calculated by using appropriate formula.
Result: In case of male sprinter subject no.1 had better reaction time ability and acceleration ability and percentage of deceleration was little, that's why he took least time to complete 100m sprint. In contrary subject no. 5 had poor reaction time ability, acceleration ability and deceleration ability, that's why he took more time to complete 100m. In case of female subject no.1 had better speed ability, speed endurance and little percentage of deceleration so, she took least time to cover 100m. In contrast, subject no. 3 although had better reaction time ability but speed ability and deceleration ability was poor, that's why she took more time to cover 100m.

Keywords: Zonal time, zonal velocity, reaction ability, speed endurance

Introduction
The 100-metre dash is a sprint race in track and field competitions. The shortest common outdoor running distance, it is one of the most popular and prestigious events in the sport of athletics. It has been contested at the Olympics since 1896 for men and since 1928 for women (Wikipedia). The 100m can rightly be considered the most remarkable event of athletics at major championships. The sheer speed of the 100m allows the winner to claim that he is the fastest runner in the country or in the world (Brüggeman, G. P., Koszewski D., Müller H. 1997) [9]. Running a relatively short distance with maximum possible speed is considered as sprinting (Bhowmick *et al*., 2003) [45]. Sprinting ability is the most important factor for performance excellence in most of the games and sports. In athletics there are basically two sprinting events: 100m & 200m run. The nature and characteristics of sprinting ability of an athlete can be better understood by 100m run.
The world best sprinters run 100m faster than 10 seconds, which makes the average velocity over the distance more than 10m per seconds. The world-class athletes make in average 45 steps in a world championship finals. However, during this short time and small number of steps the sprinter experiences five different phases of speed, viz. 1) the reaction speed phase in the start; 2) the acceleration phase; 3) the maximal speed phase; 4) the speed maintenance phase 5) finishing style. To assess reaction ability, acceleration ability, and maximum speed and speed endurance of a sprinter, time analysis of the sprint race is very effective and popular kinematic approach.

Again the supremacy of the sprinters in 100m race can be very good understood if it is compared with other sprinters. The time from the start to first 10m is a very good indicator of reaction ability of the athlete. Time for first 40m indicates the acceleration ability of the sprinters. The speed endurance can be judged from a) time difference between first and last 50 m. of the race, b) length of deceleration zone and c) loss of speed at finish.

Short sprint performance (100-m. and 50-m. or 60-m) strongly relies on athletes' capability to accelerate their mass and generate high amounts of running speed in the forward direction of motion. To do so, their neuromuscular system, and especially that of their trunk and lower limbs generate force, and this force is in turn applied onto the supporting ground during the support phase of the running step cycle, i.e. during the short (≈100 mille seconds or less in top sprinters) contact between the foot (and mostly the forefoot) and the ground.

Acceleration is the phase of sprint races where the kinematic parameters of the stride are changing most dynamically. This phase is a complex cyclic movement defined predominantly by the increase of the frequency and length of strides, the duration of the contact and flight phases and the position of the body's centre of mass (CM) at the moments of ground contact. All of the above parameters are interdependent and each is conditional on the central movement regulation processes, bio-motor abilities, energetic processes and morphological characteristics of the athlete (Müller, Hommel 1997) [43].

The importance of stride length and stride frequency to the velocity curve of the 100 metres is well documented in the sport science literature (Ferro *et al*., 2001) [24]. However, it is not clear how these kinematic parameters affect the different phases of a sprint race. Little is known about how sprinters manipulate their stride patterns during the phases of acceleration, maximum velocity, and deceleration to reach optimal efficiency. Moreover, there is the question as to whether the phase structure of the 100 metres is the same for athletes of different levels of performance.

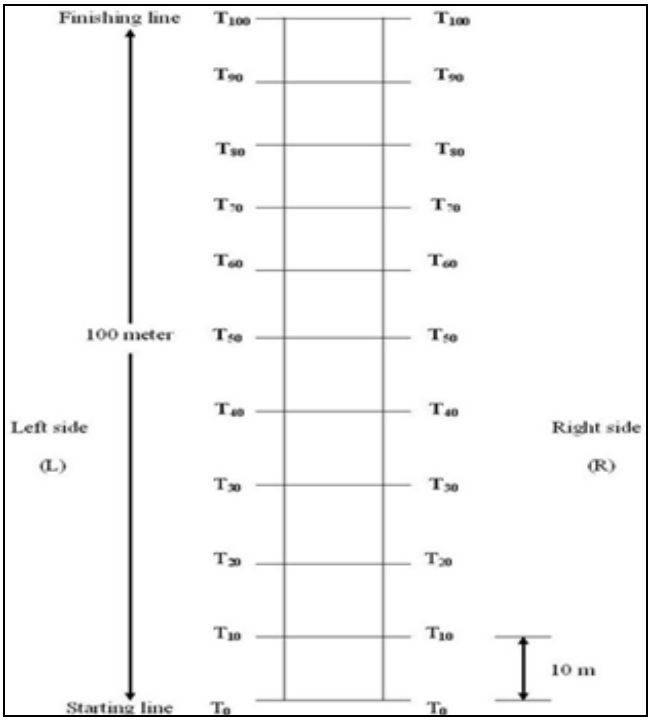

Fig 1: Linear path of 100m divided into 10 equal distance interval of 10m each

In the present study time analysis in 100m sprint were performed in Kalyani University sprinters and their performance were analyzed to understand the difference of timing in different distance zones and to understand the difference in kinematic variables of the sprinters. Thus the purpose of the study was to analyze the 100m sprint ability in time and other kinematic variables i.e., velocity and acceleration of the Kalyani University male and female sprinters. In the present study time analysis technique was used.

Methodology

5 male sprinters and 3 female sprinters of Kalyani University from B.P.Ed and M.P.Ed course were selected as subject. Age was ranged from 22 to 25 years. In the present study the only measuring criterion was the time to cover different distance zone as segmented by the researcher purposefully. 100m running distance were divided into ten (10) equal distance zones (Fig-1). The kinematical variables studied were *Time*, *Zonal time* and *Zonal Velocity*. The subject was advised to give his best possible effort. Before the race the opportunity of sufficient worm-up was given to the subject. At the end of each 10m segment two time keepers were posted both side of the lane. The times were taken by manual stop watch. The average of the two times of the two timekeepers for each zone was taken as time data. Two 100m trial were taken and the best timing was taken as final data. After one hour of first trial, the second trial was taken. From the collected data, *Zonal time* and *Zonal Velocity* were calculated by using appropriate formula.

Formula Used for Calculating Zonal Time of the Second Zone was: $T_{10-20} = T_{20} - T_{10,}$ Likewise the formula for calculating Zonal Time of the Third Zone was: $T_{20-30} = T_{30} - T_{20}$, and so on. Again the formula used for calculating Zonal Velocity of the Second Zone**:** $V_{20} = \frac{(20-10)}{(T_{20}-T_{10})}$, Likewise the formula for calculating Zonal velocity of the Third Zone was: $V_{30} = \frac{(30-20)}{(T_{30}-T_{20})}$ and so on. In the following Fig-2 during data collection the timers were taking time data for different zones for different sprinters in the ground of Kalyani University have been depicted.

Fig 2: During collection the timers were taking time for different zones in the KU ground

Analysis of data: The data of 100m sprint of every individual athlete were presented in different table.

Table 1: Time at the end of different zonal distances of male sprinters

Subject No.	Time in seconds while crossing the respective zone in the subscripts									
	T_{10}	T_{20}	T_{30}	T_{40}	T_{50}	T_{60}	T_{70}	T_{80}	T_{90}	T_{100}
1	1.88	3.06	4.18	5.14	6.08	7.03	8.04	9.21	10.38	11.58
2	1.95	3.19	4.4	5.33	6.24	7.18	8.22	9.28	10.4	11.6
3	1.90	3.09	4.24	5.31	6.18	7.16	8.28	9.4	10.58	11.78
4	1.89	3.26	4.48	5.65	6.59	7.53	8.61	9.71	10.88	12.17
5	1.97	3.38	4.69	5.95	7.05	8.25	9.46	10.89	12.37	13.88

Table - 1 shown the time of different sub divided zones. And also shown that subject no 1 was the fastest athlete. From the above table zonal time was calculated and presented in Table-2.

From this distance-time information, the zonal times was calculated for all the subjects and have been presented in Table-2.

Table 2: Zonal Time at different male sprinters

Subject No.	Zonal Time in seconds while crossing the respective zone in the subscripts									
	$T_{(0-10)}$	$T_{(10-20)}$	$T_{(20-30)}$	$T_{(30-40)}$	$T_{(40-50)}$	$T_{(50-60)}$	$T_{(60-70)}$	$T_{(70-80)}$	$T_{(80-90)}$	$T_{(90-100)}$
1	1.88	1.18	1.21	0.96	0.94	0.95	1.01	1.17	1.17	1.2
2	1.95	1.24	1.21	0.93	0.91	0.94	1,04	1.06	1.12	1.2
3	1.90	1.19	1.15	1.07	0.87	0.98	1.12	1.12	1.18	1.2
4	1.89	1.37	1.22	1.17	0.94	0.94	1.08	1.1	1.17	1.29
5	1.97	1.41	1.31	1.26	1.1	1.2	1.21	1.43	1.48	1.51

Table - 2 shows that the athlete had taken least time in 40-50m zone and after 80m deceleration phase was started. From Table - 2 zonal velocity was calculated which was shown at Table -3.

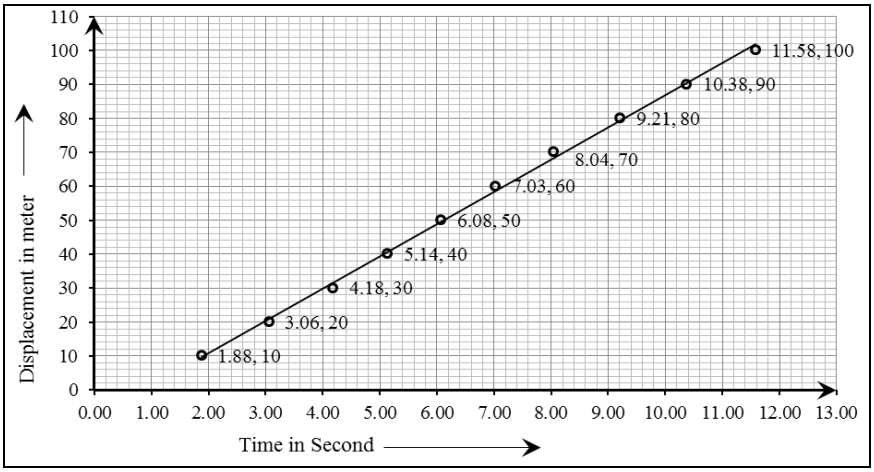

Fig 3: Displacement - Time Graph for the fastest male sprinter

In Fig – 3 the Displacement Vs Time Graph for the fastest sprinter has been drawn which is almost a straight line. From this graph velocity of the athlete were calculated and in Fig-4 the Velocity Vs Time Graph for the fastest male sprinter has been drawn. Likewise for the other sprinters the both graphs were drawn to calculate their velocity but were not depicted in this paper due to lack of space.

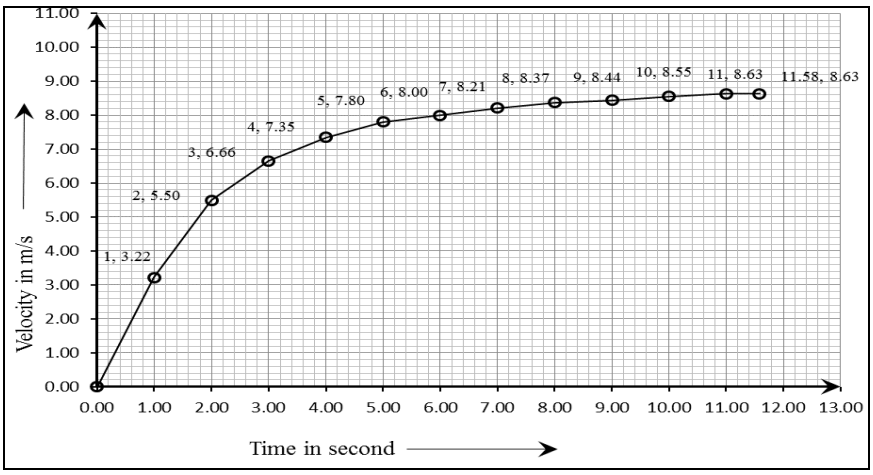

Fig 4: Velocity - Time graph for the fastest male sprinter

Table 3: Zonal velocities of different male sprinters

Subject No.	Zonal Velocity in m.Sec^{-1} while crossing the respective zone in the subscripts									
	$V_{(0-10)}$	$V_{(10-20)}$	$V_{(20-30)}$	$V_{(30-40)}$	$V_{(40-50)}$	$V_{(50-60)}$	$V_{(60-70)}$	$V_{(70-80)}$	$V_{(80-90)}$	$V_{(90-100)}$
1	5.31	8.47	8.92	10.41	10.63	10.52	9.90	8.54	8.54	8.33
2	5.12	8.06	8.26	10.75	10.98	10.63	9.61	9.43	8.92	8.33
3	5.26	8.40	8.69	9.34	11.49	10.20	8.92	8.92	8.47	8.33
4	5.29	7.29	8.19	8.54	10.63	10.63	9.25	9.09	8.54	7.75
5	5.07	7.09	7.63	7.93	9.09	8.33	8.26	6.99	6.75	6.62

Table - 3 shown the zonal velocity of different athlete and also shown that at 40-50m zone maximum velocity was achieved.

Table 4: Time at the end of different zonal distances of female sprinters

Subject No.	Time in seconds while crossing the respective zone in the subscripts									
	T_{10}	T_{20}	T_{30}	T_{40}	T_{50}	T_{60}	T_{70}	T_{80}	T_{90}	T_{100}
1	2.31	4.14	5.77	7.09	8.08	9.07	10.31	11.6	12.93	14.53
2	2.14	3.55	4.9	6.22	7.31	8.61	10.05	11.52	13.0	14.56
3	2.18	3.74	5.13	6.4	7.66	9.01	10.37	11.78	13.29	14.86

Table – 4 shown the time of different sub divided zones. And also shown that female subject no 1 was the fastest female athlete. From the above table zonal time was calculated and presented in Table-5.

In Fig – 5 the Displacement Vs Time Graph for the fastest female sprinter has been drawn which is almost a straight line. From this graph velocity of the fastest female athlete were calculated and in Fig-6 the Velocity Vs Time Graph for the fastest female sprinter has been drawn. Likewise for the other female sprinters the both graphs were drawn to calculate their velocity but were not depicted here due to lack of space.

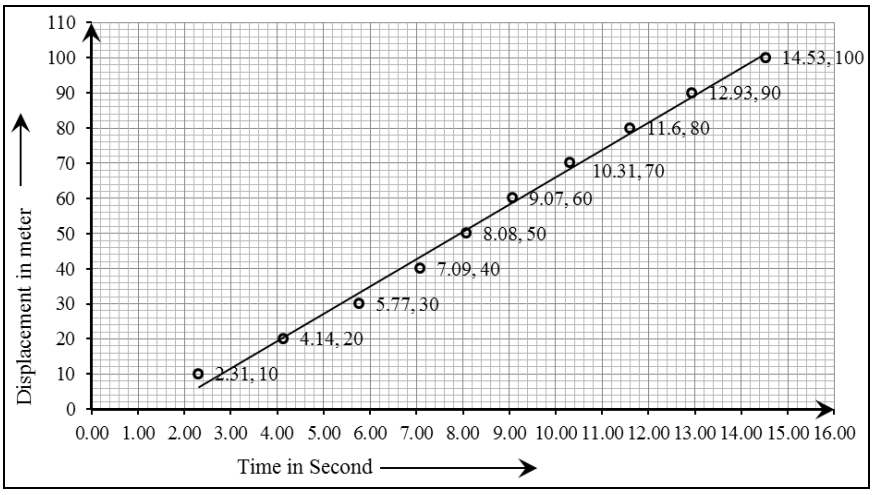

Fig 5: Displacement - Time Graph for the fastest female Sprinter

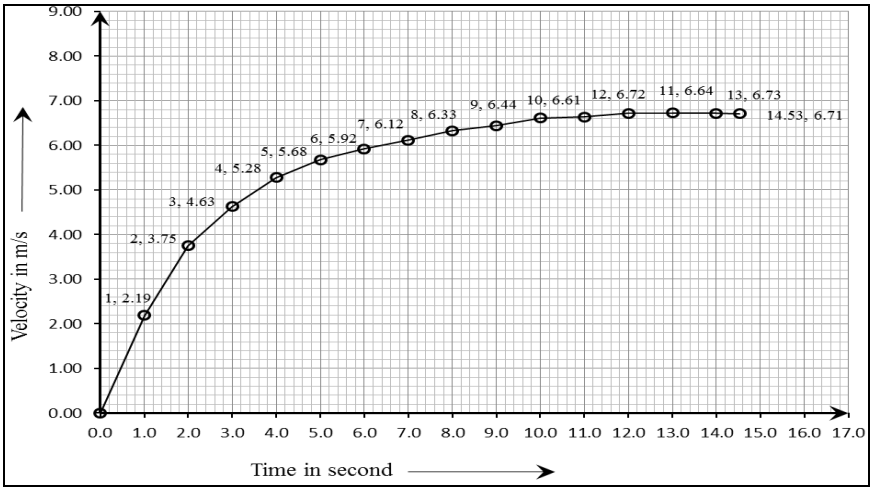

Fig 6: Velocity - Time graph for the fastest female Sprinter

Table - 5 shown, the least time was taken in 40-50m zone and after 80m deceleration phase was started. From Table no. 5 zonal velocity was calculated which was shown at Table - 6.

Table 5: Zonal Time at different female sprinters

Subject No.	Zonal Time in seconds while crossing the respective zone in the subscripts									
	$T_{(0-10)}$	$T_{(10-20)}$	$T_{(20-30)}$	$T_{(30-40)}$	$T_{(40-50)}$	$T_{(50-60)}$	$T_{(60-70)}$	$T_{(70-80)}$	$T_{(80-90)}$	$T_{(90-100)}$
1	2.31	1.83	1.63	1.32	0.99	0.99	1.24	1.29	1.33	1.6
2	2.14	1.41	1.35	1.32	1.09	1.3	1.44	1.47	1.48	1.56
3	2.18	1.56	1.39	1.27	1.26	1.35	1.36	1.41	1.54	1.54

Table-6 shown the zonal velocity of different athlete and also shown that at 40-50m zone maximum velocity was achieved.

Table 6: Zonal velocities of different female sprinters

Subject No.	Zonal Velocity in $m.Sec^{-1}$ while crossing the respective zone in the subscripts									
	$V_{(0-10)}$	$V_{(10-20)}$	$V_{(20-30)}$	$V_{(30-40)}$	$V_{(40-50)}$	$V_{(50-60)}$	$V_{(60-70)}$	$V_{(70-80)}$	$V_{(80-90)}$	$V_{(90-100)}$
1	4.32	5.46	6.13	7.57	10.10	10.10	8.06	7.75	7.51	6.25
2	4.67	7.09	7.40	7.57	9.17	7.69	6.94	6.80	6.75	6.41
3	4.58	6.41	7.19	7.87	7.93	7.40	7.35	7.09	6.49	6.49

Discussion

There are five phases in 100m sprint named Reaction time, Acceleration, Maximum velocity, Speed maintenance and Deceleration. And performance of 100m sprint depends on these phases. Good reaction time ability indicates good start; here first 10m indicates reaction time ability. Acceleration ability indicates the ability to reach high speed in smallest time; here speed gained up to 30m is indicator of acceleration ability. Maximum velocity is the ability to reach highest speed and by calculating zonal velocity maximum velocity measured. Speed maintenance is also known as speed endurance. It is the ability to maintain maximum speed as long as possible and through zonal velocity it is calculated. Last phase of 100m sprint is deceleration and calculating loss of velocity at finish (%) it is measured. Table no. 7 shown the different phases of 100m sprint of male athlete of Kalyani University.

Table 7: Different phases of 100m sprint of male athlete.

Sub no.	Time taken for first 10m	Time taken for first 30m	Maximum zonal velocity achieved (m/s)	Maintenance zone (m)	Diff of time Between First & second 50m (s)	Loss of velocity at finish (%)
1	1.88	4.18	10.63	40-60	0.58	21.64
2	1.95	4.40	10.98	40-60	0.88	24.13
3	1.90	4.24	11.49	40-60	0.58	27.50
4	1.89	4.48	10.63	40-70	1.01	27.09
5	1.97	4.69	9.09	40-60	0.22	27.17

In table no. 7 it is observed that subject no. 1 had best reaction ability and got a good start. His acceleration ability was also better than others athlete. But maximum speed was achieved by subject no.3. Speed maintenance ability was better of subject no.4 and his timing difference between first and second 50m was least.

Table 8: Different phases of 100m sprint of female athlete.

Sub no.	Time taken for first 10m	Time taken for first 30m	Maximum speed achieved (m/s)	Maintenance zone (m)	Diff of time Between First & second 50m (s)	Loss of velocity at finish (%)
1	2.31	1.63	10.10	40-60	1.63	38.12
2	2.14	1.35	7.69	40-60	0.06	30.10
3	2.18	1.39	7.93	40-70	0.46	18.16

In table no. 8 it is observed that subject no. 2 had best reaction ability and got a good start. His acceleration ability was also better than others athlete. But maximum speed was achieved by subject no.1. Subject no. 3 had better speed maintenance ability. And subject no. 1 had least timing difference between first and second 50m.

After discussion table no.7 and 8 the researcher saw that in case of male sprinter subject no.1 had better reaction time ability and acceleration ability and percentage of deceleration was little, that's why he took least time to complete 100m sprint. In contrary subject no. 5 had poor reaction time ability, acceleration ability and deceleration ability, that's why he took more time to complete 100m. In case of female subject no.1 had better speed ability, speed endurance and little percentage of deceleration so, she took least time to cover 100m. In contrast, subject no. 3 although had better reaction time ability but speed ability and deceleration ability was poor, that's why she took more time to cover 100m.

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