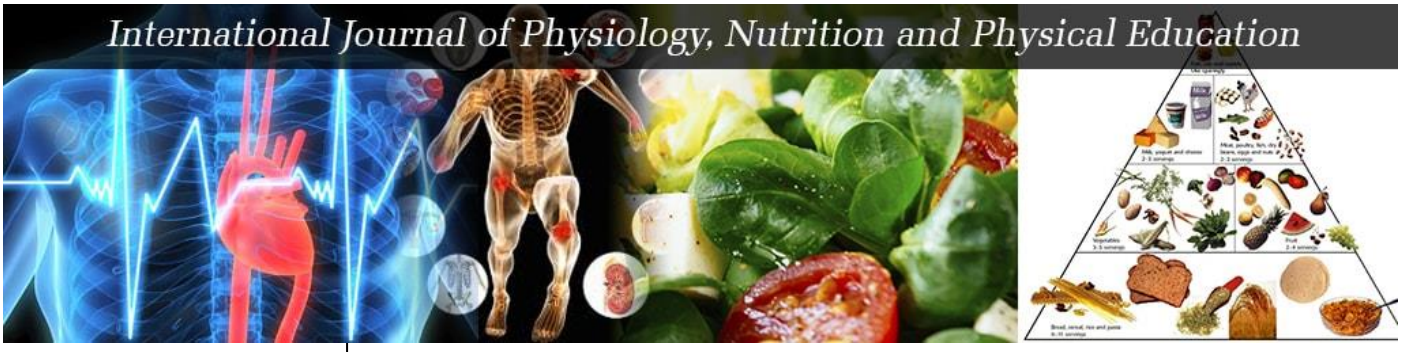

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A kinematic comparison of the techniques of athletes and decathletes in 110m hurdles of inter university players

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Abstract
Aims: The purpose of this study was to a kinematic comparison of the techniques of athletes and decathletes in 110 m hurdles of Inter university players.
Materials and Method: For the purpose of the study, eight Athletes (hurdle specialist) and eight Decathletes hurdler of different university, who was participated in 75th All India Inter University. The Kinematic parameters were determined by using a video kinematic analyzer.
Results: Some of the most important variable have been determined it was found that athletes are distinguished from decathletes by Shorter stride length over the hurdle, Shorter flight time over the hurdle, Lower C.G. in takeoff to landing, Shorter supporting time in 1st stride post hurdle, Shorter 1st stride post hurdle, Shorter flight time in 1st stride post hurdle.
Conclusion: The result of this study showed there was not statistically significant difference in all kinematic parameters between athletes and decathletes but there was a significant difference in most of the kinematics and Physical parameters.

Keywords: kinematic, hurdles, techniques, take off, landing, decathletes

Introduction
The hurdle clearance technique is one amongst the key components defining the competition result from the aspect of biomechanics; hurdles are a fusion of cyclic sprinting and acyclic clearance of ten 1.067 M hurdle. The hurdler so creates a high level of sprinting skills, special flexibility at the hip joint, quick strength, and a high level of technical knowledge. During clearing the hurdle, the loss of horizontal velocity must be as small as possible, however, this depends on various factors, particularly those who define the takeoff and also the landing point of hurdle clearance are crucial. the proper position of those 2 points could be a precondition for an optimal path of the flight of the CG and it reflects within the flight time that must be as short as possible Besides the proper position, the kinematic - dynamic structure of takeoff and landing that directly influences the velocity of hurdle clearance is also significant.

Method
The purpose of this study was to a kinematic comparison of the techniques of athletes and decathletes in 110 m hurdles of Inter university players. For the purpose of the study, eight Athletes (hurdle specialist) and eight Decathletes hurdler of different university, who was participated in 75th All India inter-university Athletic championship organized by Rajiv Gandhi University of Health Sciences, Karnataka, Bangalore and Alva's Education Foundation(R), Moodbidri dated 16th to 20th January 2015 were selected as subjects. For the purpose of the study, data are collected over 16 male Inter university players divided in to eight athletes(hurdle specialist) age: 23.10 ± 0.87 years, body weight 74.62 ± 2.82 kg., standing height: 1.81 ± 0.04 m., and decathletes (decathletes hurdler) age: 24.35 ± 0.65 years, body weight 73 ± 1.6 kg., standing height: 1.84 ± 0.01 meters.

Selection of Variables
To obtain variable Measurements, standard and calibrated equipments like high-definition video cameras (SONY PMW 200) series, steel tape, weighing machine, and specialized

motion analyzing software (APAS-Ariel performance Analysis system.- U.K.) were used.

Physical variables

1. Age
2. Body weight
3. Standing height

Kinematic variables

1. The takeoff distance at front of the place of the hurdle.
2. The stride length over the hurdle.
3. The landing distance at behind the place of the hurdle.
4. The length of 1st stride of post hurdle.
5. The height of C.G. at the contact before the hedge attack.
6. The height of C.G. at the takeoff while attacking the hedge.
7. The max height of C.G. at crossing the hedge.
8. The height of C.G. at landing of post hurdle.
9. The flight time of over the hurdle.
10. The height of C.G. at takeoff in 1st stride of post hurdle.
11. The support time of 1st stride of post hurdle
12. The flight time of 1st stride of post hurdle.
13. The performance (entire hurdle-race time)

Filming protocol

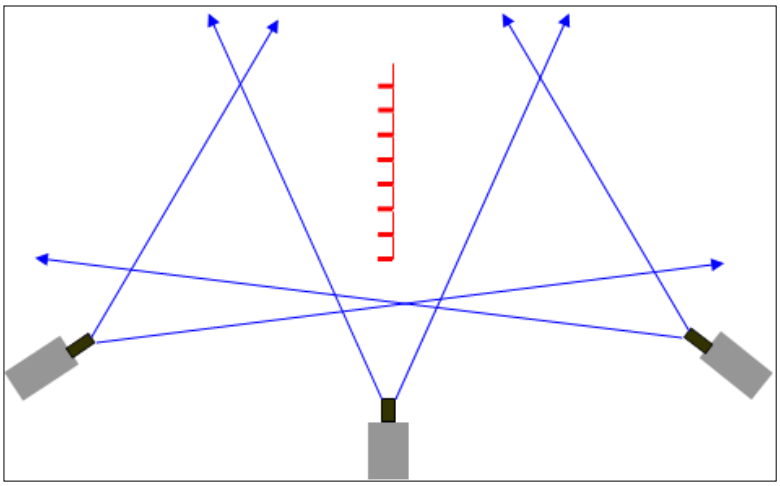

Fig 1

Three synchronized high definition video (SONY PMW 200 series) cameras using by Researcher. The subjects were filmed in sagittal plane only. Only one hurdle clearance and stride before or after the clearance were registered for analysis purposes, the filming zone was wide enough to accommodate the required sequence of movement. The camera was positioned near the 1st hurdle. An angle 45^0, 90^0, 45^0. The frequency of the cameras was 120 Hz, Manual filming system was used to record the performance of the subject. The performances were recorded in 1/100 of a second. The subjects were filmed during the competition only. The cameras were placed on the tripod. Cameras and the filmed target was 11 m. whilst the height of its attachment was 1.27 m and remained un-change during the recordings.

The captured video film was adding into the APAS-Ariel performance Analysis system-software and it gives an appropriate treatment for the comparison of the athletes and decathletes kinematic variables.

Statistical procedures

For the statistical calculation of the physical and kinematics variables, Independent t-test was used to examine the difference between athletes and decathletes. The mean and standard deviation of two groups' physical and kinematics variable were calculated with the SPSS (V. 16) software. In all statistic analysis, the significance threshold was set at $p<0.05$.

Table 1: Kinematic variable comparison of athletes and decathletes

Parameter	HS (n = 8)	DH (n = 8)
The takeoff distance at front of the place of the hurdle	1.90m	2.10
The stride length over the hurdle	3.50m	3.75m
The landing distance at behind the place of the hurdle	1.60m	1.65m
The length of 1st stride of post hurdle.	1.54m	1.66m
The height of C.G. at the contact before the hedge attack	1.03m	1.04m
The height of C.G. at the takeoff while attacking the hedge	1.15m	1.17m
The max height of C.G. at crossing the hedge	1.27m	1.36m
The height of C.G. at landing of post hurdle	1.15m	1.22m
The flight time of over the hurdle	0.37s	0.40s
The height of C.G. at takeoff in 1st stride of post hurdle	1.08m	1.11m
The support time of 1st stride of post hurdle	0.10s	0.12s
The flight time of 1st stride of post hurdle	0.07s	0.08s

Kinematic variables of hurdle clearance technique and the first stride of post hurdle of athletes

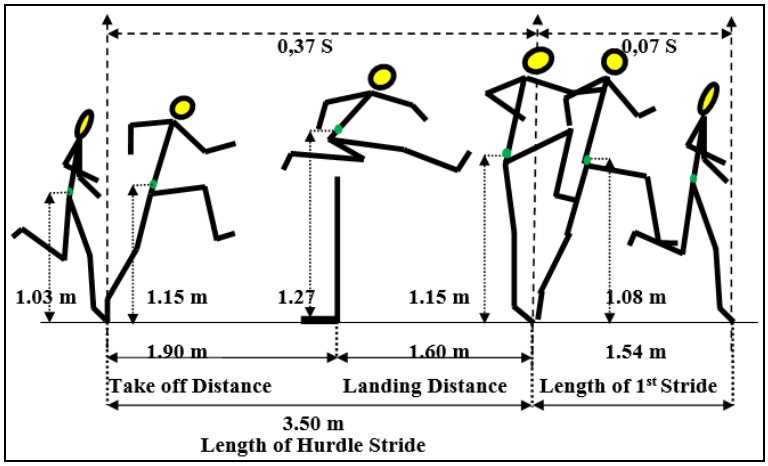

Fig 2

Kinematic variables of hurdle clearance technique and the first stride of post hurdle of decathletes

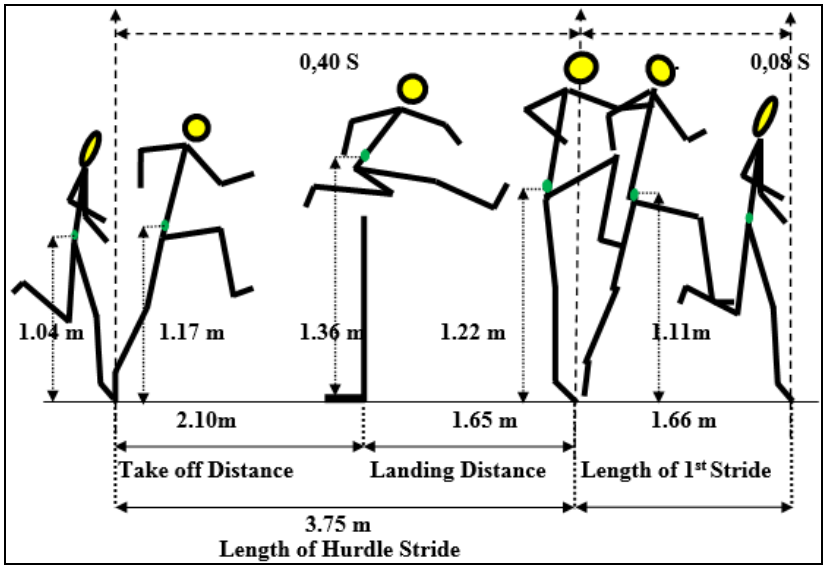

Fig 3

Result

For the purpose of the study, data are collected over sixteen male Inter university players divided in to eight athletes (hurdle specialist) age: 23.10 ± 0.87 years, body weight74.62 ± 2.82 kg., standing height: 1.81 ± 0.04 m., and eight decathletes (decathletes hurdler) age: 24.35 ± 0.65 years, body weight 80.34 ± 1.92 kg., standing height: 1.84 ± 0.01 m., the Performance of 110 m. hurdle race achieved by athletes (SH) were significantly better than those decathletes (p< 0.05). The relative value was 14.95 ± 0.61 s., and 16.35 ± 0.76 s., respectively.

1. The takeoff distance at front of the place of the hurdle

The takeoff distance was1.90 ± 0.01 m. in athletes and 2.10 ± 0.01 m. in decathletes that represents 54.28% and 56% of the whole hurdle stride length. There was a significant difference between athletes and decathletes.
Significant at $p < 0.05$.

2. The stride length over the hurdle

The stride length at over the hurdle was 3.50 ± 0.02 m. in athletes and 3.75 ± 0.02 m. in decathletes, it was greater than athletes. There was a significant difference between athletes and decathletes.
Significant at $p < 0.05$.

3. The landing distance behind the place of the hurdle

The landing distance at behind the place of the hurdle was 1.60 ± 0.01 m. in athletes and 1.65 ± 0.01 m. in decathletes which represents 45.72% and 44% of whole hurdle stride. There was a significant difference between athletes and decathletes.
Significant at $p < 0.05$.

4. The length of 1st stride of post hurdle

The length of 1st stride of post hurdle was 1.54 ± 0.01 m. in athletes and 1.66 m. in decathletes, there was larger than athletes. There was a significant difference between athletes and decathletes.
Significant at $p < 0.05$.

5. The height of C.G. at the contact before the hedge attack

The height of C.G. at the contact before the hedge attack was1.03 m. in athletes and 1.04 m. in decathletes, which represents 57.22% and 56.52% of their body height 1.80 m.

and 1.84m.Decathletes C.G. was higher than that of athletes. There was a significant difference between athletes and decathletes.
Significant at $p < 0.05$.

6. The height of C.G. at the takeoff while attacking the hedge
The height of C.G. at the takeoff while attacking the hedge was 1.15 m. in athletes' and1.17 ± 0.01 m. in decathletes, which represents 61.66% and 63.58% of their body height 1.80 m. and 1.84 m. Both groups were equal, there were not significant.
Not significant at $p< 0.05$.

7. The max height of C.G. at crossing the hedge
The max height of C.G. at crossing the hedge was 1.27 ± 0.01 m. in athletes and 1.36 m. in decathletes, there were higher than that in athletes, body position above the hurdle was also higher in decathletes. There was a significant difference between athletes and decathletes.
Significant at $p < 0.05$.

8. The height of C.G. at landing of post hurdle
The height of C.G. at landing of post hurdle was 1.15 m. in athletes and 1.22 m. in decathletes, there were higher than that in athletes, body position at landing (touchdown) was also extra higher in decathletes. There was a significant difference between athletes and decathletes.
Significant at $p < 0.05$.

9. The height of C.G. at takeoff in 1st stride of post hurdle
The height of C.G. at takeoff in 1st stride of post hurdle was 1.08 m. in athletes and 1.11 m. in decathletes, there were higher than that in athletes, body position at takeoff in 1st stride post hurdle was also extra higher in decathletes. There was a significant difference between athletes and decathletes.
Significant at $p < 0.05$.

10. The flight time of over the hurdle
The flight time of over the hurdle was 0.37 s. in athletes and 0.40 s. in decathletes, there was higher than that in athletes, stride length over the hurdle was also larger in decathletes. Decathletes took more time in flight than the athletes. There was a significant difference between athletes and decathletes.
Significant at $p < 0.05$.

11. The support time of 1st stride of post hurdle
The support time of 1st stride of post hurdle was 0.10 ± 0.00 s. in athletes and 0.12 s. in decathletes, there were higher than that in athletes. There was a significant difference between athletes and decathletes.
Significant at $p < 0.05$.

12. The flight time of 1st stride of post hurdle
The flight time of 1st stride of post hurdle was 0.07 ± 0.00 s. in athletes and 0.08 ± 0.00 s. in decathletes. There was a significant difference between athletes and decathletes.
significant at $p< 0.05$.

Discussion of findings
Efficient hurdle clearance is defined by the length of the stride before hurdle clearance and after hurdle clearance. The entire hurdle stride length of athletes groups was 3.50 meters and decathletes group was 3.75 meters. The take-off distance at front of the hurdle was 1.90 meters in athletes and 2.10 meters in decathletes that represent 54.28% and 56% of the entire hurdle stride length. The landing distance behind the hurdle was 1.60 meters in athletes and 1.65 meters in decathletes, that is 45.72% and 44% of the entire hurdle stride length. The optimal ratio between the take-off point and landing point in athletes was 54:46 and 56:44 in decathletes. We can see that athletes have a slightly shorter stride before hurdle clearance and a slightly longer after hurdle clearance.
The take-off in front of the hurdle is one among the elements of vital importance to best hurdle clearance since it directly defines the flight of the movement. The quality of hurdle clearance is directly related to the height of the C.G. in the take-off phase. From the aspect of kinematics, an efficient hurdling is that the one in which vertical oscillations of the C.G. are as small as possible. The hurdler must maintain a high position of the C.G. during take-off. The athletes height of the C.G. at the end of the propulsion phase is 1.15 meters, and 1.17 meters in decathletes, that represents 63.53% and 63.58%of their body height (BH=1.81m and 1.84m). The raising of the C.G. from the braking phase to the propulsion phase amounts to 12 cm. in athletes and 12 cm. in decathletes. The max height of C.G. is depends on the technique of takeoff in front of a hurdle and on the anthropometrical characteristics of the flight.
The criterion of an efficient hurdle clearance technique is that the shortest possible time of the flight phase (hurdle clearance time) since the hurdler loses speed in the air. The length of the flight of the C.G. of athletes is 3.50 meters, and 3.75 meters, in decathletes. The flight time is 0.36 seconds, in athletes and 0.40 seconds in decathletes. The height of the C.G. at over the hurdle is in positive correlation with the hurdle clearance times. As a rule, the higher the trajectory of the flight of the C.G., the longer the flight phase. In athletes, this value was 1.27meters, and decathletes this value was 1.36 meters, that in this case the foremost efficient trajectory of the flight of C.G over the hurdle. The raising of C.G relative to the take-off phase is so 1.15 meters, in athletes and 1.17 meters, in decathletes, that is maybe the results of a comparatively short take-off distance of athletes.
The landing phase is one among the foremost vital elements of the hurdling technique. This phase has the largest reserve potential for improving the competition result. In the landing phase, it's necessary to carry out as efficiently as possible the transition from hurdle clearance to running between hurdles. This transition from acyclic movement into cyclic movement needs a high degree of technical knowledge; the support time in 1st stride of post hurdle was 0.10 seconds in athletes and 0.12 seconds in decathletes. The athletes' groups maintain a C.G. position of 1.15 meters and therefore the decathletes teams don't maintain a C.G. position. Decathletes teams C.G. position at the time was a 1.22 meters. It was much more than the athletes. "Soft" landing of the hurdler after hurdle clearance is indicated by the vertical velocity that may be a negative influence. The maintenance of the horizontal velocity of the C.G. after hurdle clearance and that may be a requirement for an efficient model of running to the next hurdle.
The length of the post stride allows to achieving best speed between the hurdles. The athletes' 1st stride of post hurdle length was 1.54 meters and 1.60 meters in decathletes. The height of C.G. at takeoff in 1st stride of post hurdle was 1.08 meters in athletes and 1.11 meters in decathletes, there were higher than that in athletes, body position at takeoff in 1st stride of post hurdle was also extra higher in decathletes groups. These divergences, conformation between the support

time duration of the 1st stride post hurdle

On the basis of this parameter, it can be established that the athletes' were an efficient hurdle technique according to the result, the researcher found that improving the performance in hurdle race involves a number of reduction must be required in kinematics parameters.

A kinematic comparison of the techniques of athletes and decathletes in 110 m hurdles of Interuniversity players allowed determining the common parameters and the specific distinctive technical component of each group by examining the kinematic particularities in the phases of the takeoff, flight, and landing, some of the most important variable has been determined it was found that athletes are distinguished from decathletes by-

- Shorter stride length over the hurdle
- Shorter flight time over the hurdle
- Lower C.G. in takeoff to landing
- Shorter supporting time in 1st stride of post hurdle
- Shorter 1st stride of post hurdle
- Shorter flight time in 1st stride of post hurdle

Recommendations

The result of this study to showed that athletes are distinguished by rational and efficient hurdle clearance techniques which were expressed in the better outcome of the latter.

1. A similar study may be conducted by selecting kinetic and angular kinematics variables.
2. A similar study may be attempted by junior age group players.
3. A similar study can also be conducted on female players.
4. The study may be undertaken with a large number of variables.
5. A Similar study may be undertaken to analyze the other games and event players.
6. A Similar study may be conducted by more sophisticated equipment of different sports.
7. A Similar study may be conducted on college, state and international players.

References

1. Ali Mahmoud Attia Bakhet, Said Mohamed Ben Ahmed. 'Kinematic analysis of the Hurdle clearance techniques and the first stride after clearance in 110m sprint Hurdles; Comparative Study under real competition between elite Hurdler specialists and elite decathletes,' Sports Science in the Heart of the Arab Spring Hurghada. 2013; 1:73-85.
2. Bartlelt Roger. Introduction of Sports Biomechanics, 2nd Edition, Taylor and Francis Groups e library, 2007, 111.
3. Bubanj *et al*. Comparative Biomechanical analysis of techniques on 110m running with Hurdles of elite and non-elite Athletes. Serbian Journal of Sports Sciences. 2008; 02(1-4):37-44.
4. Coh Milan, Iskra Janusz. Biomechanical studies of 110m Hurdle Clearance Technique. International Scientific Journal of Kinesiology Sport science. 2012; 05:10-14.
5. Hunter Joseph P, Marshall Robert N, Mc Nair. Interaction of step length and step rate during sprint running. Medicine & Science in Sports & Exercise. 2003; 36(2):261-264.
6. Kampmiller Tomas, Slamka Milos, Vanderka, Marian. Comparative Biomechanical of 110m Hurdle of Igor Kovac and Peter Nedelicky, Comparative Biomechanical analysis, analysis Kinesiologia Slovenica. 1999, 26-30.
7. Khan Hussain IA, Mohammad A. Comparison of kinematical variables between successful and unsuccessful Fosbury-flop high jump technique. Golden Research Thoughts. 2011; 01(01):83-85.
8. Kunz H, Arbeit Dipl, Kaufmann DA. Biomechanical Analysis of Sprinting; Decathletes Versus Champions. British Journal of Sports Medicine. 1981; 15(3):177-181.
9. Mackala Krzysztof. Optimisation of Performance through Kinematic analysis of the different phases of the 100 meters. New Studies in Athletic. 2007; 22:7-16.
10. Mann Ralph. The Elite Athlete, Project Sprints and Hurdles, Track Technique. 1983; 51:2672.
11. Moria Pherson Mc. A systematic Approach to Skill Analysis, Sports science Periodical of Research and Technology in Sports. 1990; 11(1):210.
12. Murphy Aron J, Lockle Robert G, Courtts Aaron J. Kinematic determinants of early acceleration in field sports Athletes. Journal of Sports Science and Medicine. 2003; 02:144-150.
13. Nechita Florentina. Application of Mechatronics Systems to 110m hurdles training - a case report, Palestrica of third Millennium - Civilization and Sport. 2012; 13(04):348-353.
14. Park Sang-Kyoon, *et al*. Sprinting characteristics of Women's 110m finals at the IAAF World Championship, Daegu, Korean Society of Sport Biomechanics, 2011, 2012, 228.
15. Payton Carl J, Bartieltt Roger M. Biomechanical Evaluation of Movement in Sport and Exercise. The British Association of Sport and Exercise Science Guidelines, 2008, 29.
16. Salo Aki IT. Technical Changes in Hurdle Clearances at the beginning of 110m Hurdle event A pilot Study, Caceress - Extremadura - Spane, ISBS, 2002, 84-87.
17. Shaw Dhananjoy, Gambhir Shalini. Dictionary of Physical Education Sports & Exercise Science, (New Delhi, Friends Publication, 2000, 41.
18. Mandeep S. Evaluation and improvement of sports techniques through biomechanical updated analyzing technology, University News-Special issue, Association university, 48:54-57.
19. Amritpal S, Jangbahadur Shamsher. International Journal of science and research (IJSR). 2015; 4(10):1591-1594.
20. Sidhu Amritpal Singh, Mandeep S. Kinematical Analysis of Hurdle Clearance Technique in 110M Hurdle Race. International Journal of Behavioral Social and Movement Sciences. 2015; 04(02):28-29.
21. Spinks Christopher D *et al*. 'The effects of Resisted Sprint Training of Acceleration Performance and Kinematic in Soccer, Rugby union and Australian Football Players. Journal of Strength and Conditioning Research. 2007; 21(1):77-85.
22. Tan John Poh Danny, Koh Michael. Kinematic Analysis of Junior women hurdling', Beijing, China. ISBS. 2005, 684-687.