ISSN 1750-9823 (print)
International Journal of Sports Science and Engineering
Vol. 05 (2011) No. 04, pp. 213-218

Analysis of Selected Kinemetical Parameters of Two Different Level Male Long Jumpers

Ikram Hussain[1], Asim Khan[2], Arif Mohammad[2]

[1]Professor and Chairman, Department of Physical Health and Sports Education, Aligarh Muslim University, Aligarh, (U.P.), India.

[2]Research Scholar, Department of Physical Health and Sports Education, Aligarh Muslim University, Aligarh, (U.P.), India.

(*Received August 19, 2011, accepted September 9, 2011*)

Abstract. The purpose of this study was to compare the selected kinematical parameters of intervarsity and interschool level long jumpers. A total of twelve (six intervarsity and six interschool level) long jumpers were selected for the present study as subjects. To acquire kinematical data two digital Sony DCR SX40E video recording cameras, operating at 1/2000 with a frame rate of 60 frames per second, were used during the respected events. The selected kinematics variables for this study were approach speed, last stride length, velocity of last stride, angle of foot planting, knee angle at take-off and total covered distance. For capturing the movement and motion of the athlete, one camera was placed at a distance of ten meters right side of the run way mounted at a height of five feet used to capture approach run, second camera was used to capture the last stride, foot planting and take-off of the jumpers which was placed perpendicular at a distance of seven meters on the right side of the take-off board the height of the camera was set five feet from the ground. All jumps performed by the selected jumpers during competition were recorded and the best valid jump for each athlete was selected for further analysis. The recorded video footages were downloaded, slashed and edited by using the downloaded version of STHVCD55 software. Digitization, smoothing and analysis were conducted using the Silicon Coach Pro7 motion analysis software. Acquired data were subjected to an independent sample t test for the comparison of the kinematics parameters between intervarsity and interschool male long jumpers. All statistical procedures were conducted using the SPSS (16.0 Version) software. A level of significance was set at 0.05. The results of the study revealed that there was significant difference between intervarsity and interschool level long jumpers in their approach run speed, velocity of last stride and total covered distance where as insignificant differences were observed between intervarsity and interschool level long jumpers in their last stride length, take-off leg knee angle and angle of foot planting. On the basis of the results it is concluded that intervarsity and interschool level long jumpers both exhibited almost same angle of foot planting. Intervarsity athlete yielded good result as their approach run speed velocity of last stride and total covered distance than interschool level jumpers. This might be due to the reason that the training age of the intervarsity jumpers was higher than the interschool level long jumpers.

Key words: Kinematics, Long Jumpers, Intervarsity and Inter school.

1. Introduction

The long jump has been part of modern Olympic competition since the inception of the Games in 1896. In 1914, Dr. Stewart recommended the "running broad jump" as a standardized track and field event for women. However, it was not until 1928 that women were allowed to compete in the event at the Olympic level. According to biomechanical characteristics, long jump belongs to a group of complex spatial movement and according to motor activity character belongs to a group of natural locomotion without usage of technical accessories. Long jump as athletic discipline consists of four different phases i.e. approach (run-up) phase, phase of bounce off, phase of leap and the last is landing phase. (Hay, 1986). Many jumpers use their maximal speed of approach combined with technique (optimal technique is used to achieve as bigger speed while sprinting as possible and to bounce off as much as possible) hoping to achieve the longest possible distance(Bridgett, Galloway & Linthorne, 2002). The long jumping performance is determined primarily by the athlete's ability to attain a fast horizontal speed at the end of the approach run (Lees et. al., 1993). While approaching, the jumpers regulate acceleration using their visual regulation in the last three steps (Glizen & Laurent, 1997).To make best use of the run-up speed the athlete must use an appropriate

take-off technique to launch the body into the air (Bridgett and Linthorne, 2006). The approach speed (Berg and Greer, 1995) found to be lower than the optimal speed. The findings of Hay (1978); Lees & Smith (2005) and Bridgett and Linthorne (2006) suggested that the approach speed are close to a top level sprinter. The other component on which the performances relay is take-off and is one of the most technical parts of the long jump which determine the distance of the jump. There are four main styles of take-off which used by the long jumpers: the kick style, double-arm style, sprint take-off and the power sprint or bounding take-off. During the take-off phase Lees et al (1994) found a knee angle of 172° ± 3.1 and 165–170 °. This was greater than the 158° seen by Adrian and Cooper (1995) but close to the mathematical model found by Alexandra (1990) of 170-180°. Alexandra's (1990) model for the optimal angle of take-off related to Ruan and Wei (2000) study who evaluated the optimal projection angle for male long jumpers from the 8th Chinese -games. Results suggested the optimal take-off angles ranges from 18.3° to 24.6°, but suggested a higher projection angle at the expense of the normal, but unspecified the loss of projection velocity, however would increase the distance. Thus the present study was designed to explore and compare the kinematics parameters of the technique of intervarsity interschool level male long jumpers.

2. Methodology

2.1. Participants

A total of twelve, six intervarsity and six interschool level long jumpers were selected as subjects for this study. For the purpose of this study interschool level jumpers were those who represented their school team in the interschool competition and intervarsity level athletes were those who represent their university team in the all India intervarsity competition.

2.2. Videography Technique

2.2.1. Videographic Equipments and Location

Two-dimensional coordinate data from one side of the body were obtained with two high speed Sony DCR SX40E camcorder operating at 1/2000 with a frame rate of 60 frames per second was used to capture the biomechanical data. One camera was placed perpendicular to saggital plane on the right side at a distance of ten meters from the run way to capture the approach run and the second camera was placed on the same side at a distance of seven meters from the take-off board to capture the last two strides (just before the take-off board), the foot planting (planting of foot on the take-off board), the take-off (take-off/point break of contact from the take-off board) and the landing (the point where touch the body on sand) of the jumpers. The following biomechanical parameters were considered for this study, i.e. approach speed, last stride length, velocity of last stride, knee angle at take-off, angle of foot planting and total covered distance.

2.2.2. Subject and Trail Identification

To identify the subject in the video graph, a number was given to the each player for distinguish them in the recorded data. For identification purposes of a best performance, the trails were viewed on the computer system and exarter on the subject (jumper) demarketed the trail for the data acquisition.

2.3. Data Reduction

All officials allotted and valid jumps performed by the jumpers were recorded and the best jump for each jumper was identified and selected. After video recording session was over, the selected video footages were downloaded, slashed and edited by using the downloaded version of STHVCD55 software. The identified trails were played with the help of Silicon Coach Pro 7 (Motion Analysis Software) to make separate clips of each player and trial. The separate clips were then opened into the Silicon Coach Pro-7 software. The software has provision to analyze the velocity, speed, angles, distance and number of frames as in the feature. The numeral data were acquired of the variables by digitizing video data using the software (Silicon coach pro 7).

2.4. Statistical Analysis

It is an important aspect of any endeavor to reach at last inferential point, for this the raw data were arrange sequentially, tabulated and subjected for the descriptive statistical analysis, followed by 't' test by using SPPS (16.0)

3. Results

The results of this empirical investigation is presented in the preceding tables and graphs.

Table 1: Anthropometric descriptions of Intervarsity and interschool male Long Jumpers

Groups	Mean & SD	Anthropometric Description				
		Age (Years)	Height (cm)	Weight (kg)	Arm Length (cm)	Leg Length (cm)
Intervarsity	Mean	22.25	177.17	66.53	59.74	87.74
	SD	0.94	5.85	1.00	1.05	1.73
Interschool	Mean	18.83	169.00	62.03	56.96	82.23
	SD	0.82	1.65	1.11	0.80	1.20

Table 2: Mean and Standard Deviation of Selected Biomechanical Parameters

Groups	Mean/ SD	Biomechanical Parameters					
		ARS	LSL	VLS	AFP	TKA	TCD
Intervarsity	Mean	8.84 (m/s)	1.71 m	8.85 m/s^2	22.00^o	142.23^o	7.02 m
	SD	0.20	0.10	0.13	0.17	1.53	0.19
Interschool	Mean	7.80 (m/s)	1.48 m	7.02 m/s^2	19.84^o	134.32^o	6.31 m
	SD	0.24	0.09	0.13	0.38	2.41	0.27

ARS= Approach Run Speed, LSL= Last Stride Length, VLS= Velocity of Last Stride, AFP= Angle of Foot Planting, TKA= Take-off Leg Knee Angle, TCD= Total Covered Distance.

As indicated in Table-2 intervarsity long jumpers have longer Last Stride Length (1.71 m.) as compare to interschool level long jumpers (1.48 m.), that might be the reason the velocity of last stride of intervarsity long jumpers (8.85 m/s) is greater than interschool level (7.02 m/s) long jumpers. The take-off leg knee angle of intervarsity long jumpers was greater than the interschool level long jumpers. Angle of foot planting of intervarsity long jumpers found (22.00^0) which resulted the total covered distance (7.02 m) that was more than interschool level long jumpers i.e. 19.84^0, 6.31 m. respectively.

Table 3: Independent t Value of Selected Parameters between Intervarsity and Interschool Level Long Jumpers

Parameters	Calculated 't' value
ARS	2.26*
LSL	0.01
VLS	9.21*
AFP	1.34
TKA	0.001
TCD	6.23*

*Significance at 0.05 level of confidence with 10 df . Tab't'= 2.23

As showed in the Table 3 there were significant difference found between intervarsity and interschool level long jumpers in their Approach Run Speed and Velocity of Last Stride and Total Covered Distance whereas insignificant differences were found between intervarsity and interschool level long jumpers in their Last Stride Length, Angle of Foot Planting and Take-off Leg Knee Angle.

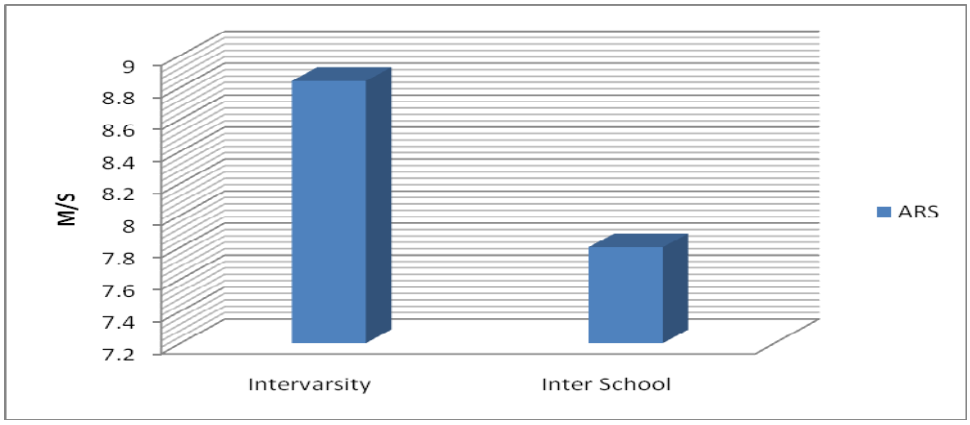

Figure 1.1: Showing Comparison of Approach Run Speed

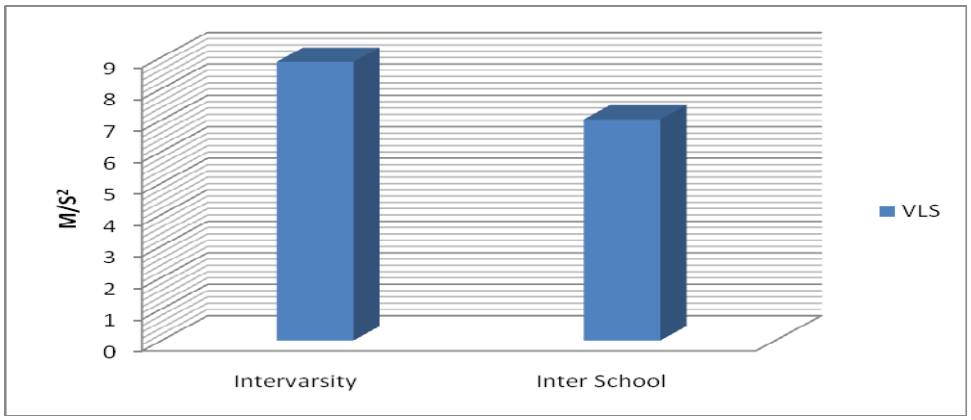

Figure 1.2: Showing Comparison of Velocity of Last Stride

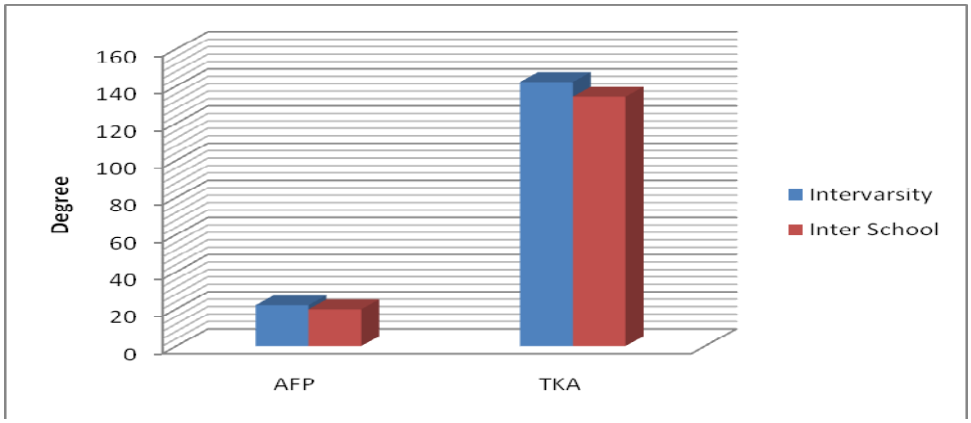

Figure 1.3: Showing Comparison of Angle of Foot Planting and Take-Off Leg Knee Angle

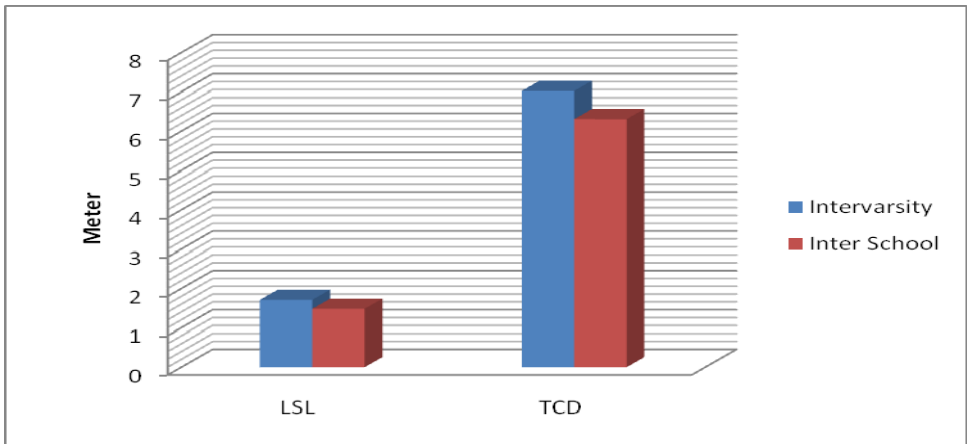

Figure 1.4: Showing Comparison of Last Stride Length and Total Covered Distance

4. Discussion

The result of present study has shown that intervarsity level long jumper exhibit higher approach run velocity than the interschool level long jumpers, a study by Omura et al. (2005) shown the similar result that the approach run velocities of the top jumpers (ranging from 10.3m/s to 10.4m/s) were higher than those of the junior long jumpers. However, the values were lower than those of the Japanese top jumper (10.8m/s; 8m18) and the World's class jumper (Phillips; 11.0m/s, 8m31). A significant difference in their velocity of last stride and has similar result of Seyfarth , Wandk & Blickhan (1999) study, found the jump distance increases that when jumper increases the touchdown velocity of the supporting leg. In the literature, Georag and Tuttle (1950) identified that a long jumper who is able to utilize 95% of his maximum velocity will be

able to achieve the longest jump. This being the case, long jumpers able to take-off at very high velocity will have direct effect on the distance jumped i.e the greater the velocity, the greater the corresponding distance will be. The horizontal velocity at take-off has the largest influence on the flight distance. It was observed that both intervarsity and interschool level long jumpers utilize the "almost similar last stride" the technique allow the jumpers to achieve the goal of the approach run, i.e. to adjust their body position in the preparation for the take-off and to facilitate optimum conditions for the jump (Hay & Nohara, 1990).

Despite the good demonstration of the long jump technique, the Greek jumpers performed the long jump with less advantageous values of crucial biomechanical parameters, when compared to elite jumpers worldwide (Koyama et al., 2008; Muller & Bruggemann, 1997; Nixdorf & Bruggemann, 1990). The individual difference in technique for both intervarsity and interschool level long jumpers do not stop in perfection, it is not necessary for jumpers to have the same biomechanical parameters, approach run speed, segmental angles, last stride length. One player can have low angle at knee or ankle at the other hand other can have high angle at hip or elbow etc. and both can achieve the maximum distance in their jump. The result of the present study showed that the jumping technique can have any segmental angle variation to get maximum performance in the long jump.

5. Conclusion

On the basis of the findings it is concluded that intervarsity and interschool level long jumpers significantly differ in their approach run speed and velocity of last stride which indicates that enhancement in these variables which have a great impact in the total covered distance performance.

The mean scores of intervarsity and interschool level long jumper's last stride length, velocity of last stride, take-off leg knee angle and the total covered distance clearly indicates that intervarsity level jumpers have higher values than interschool level jumpers, if interschool level jumpers improve in these parameters will certainly increase in the covered distance or long jump performance. The angle of foot planting of intervarsity and interschool level jumpers showed a little difference in the mean score, indicating not much impact in performance improvement.

6. Acknowledgement

The present empirical research work has been undertaken under UGC, SAP (DRS-I) Programme, Department of Physical Health and Sports Education, Aligarh Muslim University, Aligarh**.**

7. References

[1] Alexander, R. M. Optimum Take-off Techniques for High and Long Jumps. *Phil. Trans. R. Soc. Lond.*1990, **329**: 3-10.

[2] Bridgett, A. Galloway, M. and Linthorne, N.P. The Effect of Run-up Speed on Long Jump Performance. *In Scientific Proceedings of the xxth International Symposium on Biomechanics in Sports, Cáceras, Spain, (Edited by K.E. Gianikellis), Caceras: Universidad De Extremadura.* July 1-5, 2002, pp. 80-83.

[3] Bridgett, Lisa A. and Linthorne, Nicholas, P. Changes in Long Jump Take-off Technique with increasing Run-up Speed. *Journal of Sports Sciences.* 2006, **24**(8): 889-897.

[4] Georag, T. Bresnahaned and Tuttle, W. W. Track and Field Athletic. *3rd ed. St. Loui the CV Mosby Co,* 1950.

[5] Berg, W.P. and Greer, N.L. A Kinematic Profile of the Approach Run of novice Long Jumpers. *Journal of Applied Biomechanics.* 1995, **11**: 147-162.

[6] Cooper, J.M. & Adrian, M.J. The Biomechanics of Human Movement. *Second Edition. Brown and Benchmark,* 1995.

[7] Graham-Smith, P. and Lees, A. A Three-dimensional Kinematic Analysis of the Long Jump Take-off. *Journal of Sports Sciences*. 2005, **23**: 891-903.

[8] Glizen, d. Laurent, M. Controlling Locomotion during the Acceleration Phase in Sprinting and Long Jumping. *Journal of Sport Science.* 1997, **15**: 181-189.

[9] Hay, J.G. The Biomechanics of the Long Jump. *Exercise and Sport Sciences Reviews.* 1986a, **14**: 401-446.

[10] Hay, J.G. Approach Strategies in the Long Jump. *International Journal of Sport Biomechanics.* 1988, **4**: 114-129.

[11] Hay, J.G. and Nohara, H. Techniques used by Elite long Jumpers in Preparation for Takeoff. *Journal of Biomechanics.* 1990, **23**: 229-239.

[12] Koyama, N. Muraki, V. Takamoto, µ. and Ae, µ. Kinematics of Takeoff Motion of the World Elite Long Jumpers. *Proceedings of the 26th International Conference on Biomechanics in Sports.* 2008, pp. 695.

[13] Lees, A. Fowler, N. and Derby, D. A Biomechanical Analysis of the last Stride, Touch-down and Take-off Characteristics of the Women's Long Jump. *Journal of Sports Sciences.* 1993, **11**: 303-314.

[14] Lees A. A Biomechanical Analysis of the Last Stride, Touch-down, and Take-off Characteristics of the Men's Long Jump. *Journal of Applied Biomechanics*. 1994, **10**: 61-78.

[15] Muller, H. and Bruggemann, G. P. Long jump. Biomechanical Research Project at the Vlth World Championships in Athletics, Athens 1997: *Preliminary Report. New Studies in Athletics.* 1997, **13**: 56-59.

[16] Nixdorf, E. and Bruggemann, G. P. Biomechanical Analysis of the Long Jump. *Scientific Report on the Second IAAF World Championships in Athletics e1 – e54. Monaco: International Athletic Foundation,* 1988.

[17] Omura, I. Iiboshi, A. Koyama, H. Yuya Muraki, Y. and Ae, M. Analysis of the Approach run and the Take-off in the Japanese Junior Long Jumpers. *ISB xxth Congress - Asb 29th Annual Meeting.* July 31 - august 5, 2005, Cleveland, Ohio.

[18] Seyfarth, A. Blickhan, R. and Van Leeuwen, J.L. Optimum Take-off Techniques and Muscle design for Long Jump. *The Journal of Experimental Biology.* 1999. **203**: 741-750.

[19] Ruan, F. M. and Wei, Y. An Analysis of Projection Angle of the Long Jump (Cited in Proceedings of XVIII International Symposium on Biomechanics in Sports. 2000, **1**: 329-332.

[20] T.G. and Misuta, M.S. A 3D Kinematical Analysis of Long Jump in the "Gold Meeting RIO of Athletics. *Proceedings of the xxv ISBS Symposium, Ouro Preto – Brazil*. 2007, pp. 487-490.