Impact Factor 2.147

ISSN 2349-638x

Refereed And Indexed Journal

AAYUSHI INTERNATIONAL INTERDISCIPLINARY RESEARCH JOURNAL (AIIRJ)

Monthly Publish Journal

VOL-III ISSUE-VIII Aug. 2016

Address
•Vikram Nagar, Boudhi Chouk, Latur.
•Tq. Latur, Dis. Latur 413512
•(+91) 9922455749, (+91) 9158387437

Email
•aiirjpramod@gmail.com

Website
•www.aiirjournal.com

CHIEF EDITOR – PRAMOD PRAKASHRAO TANDALE

A Comperison of Selected Kinemetical Parameters between Male and Female Intervarsity Long Jumpers

Dr.Kulbhushan P. Bauskar
Assistant Professor,
M.A. (Geo), M.P.Ed., M.Phil., B.Ed., Ph.D., NET
Dept. of Physical Education,
Late.Ku. Durga K. Banmeru Science College
Lonar, Dist. Buldana - 443302

Abstract:

The aim of the present study is to compare selected kinematical parameters of male and female long jumpers. A total 12 (six male and six female) All India Intervarsity level long jumpers were randomly selected from the All India Intervarsity Athletic Championship, held at Chennai, India as participant. 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 event. 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 meter right side of the run way mounted at a height of three 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 four 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 male and female. 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 were significant differences found between male and female intervarsity level long jumpers in their last stride length, velocity of last stride, take-off leg knee angle and total covered distance, where as insignificant differences were observed between male and female intervarsity level long jumpers in their approach run speed and angle of foot planting. On the basis of the results it is concluded that male and female both exhibited same approach run speed and angle of foot planting but male athlete yielded good result as their total covered distance was more than female, this is just because of males possesses greater muscles strength than females.

Key words: Biomechanics, Long Jumpers, Intervarsity, Gender.

Introduction:

Biomechanics is the application of laws of mechanics to the anatomical (structural) and physiological (functional) aspects of a living organism and thus can be defined as the application of the principle of mechanics to study the biological systems. Analyses of biological system (Biomechanics) are an integral part of the technique training in high performance sports (Jaitner, et. al., 2001). The long jump an athletic event (track and field) in which athlete combines approach speed, last stride, foot planting, take-off, air bone and landing. The performance is obtained by measuring the length of an imaginary perpendicular line from the front edge of the take-off board to the nearest mark that the athlete makes in the sand (Hay and Miller, 1985). There were researches (Ward Smith, 1985) and on wide range the

variables that serve to influence the long jump performance. 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., 1994). 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 et al1 (1994) and Bridgett and Linthorne (2006) suggested that the approach speed are close to a top level sprinter. However the result of these studies could not be generalized due to application of diverse methods and the participant variations within experimental designs.

The optimal angle of the leg at touchdown compensates for both vertical and horizontal braking impulses (Alexandra, 1990; Seyfarth et al., 12000 and Bridgett and Linthorne, 2006). Graham-Smith and Lees (2005) study has indicated that during the contact phase when the foot is in contact with the ground the knee angle approaches 144 ° which is slightly lower than the result revealed by Adrian and Cooper (1995) who indicated that at the knee angle the point of contact is close to 158 ° however also of the view that due to the knee absorbing the various forces deepest flexion angle had decreased to 133°. The other component on which the performances relay is take-off and is one of the most technical parts of the long 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 al1(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°. Seyfarth et al1(2000) and Alexandra (1990) suggest smaller knee angles of 160° will results in a decrease jump distance of 19 cm, and for 150° a difference of 38 cm respectively. 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. Panoutsakopoulos and Kollias (2009), studied on the biomechanical analysis of the last strides, the touchdown and the take-off of top Greek male and female long jumpers. Two-dimensional kinematic data from top ten Greek male and top twelve Greek female long jumpers were collected during 2007 Greek National Championships finals. It has reported that male long jumpers exhibiting larger values than female for the kinematic parameters which relay to physical ability (i.e. speed) and body stature. A gender effect was established for the kinematic parameters which interpret technique elements. It is well known fact that application of appropriate biomechanical fundamentals improves the efficiency and ability of an athlete. Thus the present study was designed to explore and compare the kinematics parameters of the technique of intervarsity level male and female long jumpers.

Methodology:

Participants:

A total twelve (six male and six female) intervarsity high jumpers were selected as participants during the competition from All India Intervarsity Athletic Championship, held at Chennai, India in December 2009. The mean and standard deviation (SD) of male long jumpers were age (20.67 years, 1.63), height (177.17 cm, 5.85), weight (60.17 kg, 3.43), arm length (63.00 cm., 3.74) and leg length (93.33 cm., 2.73), and of female long jumpers were age (19.83 years, 1.17), height (155.00 cm., 6.69), the weight (50.83 kg, 3.06), arm length (49.33 cm., 2.73) and leg length (79.50 cm., 2.66).

Video graph Technique: Video graphic technique was further divided into two sections:

1) Video graphic Equipments and Location.

2) Subject and Trail Identification

1) Video graphic Equipments and Location:

Two-dimensional coordinate data from one side of the body were obtained with two high speeds 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) 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) demarcated the trail for the data acquisition.

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).

Results:

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) to distinguish if there were any difference across the different parameters between male and female long jumpers, the researcher reached at the results of this empirical investigation which is presented by the respective tables and graphs.

Table 1

Mean and standard deviation of selected biomechanical parameters

Groups	Mean / SD	Biomechanical Parameters					
		ARS (m/s)	LSL(m)	VLS(m/s)^2	AFP ()^0	TKA ()^0	TCD (m)
Male	Mean	9.73	1.84	9.17	22.02	143.67	6.79
	SD	0.046	0.07	0.31	2.36	5.13	0.11
Female	Mean	8.91	1.57	7.74	19.37	136.33	6.22
	SD	0.124	0.08	0.51	1.74	5.96	0.12

RS= 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 Cover distance. As indicated in Table-2 male long jumpers have longer Last Stride Length (1.84 m.) as compare to female long jumpers (1.57 m.), that might be the reason the velocity of last stride of male long jumpers (9.17 m/s) is greater than female (7.74 m/s) long jumpers. The take-off leg knee angle of male long jumpers was greater than the female long jumpers. Angle of foot planting of male long jumpers found $(22.02)^0$ which resulted the total covered distance (6.79 m) that was more than female long jumpers i". 19.37H, 6.22 m. respectively.

Table 2

Independent 't' value of selected parameters between male and female long jumpers

Parameters	Calculated 't' value
ARS	2.016
LSL	6.004*
VLS	5.92*
AFP	2.22
TKA	2.29*
TCD	8.21*

*Significance at 0.05 level of confidence with 10^{Th}'t'= 2.23

As showed in the Table 2 there were significant differences found between male and female long jumpers in there, Last Stride Length, Velocity of Last Stride and Take-off Leg Knee Angle Total Covered Distance whereas insignificant difference was found between male and female long jumpers in their Angle of Foot Planting.

Discussion:

The result of present study have shown significant difference in their last stride length, velocity of last stride and total covered distance and has similar result of Seyfarth Friedrich, Wandk and Blickhan (1999) study, found the jump distance increases that when jumper increases the touchdown velocity of the supporting leg. In agreement with Jubela Rober Otter's (1981) study, who found that the take-off velocity at about 90% of the maximum, results in the furthest jump. In the literature, Georag and Tuttle (1950) identified that a long jumper who is able to utilize 95% of his/her 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 (Nixdorf and Bruggman, 1990). Panoutsakopoulos and Kollias(2009) opine that male long jumpers exhibits larger values than female for the kinematic parameters which relay to physical ability (i.e. speed) and body stature. A gender difference effect was established for the kinematic parameters which interpret technique elements. It was observed that both male and female utilizes the "shorter last stride" technique despite of their physical appearance. 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 and 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 and Bruggemann, 1997; Nixdorf and Bruggemann, 1990). The individual difference in technique for both male and female long jumpers do not

stop in perfection, it is not necessary for jumpers to have the same biomechanical parameters (Hay J.G., 1993), 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.

Conclusion:

On the basis of these findings it is concluded that male and female intervarsity level long jumpers significantly differ in their last stride length, velocity of last stride and take-off leg knee angle, which indicates that enhancement in these variables will have impact in the total covered distance performance. The mean scores of male and female's last stride length, velocity of last stride, take-off leg knee angle and the total covered distance clearly indicates that male jumpers have higher values than female jumpers, if female umpires improve in these parameters will certainly increase in the covered distance or long jump performance. The approach run speed of male and female jumpers showed a little difference in the mean score, indicating not much impact in performance improvement.

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