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Kinematic aspects of take-off action in long jump

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Abstract

The aim of the study was to investigate the relationship among the kinematic variables and take off in long jump. To find out which kinematic variable was most contributing in the enhancement of the performance. The sample consisted of 5 (Five) Long Jumpers in the age group of 17-25 years' were purposely selected from Lakshmibai National Institute of Physical Education, Gwalior (M.P). The parameters examined Linear kinematic is Center of mass at the time of moment take off, and angular kinematic are namely, angle at ankle joint (right, left), angle at knee joint (right, left), angle at hip joint (right, left),angle at shoulder joint (right, left), angle at elbow joint (right, left). The statistical analysis of the result and relationship, long jump performance of the kinematic parameters but the relationship was statistically significant. The angular kinematic variables revealed that significant relationship of Right knee angle with the performance in long jump also provides further insight into long jump performance, although not all variables associated with real jumping performance. To conclude, it may be interpreted that the above regression equation is quite reliable as the value of R^2 is .541. In other words, the one variable selected in this regression equation explains 54.1% of the total variability in the Right Knee Angle which is quite good. Since F- value for this regression model was significant, reliable. Thus it appears that the important factors identified can also be clearly related to speed, technique and strength, and are closely related to those identified from the present regression analysis.

Keywords: athletics, kinematics, long jump, regression analysis

Introduction

The world of Games and Sports has crossed many milestones as the result of different types of research and variety of scientific advancement in general and their application in the field of sports in particular. In the modern scientific era, athletes are being trained by highly sophisticated means for better achievement in their concerned sports and they are being exposed to the exercise and training methods which have proved beneficial for achieving higher standards. In the recent years, greater stress has been laid on quality rather than the quantity of training. The Basic technique used in long jumping has remained unchanged since the beginning of modern athletics in the mid-nineteenth century. The athlete sprints down a runway, jumps up from a wooden take-off board, and flies through the air before landing in a pit of sand. A successful long jumper must, therefore, be a fast sprinter, have strong legs for jumping, and be sufficiently coordinated to perform the moderately complex take-off, flight, and landing maneuvers.. He analyzed data reported calculations included the relation between the release height and release angle, as well as between the release speed and release angle. (Langhorne Nicholas P. Brunel) The calculated optimum release angles for the athletes were in good agreement with their usual competition release angles (31–35°). Each athlete had his own specific optimum release angle because of individual differences in the rate of decrease in release speed with increasing release angle. The method was evaluated using measurements of three experienced male long jumpers who performed maximum-effort with jumps over a wide range of take-off angles. The optimum take-off angle of each jumper was calculated by combining the equation for the flight distance of a body in free flight with the measured relations between the take-off speed, the height difference between take-off and landing, and the take-off angle for the athlete. The calculated optimum take-off angle was then compared with the athlete's measured competition take-off angles. (Philip Graham, 2007) [4].

Therefore, the study was undertaken the relationship among the kinematic variables and take off in long jump.

Methodology

For the purpose of study five male LNIPE long jumper of all India inter-university level of 17-25 years age group was selected as subjects for the study. It is assumed that they possess good level of technique. The purpose of the research was explained to the subject and subjects were motivated to put in their best, effort during each attempt. From researcher's own understanding of the problem and on the basis of discussion with experts, gleaned through the literature, the following kinematic variables (linear & angular) were selected, Linear kinematic variables, Height of center of gravity at the time of moment Take-off (phase). Angular kinematic variables angle at Ankle joint (right & left), angle at knee joint (right & left), angle at hip joint (right & left), angle at shoulder joint (right & left), angle at elbow joint (right & left).

Administration of Tests

Three Trials given to the performer and all the performance was measured by the qualified officials, & recorded the distance (in meters). Measuring angle in nearest degree at selected joint at during take-off moment of Long jump. To obtain reliable measurement, standard and calibrated equipments like camera steel tape, hurdle were used the video graphs camera used in study was a Canon- 70D. The video graphs were taken by a professional photographer and various measurement values were obtained for this study & considered reliable. The performance of the subjects in the long jump, filming protocol and analysis are described as under: For the collection of data the 5 subjects were selected purposely among the long jumpers of Lakshmibai National Institute of Physical Education, Gwalior. Total observations and collection of the data was done in 6 days and two observations were recorded each day i.e. O-1 in morning session and O-2 in the evening session. The performance of the each subject was measured by using the standard procedures of IAAF, the horizontal distance covered by the subjects were considered as his performance or score and the horizontal distance was measured in meters. Three trials were given to each subject and the all attempt was considered. The video was taken by a professional photographer, who is considered to be an expert in this area. The subject was filmed only in saggital plane. The camera used for analysis was Canon- 70D. After taking the video, the photos were taken by pausing the video at the desired moment with the help of Kinovea software. For referencing purpose, the photo of hurdle was taken to find out the actual height of center of gravity of each subject at selected moment. The horizontal distance of Hurdle was 1.22 meter and vertical height of the Hurdle was 1.067 meter, Vertical Height of the camera was 1.17 meter and horizontal distance of the camera was 5.00 meter. The subjects were filmed at Lakshmibai National institute of Physical education, Gwalior. The Vediography sequence was taken under controlled condition. The subject was performing the technique three times. On the basis of Vediography obtained the scholar developed the stick figures in which data pertaining to various kinematic variables was taken. The stick figures were developed by using joint point method in which body projection and joint facing camera were consider to the measure various angle (Stick Figure-D). The inclination of torso was measured by the deviation of the torso from vertical axis. The center of gravity of the subject, at the moment take off was located by using segmentation method suggested by Hay (2005) [6].

Fig 1: Position markers on the body

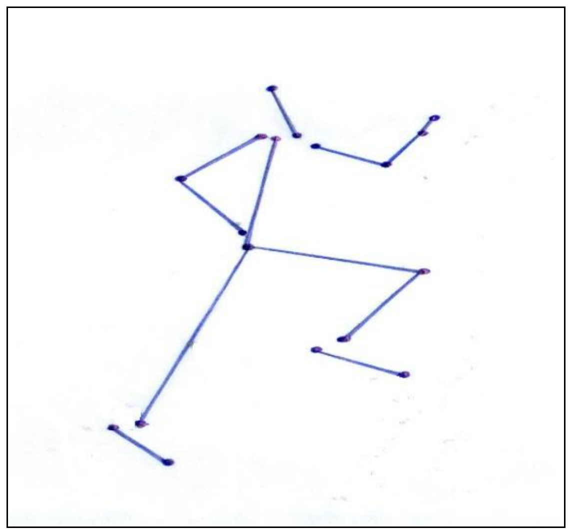

Fig 2: Stick figure- subject (d)

Statistical Technique

To find out the difference between selected kinematic variables of long jump Regression analysis was used. For testing the hypothesis the level of significance was set at 0.05.

Results and Discussion

Descriptive analysis of the data was done by computing the statistics like mean, standard deviation:

Table 1: Mean and Standard Deviation Value of Linear & Angular Kinematic Analysis at the Moment Take off in Long Jump

Descriptive Statistics			
Name of Variable	**Mean**	**Std. Deviation**	**N**
Performance	5.62	.069	15
Center of gravity	127.00	14.09	15
Right Ankle Joint	111.26	13.80	15
Left Ankle Joint	132.46	16.59	15
Right Hip Joint	118.80	14.76	15
Left Hip Joint	180.66	4.02	15
Right Knee Joint	78.46	8.06	15
Left Knee Joint	174.00	4.84	15
Right Shoulder Joint	59.46	10.34	15
Left Shoulder Joint	56.26	21.42	15
Right Elbow Joint	115.53	46.62	15
Left elbow Joint	70.73	15.82	15

The values of mean and standard deviation for the all variables are shown in table-1. These values may be used for further analysis in the study.

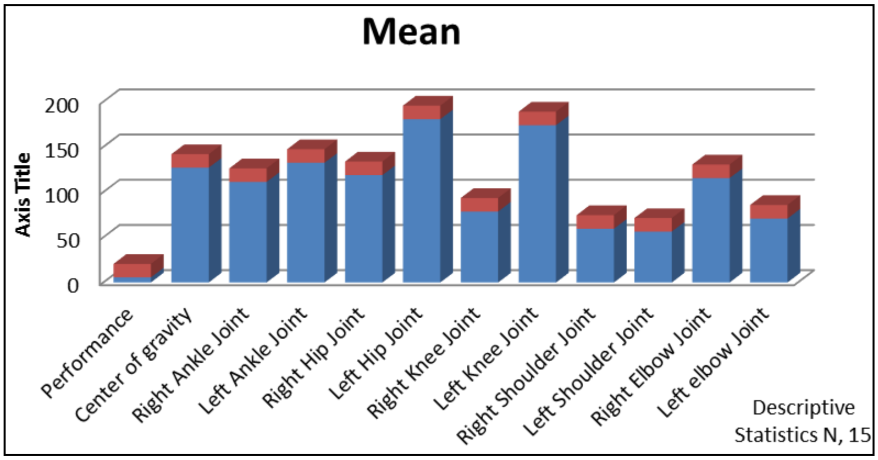

Fig 1: Graphical Presentation Shows the Mean of the Kinematic Variable at Moment Take off in long Jump

Table 2: Model Summary Along With the values of R and R^2

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.735[a]	.541	.505	.04879

Predictors: (Constant), Right Knee Joint

The regression Model generated by the SPSS had been presented in table 2 in the model, the values of R^2 is .541, which is maximum and, therefore, the model was used to develop the regression equation. It could be seen from the table 2 that model, one independent variables, Right Knee Joint had identified and, therefore, Regression equation shall be developed using one variable only. The R^2 value for this model is .541, and, therefore, these one independence variables explain 54.1% variation in Right Knee Joint for takeoff of long jump performance. Thus, this Model could be considered appropriate to develop the regression equation.

Table 3: Anova Table Showing F-Value for the Selected Model

Model		Sum of Squares	Df	Mean Square	F	Sig.
	Regression	.036	1	.036	15.299	.002
	Residual	.031	13	.002		
	Total	.067	14			

Dependent Variable: Performance

In table 3, F-value for the entire Model had been shown. Since F- value for the model was significant, it might be concluded that the model selected was efficient also. Thus, it might be concluded that the above regression equation was reliable as the value of R^2 is 0.541. In other words, the one variable selected in this regression equation explains 54.1% of the total variability in Right knee Joint which was good. Since the F-value for this regression model was significant, the model was reliable. At the same time, the regression coefficient in this model was significant, and, therefore, it might be interpreted that one variable selected in the model, Right knee Joint had significant predictability in estimating value of Long Jump Performance.

Table 4: Regression coefficient of selected variable in model along with its t – value

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
	(Constant)	6.121	.127		48.034	.000
	Right Knee Joint	-.006	.002	-.735	-3.911	.002

Dependent Variable: Performance

The regression coefficient in the model has been shown in table 4 In the one model t- value for one regression coefficient are significant as their significance values (P- value) are less than 0.05. Thus it may concluded that the variable Right Knee angle significantly explain the variation in the take-off angle in long jump performance.

Regression equation

Using regression coefficient (B) of the model shown in table 4 the regression equation can be developed which is as follow:

Performance of Long Jump=6.121-.006 x (Right knee angle)

To conclude, it may be interpreted that the above regression equation is quite reliable as the value of R^2 is .541. In other words, the one variable selected in this regression equation explains 54.1% of the total variability in the Right Knee Angle which is quite good. Since F- value for this regression model was significant, reliable. At the same time regression coefficient in this model was significant and therefore it may be interpreted that the one variable selected in the model of long jump quite valid in estimating the Right Knee Angle of the long jumper.

Conclusion

The study was concluded to find out kinematic analysis of take-off in long jump and what is the contribution of different kinematic variables in long jump performance. The kinematic variables revealed that significant relationship of Right knee angle with the performance in long jump also provides further insight into long jump performance, although not all variables associated with real jumping performance were studied. Factors which did not have a great influence on jump distance were tendon compliance, muscle fibre contraction speed and some aspects of muscle architecture. Thus it appears that the important factors identified can also be clearly related to speed, technique and strength, and are closely related to those identified from the present regression analysis. Knee extensors, Peak knee flexion velocity but also in the hip abductors and extensors. This insight will be of value to coaches who should ensure that as an athlete develops, attention was paid to not just the development of speed but also to the development of technique and strength**.**

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