RELATIONSHIP OF SELECTED KINEMATIC VARIABLES WITH THE PERFORMANCE ON STANDING LONG JUMP

Jogiswar Goswami

Introduction

Man's physical activity and movement is as old as human existence. It played numerous roles from struggle for existence to struggle for excellence. In this role playing, fundamental motor skills have developed into various movement patterns. But at every stage of human history physical activity provides an exciting outlet for human expression, often creative in nature. Human beings normally run, jump, throw, catch, kick, strike and perform a multitude of basic skills. They learn these first as general skills and later, is modified as specific sports skills. All movements of material bodies whether simple or complex are subjected without exception to the laws of mechanics. It is the first task of science to recognize this because movement is not only locomotion, but is also a change in quality in fields above pure mechanics. People who are working in this field should have a basic knowledge about how a body moves, what are the major group of muscles, joints, and in what proportion and degree they are to be used to get an optimum output. This approach can provide an understanding of the nature of any skill, there economic way of execution, and their dependent factors which in turn can build into an awareness of the large scheme of economic movement. To justify a movement as an economic one it is very essential to analyse the movement first. Sometime it is very difficult for a human eye to analyse all the movements of various body segments and joints at the same time. So, various instruments like still cameras, video camera etc., are used to analyse various movements. The best method to analyse or evaluate various movements is called cinematography. This is a quantitative method which is very accurate but at the same time costly and time consuming. The role of cinematography in biomechanical research involved from a simple form of recording motion to a sophisticated means of computer analysis of motor efficiency. Over the years new techniques in filming and timing having been perfected to aid the research in achieving accurate time measurements of both simple and complex locomotion pattern. Weston Joan compared and quantified the biomechanical variables that characterised advanced and intermediate volleyball players when performing the quick and middle block jumps. Videotape and force platform were used for analysis. It was found that the CG at takeoff was an important variable for increasing jumping height. He also recommended plyometric exercises along with training drills for better blocking abilities. In another biomechanical analysis Yoshiaki Taku compared the highest score handspring with full turn vault performed during the 1992 Olympic Games with those receiving the 20 lowest scores. It was concluded that the vaults receiving high scores demonstrated. larger horizontal velocity and transitional kinetic at take off from the board, large vertical velocity and transitional kinetic energy at take off from the house, great amplitude of post flight, greater height of CG and superior landing performances. New techniques develop as a result of scientific analysis only. Scientific analysis helps to identify the economic technique for better results. For instance, in the high jump, there are no less than six named styles (scissors, modified scissors or back layout, eastern cut off, western roll, straddle and fosbury flop. Out of which the fosbury flop is considered as the most economic technique because in this style the center of gravity of the athletes is not required to lift above the bar. It remains outside the body and even passes through or below the bar while the jump passes over it. So, the concept of evolution of movements to an economic stage is enlightened by scientific analytical studies only. The skill (standing long jump) which is analysed in the present study also has got the same approach. The main purpose of this skill is to obtain a maximum displacement of the center of gravity in a given direction. Generally, a jump is accomplished by propelling the body off the ground with the thrust form both legs. The method of launching the body into the air is the essential ingredient of the jump. Various joints, angles of the body along with the center of gravity of the body is analysed in the form of kinematic variables and related to the performances. At the time of take-off the resultant of all the forces of the various muscles are summed up to get a maximum upward and forward displacement of the center of gravity. More the force generated at this time in a proper direction, more will be the displacement.

Methodology

Five male university level gymnast of LNUPE Gwalior (M.P.) age ranging from 19 to 23 years were selected at random as the subjects for the present study. The best performance out of the three standing long jumps of each subject which was recorded to the nearest centimetre was taken as the criterion measure for this study. The performance of each subject on standing long jump was measured by using a standard procedure as suggested by Baumrartner and Jackson. Sequential photographs were taken for the selected moments only i.e. moment stance and moment take-off. The best out of the three trials was considered for the analysis purpose of the study. The stick figures were drawn from the photograph by the help of 'joint point method' and the centre of gravity of each body segments and the whole body was determined by segmentation method as suggested by Hay. The angles at various joints were also determined by the same method by using goniometric instruments from the stick figures. The relationship of various kinematic variables with the performance was found out by employing the Pearson's Product Moment correlation method. The level of significance was set at 0.05

Findings

The mean values of selected angular and linear kinematic variables and their relationship with dependent variables are presented in table 1 & 2.

Relationship of Angular Kinematic Variables with the Performance of the Subjects in Standing Long Jump

The results of the Product Moment correlation which were obtained in order to ascertain the relationship of selected angular kinematic variables; namely, the angles at (1) left elbow joint (2) right elbow joint (3) left shoulder joint (4) right shoulder joint (5) left hip joint (6) right hip joint (7) left knee joint (8) right knee joint (9) left ankle joint (10) right ankle joint (11) ankle of inclination, with the performance on standing long jump during moment stands and take off, prepared in table 1.

Table -1
Relationship of Angular Kinematic Variables with the Performance of the Subjects in Standing Long Jump.

S. No.	Variables (Angles in degree)	Stance		Take Off	
		Mean	r	Mean	r
1	Left elbow joint	162.6	-0.32	155.2	-0.23
2	Right elbow joint	170.2	0-64	138.6	0.11
3	Left shoulder joint	41.4	-0.06	165.4	0.91*
4	Right shoulder joint	30.0	-0.64	152.8	0.28
5	Left hip joint	95.4	-0.77	173.8	0.20
6	Right hip joint	100.2	-0.83	168.0	0.43
7	Left knee joint	108.2	-0.15	162.6	0.26
8	Right knee joint	112.4	-0.13	161.4	0.47
9	Left ankle joint	73.8	0.92*	122.2	0.09
10	Right ankle joint	73.6	0.88*	125.4	0.45
11	Inclination	41.2	0.89*	44.0	0.44

Significant at 0.05 level of Significance

As shown in table 1 that, at moment stance the variable which have shown significant relationship with the performance are, angle at left ankle joint, right ankle joint, angle of inclination from the vertical plane. At moment take off the other variables which have shown significant relationship with the performance is the angle at left shoulder joint.

Relationship of Linear Kinematic Variables with the Performance of Subjects in Standing Long Jump

The value of the co-efficient of correlation which were obtained in order to ascertain the relationship of selected linear kinematic variables; namely, Height of center of gravity at moment stance and Height of center of gravity at moment take off, with the performance on the standing long jump are presented in table 3.

Table -2

Relationship of Linear Kinematic Variables with the Performance of Subjects in Standing Long Jump

Sr. No.	Variable (in cm)	Mean	r
1	Height of center of gravity at moment stance	74	-0.34
2	Height of center of gravity at moment take off	89.4	0.33

As shown in table 3 that, the height of the center of gravity at moments stance and take off has not exhibited significant relationship with the performance of the subjects in standing long jump.

Discussion of the Findings

The significant relationship shown by the angular kinematic variables with the performance in standing long jump at moment stance were, angle at left ankle joint, right ankle joint and angle of inclination from the vertical plane. At moment stance, the subject took crouch position in which the center of gravity was lowered. The benefit of deeper crouch position in which the center of gravity was lowered. The benefit of deeper crouch is the increased distance over which the force is applied prior to the take off. If this distance is increased then the time for application of force is also increased, thus, the impulse will be greater. This can be seen from the higher negative value of Coefficient of correlation in case of the left and right ankle joint indicated that excessive flexion may not be of much help for better performance of standing long jump. The significant value of the angle of inclination shows that when the angle of inclination is increased the distance over which the force is to be applied prior to the take off also increases. The angle of inclination also helps in propelling the body off the ground and helps in launching it into the air. And if the torso is not inclined during the take off, it will resist the movement. Thus, more angle of inclination has favoured the better performance of the subjects. The results were in agreement as mentioned by Bunn. At moment take off the significant relationship was shown by the angle at left shoulder joint with the performance of the subjects in standing long jump. This means, angle at shoulder joint has got a positive relationship with the performance. At the time of take off the resultant of all the forces generated from the various muscles of the body were summed up to get a maximum upward and forward displacement of the center of gravity. More the forces generated at the time of take off in a proper direction, more will be the displacement. More the angle at the shoulder joint means more is the arm swing in upward and forward direction which results in more angular momentum of the arm. When the arms are stopped on an appropriate height after an adequate body stretch during take off, the angular momentum will be transferred into the body and this adds to the performance of the subjects. So, the increase in the angle at the left shoulder joint has favoured the better performance of the subjects. As a whole, the variables which have shown higher relationship with the performance must have contributed towards the performance of standing long jump. Along with these variables, other motor components also might have contributed to the performance. In case of the other variables which have shown low values of co-efficient of correlation does not mean, that these variables were not contributing to the performance. It does contribute, but the insignificant values of co-efficients of correlation of such variable with the performance might have been due to the small size of the sample and other factors. Since, the results have shown significant relationship of few selected angular kinematic variables with the performance of standing long jump, the hypothesis stated earlier that, "there will not be any relationship of the selected kinematic variables with the performance of standing long jump", stands rejected.

References

Baumgartner, Ted A. and Jackson, Andrew S. Measurement for Evaluation in Physical Education and Exercise Science. 4th ed. U.S.A: Wm C. Brown Publishers, 1991.

Bouchard, Claude et al., Physical Activity Sciences. U.S.A: Human Kinetics Publishers, Inc., 1992.

Clarke, David H. and Clarke, H. Harrison. Research Process in Physical Education, 2nd ed. New Jersey: Prentice Hall, Inc 1970.

Hachmuth, Gerald: Biomechanics of Athletics. Berlin: Sportverloug, 1984.

Hay, James G. The Biomechanics of Sports Techniques, 3rd ed. New Jersey: Prentice Hall, Inc., 1985.

Wickstrom, Ralph L. Fundamental Motor Pattern. 2nd ed. Philadelphia: Lea and Febiger, 1977.

Joan, Weston. "A Study of Biomechanical Variables in the Counter Moment Jump and Drop Jump by Female Intercollegiate Athlete". Dissertation Abstract International 54:1 (July 1993): 126: A.

Takei, Yoshiaki, et al. "A Three-Dimensional Analysis of the Mens Compulsory Vault Performed at the 1992 Olympic Games". Journal of Applied Biomechanics 12:2 (1996) :237.