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Dr. T Onima Reddy

Associate Professor, Department
of Physical Education, BHU,
Varanasi, Uttar Pradesh, India

Dr. Vikram Singh

Associate Professor, Department
of Physical Education, BHU,
Varanasi, Uttar Pradesh, India

Correlation of high jump performance and selected angular kinematical variables during take-off of Fosbury-flop technique

Dr. T Onima Reddy and Dr. Vikram Singh

Abstract

The Purpose of the study was to find Correlation between Dependent Variable (High Jump Performance) and Independent Variables (Selected Angular Kinematical Variables) during Take-off of Fosbury-Flop Technique.

Selection of Subjects: Universe of the Study: The study was confined to India only. Sampling Frame: Subjects were selected as a sampling frame from India only and their age was ranging from 16 to 28 years. Sampling Methods: Subjects were selected on the basis of purposively random sampling method. Sampling Size: A total of 8 male professional High Jumpers (who had been participating regularly and who have attained the performance level of 1.95 meters) from India were selected for the study.

Selection of Variables: Anthropometrical Variables: Age, Height, Weight, And Hand Length, Fore Arm Length, Upper Arm Length, Fore Leg Length, Upper Leg Length and Foot Length.

Angular Kinematical Variables: Ankle Joint (Angle of left & Right ankle joint), Knee joint (Angle of left & Right knee joint), Hip joint (Angle of left & Right hip joint), Shoulder joint (Angle of left & Right shoulder joint), Elbow joint (Angle of left & Right elbow joint), Wrist joint (Angle of left & Right wrist joint), Angle of trunk inclination and Angle of Head Inclination.

Criterion Measures: Age of subject was measured by Chronological Age in year, Height of the subject was measured by Anthropometric Rod in meter, Weight of the subject was measured by Lever Balance/Weighing Machine in kilogram, Height of bar/highest performance of the subject was measured by Non Stretchable Tape in meter and Angle of angular kinematical variables of different phases of take-off skill in Fosbury-flop technique was measured by Max Traq 2D / Silicon Coach Pro-7 Motion Analysis Software in degree. Max Traq 2D / Silicon coach pro-7 motion analysis software was use for Kinematical analysis of take-off in Fosbury-flop techniques. The centre of gravity of the subject at the time of different phases of take-off skill in fosbury- flop technique by segmentation method as suggested by Games G. Hay was recorded.

Statistical Technique: To Kinematical analyze of Fosbury-flop technique in high jump and to determine the key components of Fosbury-flop technique, descriptive statistic was used. To find out correlation between dependent variable (high jump performance) and independent variables (selected angular kinematical variables) during Take-off of Fosbury-flop technique in high jump, Pearson correlation was used. The level of significance was set at 0.05.

Conclusions: Further, mean, standard deviation, scores of angular kinematics variables in degree of during Take-off (Total Body Weight on the Take-off Foot) in Fosbury-flop Technique have been found as follow: Left Ankle Angle (101.25 ± 5.78), Right Ankle Angle (106.62 ± 8.18), Left Knee Angle (140.25 ± 5.01), Right Knee Angle (44.50 ± 12.81), Left Hip Angle (149.25 ± 5.50), Right Hip Angle (138.62 ± 18.16), Left Shoulder Angle (32.13 ± 20.40), Right Shoulder Angle (36.38 ± 10.36), Left Elbow Angle (113.25 ± 9.21), Right Elbow Angle (113.25 ± 18.30), Left Wrist Angle (199.12 ± 10.02), Right Wrist Angle (185.12 ± 19.65), Trunk Inclination Angle (6.50 ± 4.11), Head Inclination Angle (10.13 ± 2.59) respectively. Insignificant relationship of Angular Kinematical Variables with High Jump Performance of subjects at during Take-off in Fosbury flop Technique.

Keywords: Kinematical analysis, Fosbury-flop technique

Introduction

When a coach is confronted with the problem of detecting and correcting the faults, it is not difficult for an experienced eye to find the faults in the movement performed by the athlete but the most difficult aspect is to locate the cause of the fault. In such a situation, a coach may try to correct the effect (fault), may be without being able to discover the underlying cause.

Correspondence

Dr. T Onima Reddy

Associate Professor, Department
of Physical Education, BHU,
Varanasi, Uttar Pradesh, India

Such a corrective approach may lead to further deterioration of an athlete's performance. It is very difficult to analyze and evaluate the dynamic aspects of human movement precisely by the naked eye observation alone. In these days of automation, the coach has to go beyond the stage of subjective analysis. It is here that procedures of biomechanics come to the help of the coach to evaluate various motor actions. With the application of biomechanical procedures, we can discover whether the existing technique fulfils the theoretical requirements of mechanics. Furthermore, a new approach to technical problem may emerge or a new technique is conceptualized which fulfils the requirement of mechanics, which may be simpler to learn, simpler to execute and may result in a better performance than that of the existing technique.

The laws governing motion indicate that motion is modified by a number of external environmental forces. Whether these forces are of help or these are hindrances, depends upon the prevailing conditions and the nature of motion. The problem in sports is to learn how to take maximum advantage of these external environmental forces under prevailing condition.

Ultimately, there emerged one term that gained much wider acceptance than any other. That term was biomechanics. The term biomechanics has been variously defined as:

"The mechanical bases of biological, especially muscular activity and the study of the principles and relations involved."

Biomechanics

1. Biomechanics is the detailed study of the motion in relation to the conventional laws of classic physics.
2. Biomechanics is the science concerned with the internal and external forces acting on human body and effect produced by these forces.

Objectives of the Study

1. First objective of the study was to Kinematical analyze the Fosbury-flop technique.
2. The objective of the study was to find out the correlation between dependent variable (high jump performance) and independent variables (selected angular kinematical variables) during Take-off of Fosbury-flop technique.

Research Questions or Hypotheses

- a. To test the significance of relationship between high jump performance and kinematical parameters.
- b. To test the significance of relationship among independent Variables.
- c. Whether few kinematical parameters are highly related with high jump performance.

Research Methodology

Coverage/ Selection of Subjects

1. Universe of the Study: The study was confined to India only.
2. Sampling Frame: Subjects were selected as a sampling frame from India only and their age was ranging from 16 to 28 years.

3. Sampling Methods: Subjects were selected on the basis of purposively random sampling method.
4. Sampling Size: A total of 8 male professional High Jumpers (who had been participating regularly and who have attained the performance level of 1.95 meters) from India were selected for the study.

Selection of Variables / Units of Observation

The following Anthropometrical and kinematic (Linear) variables were selected for the purpose of this study:-

Anthropometrical Variables: Age, Height, Weight, Hand Length, Fore Arm Length, Upper Arm Length, Fore Leg Length, Upper Leg Length and Foot Length.

Angular Kinematical Variables: Ankle Joint (Angle of left & Right ankle joint), Knee joint (Angle of left & Right knee joint), Hip joint (Angle of left & Right hip joint), Shoulder joint (Angle of left & Right shoulder joint), Elbow joint (Angle of left & Right elbow joint), Wrist joint (Angle of left & Right wrist joint), Angle of trunk inclination and Angle of Head Inclination.

Criterion Measures

Criterion Measures adopted for the study were as follows: Age of subject was measured by Chronological Age in year, Height of the subject was measured by Anthropometric Rod in meter, Weight of the subject was measured by Lever Balance/Weighing Machine in kilogram, Height of bar/highest performance of the subject was measured by Non Stretchable Tape in meter and Angle of angular kinematical variables of different phases of take-off skill in Fosbury-flop technique was measured by Max Traq 2D / Silicon Coach Pro-7 Motion Analysis Software in degree.

Max Traq 2D / Silicon coach pro-7 motion analysis software was use for Kinematical analysis of take-off in Fosbury-flop techniques. The centre of gravity of the subject at the time of different phases of take-off skill in fosbury- flop technique by segmentation method as suggested by Games G. Hay was recorded.

Statistical Technique

The following statistical technique was employed: To Kinematical analyze of Fosbury-flop technique in high jump and to determine the key components of Fosbury-flop technique, descriptive statistic was used. To find out correlation between dependent variable (high jump performance) and independent variables (selected angular kinematical variables) during Take-off of Fosbury-flop technique in high jump, Pearson correlation was used. The level of significance was set at 0.05. The data was analyzed by applying SPSS19-Version.

Result and discussion

Descriptive statistics was computed to determine and analyze the angular kinematical variables at different phases of take-off of Fosbury-flop technique in high jump and result pertaining to same has been presented in table no – 1.

Table 1: Descriptive Statistics of Male High Jumpers in Relation to Angular Kinematical Variables during Take-off (Total Body Weight on the Take-off Foot) in Fosbury-flop Technique

Variable	Mean	Std. Deviation	Std. Error	Range	Min.	Max.	Sum
Left Ankle Angle in degree	101.25	5.78	2.04	18	90	108	810
Right Ankle Angle in degree	106.62	8.18	2.89	19	98	117	853
Left Knee Angle in degree	140.25	5.01	1.77	14	134	148	1122

Right Knee Angle in degrees	44.50	12.81	4.53	34	28	62	356
Left Hip Angle in degree	149.25	5.50	1.94	16	141	157	1194
Right Hip Angle in degree	138.62	18.16	6.42	46	118	164	1109
Left Shoulder Angle in degree	32.13	20.40	7.21	50	7	57	257
Right Shoulder Angle in degree	36.38	10.36	3.66	26	22	48	291
Left Elbow Angle in degree	85.75	9.21	3.26	28	68	96	686
Right Elbow Angle in degree	113.25	18.30	6.47	53	86	139	906
Left Wrist Angle in degree	199.12	10.02	3.54	29	186	215	1593
Right Wrist Angle in degree	185.12	19.65	6.95	65	152	217	1481
Trunk Inclination in degree	6.50	4.11	6.50	12	2	14	52
Head Inclination in degree	10.13	2.59	.92	9	6	15	81

It is evident from table - 1 that mean, standard deviation, scores of angular kinematics variables in degree during Take-off (Total Body Weight on the Take-off Foot) in Fosbury-flop Technique have been found as follow: Left Ankle Angle (101.25 ± 5.78), Right Ankle Angle (106.62 ± 8.18), Left Knee Angle (140.25 ± 5.01), Right Knee Angle (44.50 ± 12.81), Left Hip Angle (149.25 ± 5.50), Right Hip Angle (138.62 ± 18.16), Left Shoulder Angle (32.13 ± 20.40), Right Shoulder Angle (36.38 ± 10.36), Left Elbow Angle (113.25 ± 9.21), Right Elbow Angle (113.25 ± 18.30), Left Wrist Angle (199.12 ± 10.02), Right Wrist Angle (185.12 ± 19.65), Trunk Inclination Angle (6.50 ± 4.11), Head Inclination Angle (10.13 ± 2.59) respectively whereas standard Error and Range of scores was found as follow: Left Ankle Angle (2.04 & 18),

Right Ankle Angle (2.89 & 19), Left Knee Angle (1.77 & 14), Right Knee Angle (4.53 & 34), Left Hip Angle (1.94 & 16), Right Hip Angle (6.42 & 46), Left Shoulder Angle (7.21 & 50), Right Shoulder Angle (3.66 & 26), Left Elbow Angle (3.26 & 28), Right Elbow Angle (6.47 & 53), Left Wrist Angle (3.54 & 29), Right Wrist Angle (6.95 & 65), Trunk Inclination Angle (6.50 & 12) & Head Inclination Angle (.92 & 19) respectively.

To determine the relationship of angular kinematical variables with the performance of high jump at different phases of take-off in Fosbury-flop technique. The data collected was analyzed by using the correlation (Pearson Correlation) and result pertaining to that has been presented in table - 2.

Table 2: Relationship of Angular Kinematical Variables with the High Jump Performance during Take-off in Fosbury flop Technique.

	Correlation Coefficient (r)	
	During Take-off	
Angular Kinematical Variables	Left Ankle Angle (degree)	.423
	Right Ankle Angle (degree)	.308
	Left Knee Angle (degree)	-.019
	Right Knee Angle (degree)	.183
	Left Hip Angle (degree)	.294
	Right Hip Angle (degree)	-.064
	Left Shoulder Angle (degree)	-.405
	Right Shoulder Angle (degree)	.228
	Left Elbow Angle (degree)	-.210
	Right Elbow Angle (degree)	.161
	Left Wrist Angle (degree)	.505
	Right Wrist Angle (degree)	.096
	Trunk Inclination Angle (degree)	.278
	Head Inclination Angle (degree)	.067

*significant at 0.05 level

Coefficient of correlation required to be significant at 6 degree of freedom (.707)

Table -2 also reveals that in case of Left Ankle Angle (degree), Right Ankle Angle (degree), Left Knee Angle (degree), Right Knee Angle (degree), Left Hip Angle (degree), Right Hip Angle (degree), Left Shoulder Angle (degree), Right Shoulder Angle (degree), Left Elbow Angle (degree), Right Elbow Angle (degree), Left Wrist Angle (degree), Right Wrist Angle (degree), Trunk Inclination Angle (degree) and Head Inclination Angle (degree) during Take-off of Fosbury-flop technique obtained values are lower than tabulated value of (.707) therefore it shows insignificant relationship of these independent variables with High Jump Performance of subjects.

Conclusions

On the basis of the findings of the study, the following conclusions are drawn:

1. Mean, standard deviation, scores of angular kinematics variables in degree of during Take-off (Total Body Weight on the Take-off Foot) in Fosbury-flop Technique

have been found as follow: Left Ankle Angle (101.25 ± 5.78), Right Ankle Angle (106.62 ± 8.18), Left Knee Angle (140.25 ± 5.01), Right Knee Angle (44.50 ± 12.81), Left Hip Angle (149.25 ± 5.50), Right Hip Angle (138.62 ± 18.16), Left Shoulder Angle (32.13 ± 20.40), Right Shoulder Angle (36.38 ± 10.36), Left Elbow Angle (113.25 ± 9.21), Right Elbow Angle (113.25 ± 18.30), Left Wrist Angle (199.12 ± 10.02), Right Wrist Angle (185.12 ± 19.65), Trunk Inclination Angle (6.50 ± 4.11), Head Inclination Angle (10.13 ± 2.59) respectively.

2. Insignificant relationship of Angular Kinematical Variables with High Jump Performance of subjects at during Take-off in Fosbury flop Technique.

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