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DRA ANNUAL INTERNATIONAL CONFERENCE 2024 ON "SOCIO-ECONOMIC TRANSFORMATION: OPPORTUNITIES AND CHALLENGES"

Int. Jr. of Contemp. Res. in Multi. *PEER-REVIEWED JOURNAL* *Volume 4 [Special Issue 1] Year 2025*

Conference Paper

A Comparative Kinematic Analysis of Vertical Jump of Boys of Different Age Groups

Dr. Rekha Bhardwaj
D.P.E, Ch. Balluram Godara Government. Girls College, Sriganganagar, Rajasthan, India.

Corresponding Author: *Dr. Rekha Bhardwaj

DOI: https://doi.org/10.5281/zenodo.18160925

Abstract

Desert ecosystems, though often perceived as barren and lifeless, are complex and dynamic environments shaped by unique climatic and geomorphological factors. These ecosystems support a variety of plant and animal species that have adapted to extreme conditions of aridity, high temperatures, and nutrient-poor soils. The interplay between climate, geomorphology, and biodiversity in deserts has profound implications for ecosystem functioning, species interactions, and ecosystem services. This research explores how climatic variables such as temperature, precipitation, and wind, along with geomorphological factors like soil composition, topography, and erosion processes, influence the diversity and functioning of desert ecosystems. Additionally, the study addresses the challenges posed by climate change, human activities, and desertification on these fragile environments. Understanding these dynamics is crucial for conservation efforts and the sustainable management of desert landscapes in a rapidly changing world.

Manuscript Information

- **ISSN No:** 2583-7397
- **Received:** 13-12-2024
- **Accepted:** 27-02-2025
- **Published:** 08-03-2025
- **IJCRM:**4(SP1); 2025: 243-246

- **Plagiarism Checked:** Yes
- **Peer Review Process:** Yes

How to Cite this Article

Dr. Rekha Bhardwaj. A Comparative Kinematic Analysis of Vertical Jump of Boys of Different Age Groups. Int J Contemp Res Multidiscip. 2025;4(6):243-246.

Access this Article Online

www.multiarticlesjournal.com

KEYWORDS: Kinematic analysis, Vertical Jump, Segmentation Method, Elgons.

1. INTRODUCTION

Sports and Physical Education includes the development of physical fitness and motor ability as one of its important objectives which needs to be evaluated. Athletic power test are quite possible and easy to be administered at any level, starting from school through college and have been widely used in physical fitness and motor ability testing programmes.

In many sports jumping ability is a prime factor in successful terms' and individual performance. Simple as well as specialized form of hoping, leaping and hurdling are clustered

in a general category of skills called jumps. Jump is accomplished by propelling the body off the ground with the thrust from one or both the legs. The method of launching the body into the air is the essential ingredient of the jump, but in many instances the method of landing is important to skilful performance.

Vertical jump is one of the oldest performance tests in physical education. It was Dr. Dubley Sargent, who first proposed the jump for height as a measure of motor ability. It has been labelled as a test of neuro-motor efficiency, a test of maximal rate of work output in proposition to body weight and a test of dynamic strength. It is primarily a test of ability of body to develop power in relation to the weight of the individual himself.

From the principle of physics, the ratio of force per unit time applied to the mass of an object determine the speed with which it leaves the ground vertically, consequently the force/mass ratio determine the height of the jump.

The sequence of movement in the pattern of vertical jump is uncomplicated when the special arm action that occur after the take- off is disregarded temporarily, the fundamental pattern consist of four movements in the following manner:-

1. There is flexion at hips, knees and ankle during the preparatory crouch.
2. The jump begins with vigorous forward and upward lift by arms.
3. The thrust is continued by forceful extension at hip knee and ankle.
4. The body remains in extension until the foot are ready to retouch and then the ankles, knees and hip flex to absorb the shock of landing.

The above discussion on vertical jump performance with regards to its contributively component, technique of study employed there in clearly exhibit that even though lot of work has been done but the vertical jump movement pattern has not been analysed against age. In physical education and sports it is observed that here take place some variation in performance (structure of movement pattern) as a result of experience, advancement in the age etc. Therefore the present study has been under taken with a view to bring about comparative kinematic analysis of vertical jump across two age groups of boys of age groups 18 - 20 years and 22-24 years.

Kinematic Analysis

In this study kinematic analysis considered only the kinematic parameters of angles made by different segments at joints, the whole body's centre of gravity during all four phases of vertical jump and its vertical replacement during the execution of vertical jump.

For the purpose of kinematic analysis the most suitable technique used at present is cinematography which was not available and in the absence of cinematography, selected still photography was used to obtain photo sequence of four phases of vertical jump.

Keeping this in view only four subjects in each group were considered, as a large sample could not be employed. The difference in result that has come in for want of cinematography and small sample size were considered as limitation.

2. MATERIAL AND METHODS

Eight male students from basketball match practice group, four each belonging to two different age groups i.e. 18 to 20 years and 22 to 24 years were selected as subjects for this study at random.

To obtain photo sequence of four phases of vertical jump the camera used was a standard one i.e. Nikon model EM. The camera was mounted on a tripod and positioned at right angle to the plane of movement at a distance of 5.50 meters from the wall. The height of camera was kept at a constant height of 1.3 meters from the ground and the camera was set up at a speed of 8/200. Four photographs making a complete series of vertical jump of each subject was taken into consideration. The photo sequence series consisted of four phase of vertical jump namely the standing reach, the crouch, the vertical jump and reach and there landing.

Mechanical Analysis

On the basis of photographs obtained 'elgons' or stick figures, with the help of which the measurement of the vertical displacement of total body's centre of gravity during the jump. Angles at different joints and angle of inclination of torso with the vertical were carried out. The Elgons were developed by using the joint point methods in which body's projection at the joints facing the camera were considered and the centre of gravity whole body was found out by using segmental method.

Conversion Factor = Actual length of Reference Scale /Photographic length of reference scale

Table 1: Height of Centre of Gravity of Subjects during Different Phases of Vertical Jump Performance and Its Displacement

Subject	Standing Reach (m)	Crouch (m)	Jump (m)	Landing (m)	Displacement (m)
A	1.39	1.10	1.80	1.10	0.41
B	1.31	1.14	2.09	1.18	0.78
C	1.31	1.15	2.00	0.98	0.69
D	1.14	1.02	2.05	1.06	0.91
E	1.31	1.02	2.21	1.10	0.90
F	1.14	1.06	1.80	1.02	0.66
G	1.14	1.10	1.92	1.06	0.78
H	1.18	1.14	2.0	1.02	0.82

Table 2: Angles of various Joints during Different Phases of Vertical Jump Performance

Joints	Subject	Standing Reach (Degree)	Crouch (Degree)	Jump (Degree)	Landing (Degree)
Ankle joint	A	112	90	120	90
	B	110	95	110	80
	C	115	88	135	10
	D	110	100	140	75
	E	114	100	142	80
	F	112	90	138	80
	G	113	92	150	100
	H	100	96	120	120
Knee joint	A	178	130	165	105
	B	172	108	178	112
	C	175	90	168	120
	D	172	142	174	98
	E	175	120	178	100
	F	178	105	162	100
	G	170	100	178	100
	H	162	120	158	90
Hip joint	A	5	40	3	42
	B	8	50	3	35
	C	4	32	5	60
	D	4	26	52	2
	E	6	35	0	42
	F	2	48	40	38
	G	1	50	0	42
	H	12	36	10	34
Angle of incination of torso with vertical	A	4	40	-10	35
	B	4	25	5	15
	C	4	25	5	15
	C	6	20	2	30
	D	3	33	-5	15
	E	5	50	-8	25
	F	5	35	8	39
	G	-2	42	-2	-2
	H	8	40	8	35

Analysis

The comparative Kinematic analysis in the form of T-Ratio was applied to study the significance of difference in the position (height) of centre of gravity during four phases of vertical jump performance and its displacement as well as in angular modification at the different joints.

Table 3: Comparison of Height of Centre of Gravity of Boys of Selected Age Groups during Different Phases of Vertical Jump Performance and Height of the Vertical Jump

Phases of Vertical Jump Performance	t-ratio	t.05(6)=
Standing Reach	0.71*	2.45
Crouch	0.96*	2.45
Jump	0.00*	2.45
Landing	1.12*	2.45
Total displacement of centre of Gravity	2.00*	2.45
Height of vertical jump	0.457*	2.45

Not significant at 0.05 level.

i) The height of centre of gravity during standing reach ranged from 1.14 m to 1.39 m. The difference of means for two age groups were found to be insignificant at 0.05 level of significance.

ii) The height of centre of gravity during crouch ranged from 1.02 m to 1.15m. The difference in means of two age groups was insignificant at 0.05 level.

iii) The height of centre of gravity during jump and reach ranged from 1.80 m to 2.21 m. The difference in means of two age groups was found to be insignificant at 0.05 level.

iv) The height of centre of gravity during landing ranged from 0.98 m to 1.18 m. The difference in means of two age groups was found to be significant.

v) The displacement of centre of gravity during vertical jump ranged from 0.41 m to 0.91 m. The difference in means of two age groups was found insignificant at 0.05 levels.

vi) The height of vertical jump ranged from 38 cm to 58 cm. The difference in the means of two age groups was found insignificant at 0.05 level.

Table 3: Comparison of Angular Modifications at Different Joints for Boys of Selected Age Groups during Different Phases of Vertical Jump

Joints	t-ratio (at different phases)				t.05(6) =
	SR	C	J	L	
Ankle Joint	0.498	1.380	1.447	0.129	2.45
Knee Joint	0.70	0.990	0.349	0.367	2.45
Hip Joint	0.822	1.092	0.28	1.812	2.45
Shoulder Joint	1.902	0.221	0.285	1.542	2.45
Elbow Joint	9.545*	0.368	0.143	2.033	2.45
Angle of Inclination of torso with vertical	9.622*	.206	0.732	0.110	245

*Significant at 0.05 level

Key for phases of vertical jump performances:

a) SR - Standing reach
b) C - Crouch
c) J - Jump
d) L – Landing

i) The difference in the means of two age groups with respect to modifications of angles during all the four phases of vertical jump at Ankle joint, Knee joint, Hip Joint and Shoulder were found to insignificant at 0.05 level.
ii) The difference in angles at elbow joint was found to be insignificant during crouch and jump and reach and landing, however when means of angles for boys of two age groups were compared it resulted in a significant difference during the standing reach.
iii) the angle of inclination of torso with the vertical showed significant differences between two age groups during first two phases of vertical jump i.e. standing reach, and crouch and insignificant differences during the other two phases of vertical jump i.e. jump and reach and landing.

3. DISCUSSION OF FINDINGS

The findings of the study revealed that the boys of the selected age groups did not differ significantly on any of the kinematic variables during four phases of vertical jump when both groups were compared in this study.

The finding with regard to comparative kinematic analysis of vertical jump performance of selected age groups boys not showing significant difference may be attributed to the fact that both age groups boys were almost of the same skeletal maturity groups which did not differ in height as well as leg strength significantly.

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CONFERENCE ORGANIZERS

- Desert Research Association (DRA), Headquarters – Jodhpur
- Nehru Study Centre, Jai Narain Vyas University, Jodhpur
- Government Girls College, Jhalamand (Jodhpur)
- Department of Geography, Dr. Bhim Rao Ambedkar Government College, Sri Ganganagar

In Collaboration with Kalinga University, Raipur (Chhattisgarh)