

## **Percentages of the contribution of some biomechanical factors to the digital level of the triple jump runners in the State of Kuwait**

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### **Abstract :**

To identify the ratios of the contribution of some kinematic factors for the stages of the triple jump to the achievement level of the triple jump contestants in the State of Kuwait. For athletics, which numbered (6) competitors, and the researcher chose the research sample in a deliberate way from the triple jump contestants of the Kuwaiti national team, and their number was (5) contestants from the triple jump contestants, and the most important conclusions were the highest percentage of contribution to the digital achievement of the triple jump contestants, which was estimated (21.6000) for the jump, (19.000) for the step, (30.4000) for the jump. The most important recommendations were attention and guidance to the kinematic variables that most contribute to the level of digital achievement in building and codifying training programs in line with and improving the variables referred to for the triple jump players.

### **The introduction:**

The fast and increasing development occurred by the levels of achievement in most field and track competitions, was not a coincidence and did not happen out of nowhere, but it came as a result of strenuous efforts made by specialists and researchers in sports sciences following the scientific method and using the latest technology and its sciences of devices and techniques to study the minute parts Movement and its causes for investing the athlete's intrinsic strengths in overcoming the resistances affecting achievement.

Track and field competitions are considered among the basic sports in Olympic tournaments and world championships, due to the large

number of their competitions and their diversity, and they can be considered a strong basis for other sports because they require physical measurements and special physical characteristics from their practitioners, and for this reason they occupy a prominent position among the sports activities of different ages. (38:2)

The jump competitions from the point of view of descriptive kinesiology are single movements of three stages, where the approach is generally considered the preliminary stage and the ascent is the main stage, and what follows is the final stage. The distance in the vertical direction, as in the high jump and pole vaulting, and thus the body must generate a great

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ability (kinetic energy) to overcome the external forces that it encounters during the jump, such as the force of gravity - the force of air resistance - the force of ground friction (57:6)

The different rhythm between the three jumps is the distinctive feature that gives this competition the distinctive shape, where the hopscotch and the step are performed with one foot, while the jump is with the other foot. (1:53)(3:57)

The study and analysis of the stages of technical performance to identify and strengthen powers, avoid weaknesses and their causes, and modify the course of technical performance in light of the guidance of the ideal biomechanical variables for the performance of the competition is one of the most important steps to reach the highest levels in the triple jump competition. (13:57)

The triple jump competition is also one of the competitions that requires the player to exploit the forces of the various parts of his body and the compatibility of his movements during the technical performance according to the principles and biomechanical variables related to the nature of the human body movement systems and the requirements of the competition.

Abd al-Rahman Ibrahim Akl (2009) and Ahmed Saad al-Din Mahmoud (1994) agree that the stages of approach and advancement are among the main determinants that affect the length or shortness of the jump distance. (7: 9)

The distance achieved in the triple jump is the result of the force

that displaces the body of the contestant and the correct position of this body achieves the best displacement without any deviation. Approach (2:27)

And the presence of three jumps of different rhythm means a difference in the application of some mechanical foundations that affect the level of achievement and stability of the three, such as the speed and angle of flight of the body, in addition to the flight height of the center of gravity of the body. (12:66) (14:120)

Therefore, the study of movement from a mechanical point of view is the main structure of the various sports sciences, as well as providing the coach with the errors that are difficult to identify with the naked eye and their causes, no matter how experienced the coach is and whatever scientific programs are used in sports training. (8: 201) (9: 5)

The technical performance of the triple jump competition requires a special ability of technical and harmonic characteristics, especially the sense of kinetic rhythm, as well as maintaining the balance of the body during the stages of the hop, step and jump (10:84), and to achieve the largest possible distance the contestant must balance in the distribution of effort between approach, three and stability. In order to achieve the greatest possible distance. As Sareeh Abdul Karim Al-Fadhli and Khawla Ibrahim Al-Mafraji (2012) pointed out that the triple jump is one of the competitions that aims to achieve the longest possible horizontal distance, which

requires capabilities and special features for the player, as he bears the responsibility of exploiting all his latent forces, and the possibility of directing them towards reaching to the maximum possible distance. (6:54)

The real problem for triple jump competitors lies in the possibility of retaining the momentum during the rise, and the repetition of the rise and fall in each stage of the triple jump leads to a slowdown in the player's movement and thus affects the length of the total distance of the jump. (16:77)

The kinetic requirements of the jump and jump competitions from the biomechanical point of view are summed up in reaching high rates of speed at the beginning of the flight as a result of the speed resulting from the approach, as well as the net force resulting from the ascent, and the height of the center of gravity line during flight should be suitable for the type of jump

**Research problem:**

The triple jump is one of the most interesting races for viewers, and it is one of the races that were limited to men, but it has been in the Olympic Games for women for some time. Big and important for three consecutive jumps linked to different rhythms and the kinetic rhythm in this race is of great importance because of the distribution of mechanical effort in each stage until the good kinetic linkage of the three is achieved: the hopscotch, the step and the jump. (15:27)

Following the results of biomechanical analysis and adopting biomechanical theories in training and applying them in a practical and field manner will lead to improving technique and performance and thus we can build a special philosophy to evaluate this performance and develop the biomechanical aspects that depend on it in developing sports achievements and applying sports training methods requires knowledge of most of the biomechanical laws used in performance. The kinesthetic skill and the relationship of each of them to the sports aspect, through which we have information about the details of the training used and the identification of the type of biomechanical treatment used in dealing with the studied paths with the laws that are compatible with the nature of the motor performances and the knowledge of the content of the training program according to the principles and biomechanical laws that govern the kinetic performances qualitatively and quantitatively.

In light of the foregoing and after reviewing the scientific references and previous studies, I found that they aim to improve the trainer's qualitative analysis, visual assessment, knowledge of the purpose of performance, understanding movement or self-analysis, anatomical, qualitative movement or evaluation. Including correcting performance, it did not specify how to evaluate and how to build qualitative exercises, nor did it lay the foundations for building qualitative training on a biomechanical basis, and it did not address the use of

biomechanical variables in building qualitative exercises according to a specific kinetic analysis model, and for the importance of scientific diagnosis, kinetic analysis and qualitative exercises, it was necessary to try to reach to design a biomechanical qualitative analysis model for setting qualitative exercises aimed at evaluating and employing biomechanical variables according to a specific kinetic analysis model and laying the scientific and guiding basis for trainers when developing qualitative exercises for various sports activities as well as benefiting from it in training the advanced stages. Accordingly, the researchers saw the need to carry out such a study.

The technical performance of the triple jump competition requires a special ability of technical and harmonic characteristics, especially the sense of kinetic rhythm as well as maintaining the balance of the body during the stages of the hop, step and jump.

David and Middle (2002) indicate that the horizontal speed, vertical speed, the height of the center of gravity of the rider, the moment of ascent, the angle of take-off and the angle of flight are important factors that lead to the success of each of the hopscotch, step and jump and obtaining the best distance in the triple jump competition. The landing must be characterized by strength and flexibility (18:127).

Cassie W, Scott S, Joseph, H 2009 states that in order to achieve the best distance for the triple jump, the

horizontal and vertical speed must be maintained and the height of the center of gravity at the moment of ascension should be increased to obtain the most appropriate flight angle and take-off angle. Lift angle with strong and fast rise and push the free leg and arms forward strongly to achieve the largest distance from this stage while maintaining the balance of the body during flight. (17:141)

In light of the above, the researcher believes that the triple jump competition, and what it has reached, still needs more studies that depend on the use of the scientific method to develop and follow up its training programs, especially in light of the rapid development in the numbers of athletics competitions as a result of the development of sports training methods. It is based on physiological, biomechanical and psychological scientific foundations, as in the long jump competition, where the link between biomechanics and sports training has become an essential matter, as biomechanics gives sports training the scientific basis on which to plan the training load for sports movements.

Knowing the results of developing the explosive ability of the muscles of the legs using the usual physical tests may not give a sufficient indication of the contestant's ability to employ this physical development when performing the competition, so it is possible to use some mechanical indications, electrical activity of the muscles, and pressures under the foot, which express the Developing the level of performance (horizontal speed -

vertical height - flight time) when performing the skill as a test to indicate the extent of the development of the explosive ability of the two legs, as well as the ability of the contestant to employ this effort to improve the level of digital achievement. (19:4) (11:8)

Through theoretical readings, previous studies, access to many scientific researches on the international information network and personal interviews with some athletic trainers, the researcher found that functional strength training is one of the modern training methods in developing and developing muscular strength, and that most training programs lack the use of functional strength training. To develop the muscle strength of triple jump competitors.

Through theoretical readings, previous studies and exploratory study conducted by the researcher on some triple jump contestants, it was found that there is a difference in the values of some biomechanical variables affecting the triple jump competition, represented in the stages of the triple jump, as well as the difference in the digital level for each of them, so the researcher tries through this descriptive study to study And an analysis of the stages of the triple jump and the identification of the relationship between them and the level of digital achievement of the triple jump contestants in the State of Kuwait.

**Search objective:**

Identifying the percentages of contribution of some biomechanical variables to the stages of the triple jump, which contribute to the level of

achievement of the triple jump competitors, through:

- 1- Identifying the values of the kinematic variables for the stages of the triple jump at the level of achievement for the junior triple jumper.
- 2- Identifying the percentages of the contribution of the values of the kinematic variables for the stages of the triple jump, which contribute to the level of achievement.
- 3- Identifying the predictive ability of the values of the kinematic variables of the triple jump stages related to the achievement level of the triple jump contestants under study.

**Search questions:**

- 1- What are the values of the kinematic variables of the triple jump stages associated with the level of achievement of the triple jump contestants?
- 2- What are the percentages of the contribution of the values of the kinematic variables for the triple jump stages that are related to the level of achievement of the triple jump competitors?
- 3- What is the predictive ability of the values of the kinematic variables of the triple jump stages related to the achievement level of the triple jump competitors?

**Research areas:**

-**The human field:** some of the triple jump contestants in the Kuwait national football team.

-**Spatial field :** the athletic center for athletics in the State of Kuwait.

-**Time field:** Filming stage Monday 24/5/2021 AD

**Biomechanical variables:**

Angles: foot angle - leg angle - knee angle - thigh angle - torso angle.

Speed, distance, time, percentage of contribution to achievement.

**Search terms:****Biomechanics:**

It is the science that studies the human movement or some of its parts in an objective and tangible manner, whether with the aim of determining the optimal method of performance (tactics)

**Kinematic Variables:**

They are the factors that control the movement in terms of its time course and the values associated with it to allow judgment on the level of proficiency during motor performance.

**Triple jump:**

It is one of the jumping activities for strong games, and this event is performed with three jumps known as the hop, the step and the jump, one of the most important steps of which is approaching, then ascending, walking in the air and descending.

**Digital Achievement Level:**

It is the result or distance achieved by the athlete while performing the triple jump.

**Search procedures:****Research Methodology:**

The researcher used the descriptive approach with all its steps and procedures, due to its relevance to the nature of the research

**Research community:**

The research community included the triple jump contestants of the Kuwaiti national team for athletics, accredited by the Kuwait Athletics Federation, and they numbered (6) competitors.

**The research sample:**

The research sample was chosen in a deliberate way from the triple jump contestants of the Kuwaiti national team, and their number was (5) contestants from the triple jump contestants, as shown in the following table corroborating the research sample:

**Table (1)**

**The arithmetic mean and standard deviation of the variables of height, weight, age, and training age of the triple jump contestants, the research sample n=4**

<b>Variables</b>	<b>Unit measure</b>	<b>SMA</b>	<b>standard deviation</b>	<b>Mediator</b>	<b>skew modulus</b>
Age (year)	Year	21.00	0.707	21.00	0.000
Height (cm)	Cm	168.800	4.086	170.00	-0.347
Weight (kg)	Kg	63.800	1.303	64.00	-0.541
Training age	Year	7.200	0.836	7.00	-0.512

It is clear from Table (1) that the arithmetic mean of age is (21.00) years, with a standard deviation of (0.707), and the average height of the triple jump contestants in the research

sample reached (168.800), with a standard deviation of (4.086), and the arithmetic mean of body mass was (63.800). , with a standard deviation (1.303), and the arithmetic mean of the

training age was (7.200), with a standard deviation (0.836)

**Data collection methods and tools:**  
The researcher used the following tools:

**1- Devices and utilities for data collection:**

- Calibrated medical scale to measure weight to the nearest kilogram.
- Rastamer altimeter measures the total height of the body to the nearest centimeter.

**2- Kinematic Analysis Tools:**

-One (1) digital video camera (sony Hd) whose height was set at a distance of 1.5 m and was fixed on the lateral level of the performance so that it moved away from the locations of the motor performance at a distance of 1.75 m.

-So that the camera showed and shows the movement path of the ball in full, in addition to the players' shooting movement.

-The kinovea program cuts images into several segments, as well as determines the angles of the joints.

**Search procedures:**

**Survey experience:**

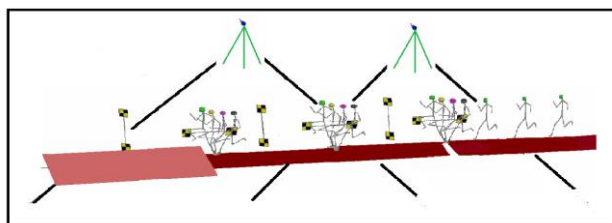
The researcher carried out this experiment on Sunday 6/6/2020 to Sunday 13/6/2021 to find

out the negatives and positives that you may encounter while conducting the main experiment to avoid them, and its purpose was:

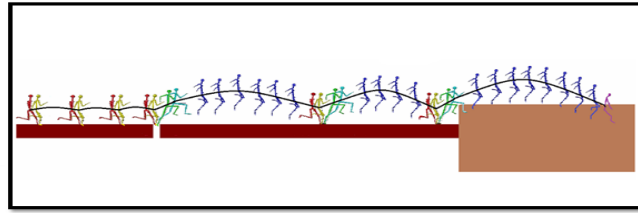
- 1- Ensuring the validity of the video cameras and assisting them in the experiment.
- 2- Determine the correct location of the cameras used in the research.
- 3- Determining the distances and heights of the photographic equipment from the field of approach, the ascent and the last three steps, and the stages of the step, the hop, and the leap.
- 4- Training the assistant team and acquainting them with the tasks entrusted to them with regard to the use of cameras and methods of recording attempts.

**Main experience:**

The researcher conducted the main experiment on Monday, corresponding to 06/21/2021 AD to Monday, corresponding to 06/28/2021 AD, on the research sample in the intentional way from the triple jump contestants of the Kuwaiti national team, and their number was (5) contestants from the triple jump contestants in the State of Kuwait.



**Figure (1) shows the main procedure of the experiment**



**Figure (2) shows the motor path of one jumper**

**Search procedures:**

The researcher installed the cameras so that the focus of the lens was 1.5 m away from the ground and placed the camera on the lateral axis of the player shooting the ball, and a drawing scale (100 x) was used to find the conversion factor, and well-defined phosphorous marks were placed 1.5 cm wide for each mark on the anatomical articulation points. For the player, it includes the ankle joint, the knee joint, the pelvis joint, the shoulder joint, the elbow joint and the wrist, and then the video was shown in slow motion, and the researcher analyzed it using the analytical program Kinovea.

**Statistical manipulations:**

The researcher used statistical treatments for the basic data within

this research using the Statistical Package for Social Science (SPSS)

- 1- Arithmetic mean
- 2- The mediator
- 3- Standard Deviation
- 4- Variation coefficient.

**Steps to carry out the search:**

**Basic research experience:**

The researcher made the basic measurements after during the period from Monday, Monday, 21/6/2021AD, to Monday, 28/6/2021AD.

**Presentation and discussion of the results:**

**First: View the search results:**

Presentation and discussion of the results of the arithmetic averages of some kinematic variables for the triple jump stage.

**Table (2)**

**Arithmetic averages and standard deviations of some kinematic variables for the hopscotch stage n=(5)**

Serial	Varaible	hopscotch			
		collision		Pushing	
		S	E	S	E
1.	foot angle	29.8200	.43243	51.0400	.89610
2.	leg angle	108.0000	1.00000	136.8200	1.38456
3.	knee angle	138.8200	1.00349	139.3000	1.03682
4.	thigh angle	117.2000	.83666	154.4800	1.91102
5.	torso angle	81.3800	.67602	78.6400	.80187



It is evident from Table (2) that the arithmetic averages value of the angle in the collision phase was limited to the lowest value (29.8200) and an estimated standard deviation (0.43243), which is represented by the angle of the foot, and the highest value of (138,8200) represented by

the knee angle, while the arithmetic averages were limited to the pushing phase. Between the lowest value (51.0400) and an estimated standard deviation (0.89610), represented by the angle of the foot, and the highest value, which is (154.4800), represented by the thigh angularity.

**Table (3)**  
**Arithmetic averages and standard deviations of some kinematic variables for the step stage n=(5)**

serial	Variable	hopscotch			
		collision		Pushing	
		S	E	S	E
1.	foot angle	38.8200	.84083	21.6400	.60663
2.	leg angle	117.3200	.65345	113.6600	1.49265
3.	knee angle	150.2000	1.39821	136.0000	.95131
4.	thigh angle	119.6200	.98843	141.2600	.83546
5.	torso angle	80.6200	1.13225	76.5200	1.90578

It is evident from Table (3) that the value of the arithmetic averages of the angle in the collision phase was limited between the lowest value (38.8200) and an estimated standard deviation (0.84083), which is represented by the angle of the foot and the highest value of (150.2000)

represented by the knee angularity in Hassan. Between the lowest value (21.6400) and an estimated standard deviation (0.60663), which is represented by the angle of the foot, and the highest value, which is (141.2600), which is represented by the angle of the thigh.

**Table (4)**  
**Arithmetic averages and standard deviations of some kinematic variables for the leap stage n=(5)**

Serial	Variable	hopscotch			
		collision		Pushing	
		S	E	S	E
6.	foot angle	29.8200	.89833	45.9200	.88713
7.	leg angle	111.5200	.58052	124.7800	2.42734
8.	knee angle	159.0000	1.06066	131.8400	1.37949
9.	thigh angle	123.6200	1.54013	147.4400	1.54693
10.	torso angle	81.5800	1.37186	76.4000	2.24833

It is clear from Table (4) that the value of the arithmetic averages of the

angle in the collision phase was limited to the lowest value (29.8200)

and an estimated standard deviation (0.89833), which is represented by the angle of the foot and the highest value of (159,000) represented by the angularity of the knee. Between the lowest value (45.9200) and an

estimated standard deviation (0.88713), which is represented by the angle of the foot, and the highest value, which is (147.4400), which is represented by the angle of the thigh.

**Table (5)**  
**Arithmetic averages and standard deviations of some kinematic variables**  
**For the triple jump n=(5)**

serial	Variable	hopscotch					
		hopscotch		Step		The leap	
		S	E	S	E	S	E
1.	distance (meters)	3.9240	.04393	3.8160	.08264	7.0000	.15811
2.	time (second)	.7200	.01581	.6520	.02864	1.1580	.11756
3.	Linear speed m/s	7.3160	.13975	8.2200	.42071	10.5800	.14832
4.	Contribution to achievement %	21.6000	1.81659	19.0000	1.58114	30.4000	2.07364

It is clear from Table (5) that the value of the averages, i.e. the achievement distance traveled for the hop, whose value was (3.9240), while the distance of the step was (3.8160) and the distance of the jump (7.0000), which shows the distance traveled in both the shot and the step, and this can be attributed to the decrease in the angle of the knee And the angle of the trunk, which affected the angle of elevation and the digital level in particular, as the jumper must cut the distance of the hopscotch with a noticeable difference from the distance of the step to gain an additional distance, which explains the player's focus on the last jump in the triple jump and some neglect of the hopscotch distance.

As it is clear from the table, the completion time for each stage, where the time for completing the jump was estimated (0.7200), while the time for

completing the step was estimated (0.6520) and the jump (1.1580). It is the largest and this is due to the player's belief and dependence on gaining additional strength through good push off the ground and the length of time he stays on it.

It is also noted from the table that the linear speed increased from one stage to another, as it reached in the hopscotch (7.3160) and in the step (8.2200), while in the jump it reached a maximum of (10.5800), and this shows the benefit of the jumpers from the linear speed as this gives a positive acceleration and a positive thrust force for the jumpers. This is due to the amount of positive energy of the movement which allows the jumper's ability to achieve a good numerical level.

It is also noted from the table that the percentage of contribution to

the digital achievement of the triple jump competitors, which was estimated at (21.6000) for the hop, (19.000) for the step, (30.4000) for the jump. The digital one is the least, then followed by the hopscotch and the jump, and the researcher believes that this could be due to the decrease in the knee angle and the trunk angle, which affect the angle of elevation and the digital level in particular, as the jump has to cut the distance of the shot put with a noticeable time difference from the distance of the step to gain an additional distance and the proportions between them vary, which is what It shows the triple jump competitors focus on the last step and neglect the distance of the hopscotch, and this is what made the ratio of the contribution of each n shot and stride close.

#### **Conclusions and Recommendations:**

##### **First, the conclusions:**

Through this study and within the limits of the nature and characteristics of the study sample, presentation and discussion of the results, the following conclusions were reached:

- 1- The highest percentage of completion distance traveled for the hop, whose value was (3.9240), while the step distance was (3.8160) and the jump distance was (7.000)
- 2- Completion time for each stage, where the time to complete the hopscotch was estimated (0.7200), while the time for completing the step was estimated (0.6520) and the jump (1.1580)

3- The linear velocity increased from one stage to another, as it reached in the hopscotch (7.3160) and in the step (8.2200)

5- The highest percentage of contribution to the digital achievement of triple jump contestants, which was estimated at (21.6000) for the hop, (19.000) for the step, and (30.4000) for the jump.

##### **Second: Recommendations:**

1- Paying attention to and being guided by the kinematic variables that most contribute to the level of digital achievement in building and codifying training programs in line with and improving the variables referred to for triple jump players.

2- Emphasis on keeping the body perpendicular to the lift board and training at the appropriate angle for the knee and torso.

3- The importance of adopting the ideal values of the mechanical variables for the triple jump competitors in evaluating the players' motor performance level.

4- Emphasis on the process of interconnection and compatibility between the technical stages of the triple jump competition, which the player must obtain as an outcome for each stage.

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