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## Special training according to mass and radii to develop some physical abilities for junior triple jump players

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### Abstract

Mass and radii are a measure of the resistance shown by the body in its rotational movement through the relationship between the mass of the rotating body and the square of the distance of its center of gravity from the axis of rotation and the possibility of controlling these two factors (mass and distance) when applying these rotational movements, especially when performing jumping movements, which contain many secondary rotational movements that occur in different parts of the body (arms, legs and trunk), whether these jumps are on the ground with the body weight or on barriers of different heights or on platforms or boxes. Therefore, the researcher believes that this topic is a scientific problem related to the application of special movements for performance that were generated from his feelings during the application of his daily training as he is one of the teachers and coaches of the College of Physical Education and Sports Sciences team in this activity. For this reason, the researcher was seriously interested in this topic to develop some scientific solutions to address it by designing strength training based on mass and radii with young age groups to lay the foundation stone properly. The researcher set the goal of the research to prepare special training according to mass and radii of the body, and the researcher assumed that there are statistically significant differences between the results of the pre-tests The post-tests in the physical abilities tests of the group under study, and the researcher used the experimental research method as it is compatible with solving the problem to be researched. The research sample was chosen randomly. They are a group of junior players for Al-Kut clubs. Their number was (12) players. Through the results, the researcher reached the most important conclusions: the development of the level of technical performance (technique) for the research group in the post-tests after using the training curriculum vocabulary, which indicated the effectiveness of this curriculum in achieving a good level of motor coherence. The researcher recommends that it should be emphasized to take the appropriate angles in the body parts while performing the triple jump stages, whether in tests or in competitions.

**Keywords:** Mass, radii, rotational movement, center of gravity

### Introduction

Mass and radii are a measure of the resistance that the body shows in its rotational movement through the relationship between the mass of the rotating body and the square of the distance of its center of gravity from the axis of rotation and the possibility of controlling these two factors (mass and distance) when applying these rotational movements, especially when performing jumping movements, which contain many secondary rotational movements that occur in different parts of the body (arms, legs and trunk), whether these jumps are on the ground with the weight of the body or on barriers of different heights or on platforms or boxes, in addition to the fact that the body when it rests on the ground is one of the bodies that move rotationally at this moment, as it is possible to control the dimensions of the body parts from the axis of rotation (the fulcrum), and thus the individual can increase the moment of inertia of his body or a part of his body by increasing the resistance to inertia resulting from the separation of the body parts from the axis of rotation (joints) proportional to the square of the distance of this separation.

On the other hand, the body weight can also be controlled by adding mass to that body or its parts, such as a weighted belt, for example, which can increase the value of the moment of inertia of that body while performing different jumping movements according to the law of moment of inertia.

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The importance of the research comes in identifying the application of special exercises to control the dimensions and angles of the body when training jump players, considering that the movements of the legs and arms of the triple jumper are considered rotational movements that affect the integration of technical performance and in reducing the resistance shown by these parts in the different stages of the jump for jumpers during training, and to clarify the role of these exercises according to this principle in developing the special strength of junior triple jump players, and to contribute to enhancing the scientific applications of sports biomechanics in the field of practical applications and to add a step to develop the achievement of the triple jump in our dear country.

### Research Problem

The researcher turned to one of the athletics events, namely the triple jump, in which the integration of motor and technical performance is achieved according to two directions: The first is the direction of the angles obtained by the body's joints during the performance of the triple jump stages, and these angles are what determine the radii of the body, considering that all parts of the body are connected to the joints (axes of rotation) Secondary rotational movements are movements that occur around secondary axes such as joints (shoulders, hips, and trunk) which we obtain from the main axes (longitudinal, transverse, and horizontal). and the correct application of these angles helps the jumper to control the torques, whether for the body or its parts, which are forces resisting movement when its value increases through the unwanted increase in the lengths of these parts. As for the second direction, it is related to studying the instantaneous force exerted at the rear and front support in each stage of the rise of the three stages. (Sareeh Abdul Karim. 2004)<sup>[1]</sup>.

Therefore, the researcher sees that this topic is a scientific problem related to the application of special performance movements that arose from his feelings during the application of his daily training as one of the teachers and trainers of the College of Physical Education and Sports Sciences team in this event. Which prompted him to pay attention to the first direction, as its application was not according to a mechanical principle by focusing on the angles and dimensions of body parts by researchers and in a manner consistent with understanding the mechanical properties of the moment of inertia. And then delving into the study of the force resisting the change in body position and overcoming this resistance when training players. For this reason, the researcher was seriously interested in this topic to develop some scientific solutions to address it by designing strength training based on mass and radii with young age groups to lay the foundation stone in a sound manner, according to the foundations of sports training and the correct mechanical foundations that guarantee the athlete's development in a manner consistent with the method of technical and motor performance of this event and with high economy, and this may help trainers and those interested in this event to work on improving the components of this training and mechanical event, which guarantees reaching the level of strength for its players to the highest levels to achieve the highest achievements in this field.

### Research objectives

- Preparing special exercises according to the mass and radii of the body.

- Identifying the effect of the training method with body weight and with added relative weights and the change in the radii of the body in developing some physical abilities.

### Research hypothesis

There are statistically significant differences between the results of the pre- and post-tests in the physical abilities tests of the group under study.

### Research areas

- **Human field:** Junior players of Al-Kut clubs
- **Time field:** 26/5/2024-20/7/2024
- **Spatial field:** Al-Kut Olympic Stadium

### Research methodology and field procedures

#### Research methodology

The researcher adopted the experimental research method because it is compatible with solving the problem to be researched and because it is one of the important means of reaching reliable knowledge.

#### Research sample

The research sample was selected randomly, and they are a group of junior players of Al-Kut clubs, where players were selected from a group of clubs by lottery, namely (Al-Kut - Wasit - Al-Mofaqiya - Al-Suwaira) clubs, and their number was (12) players, thus the total research sample amounted to (8) players after excluding players who have practice in the national teams, and the researcher conducted homogeneity for the research sample

**Table 1:** Sample homogeneity

Variables	Research sample		Coefficient of skewness	Significance
	Mean	Standard deviation		
Height	1.72	0.07	0.613	Non sig
Age	20.19	1.22	0.375	Non sig
Weight	68.23	4.10	0.109	Non sig
Achievement	8.62	0.26	0.293	Non sig

### Research devices and means of collecting information

The researcher used a number of devices and tools to obtain the research results, in addition to using the means of collecting information specific to the research.

#### Information collection means

- Arab and foreign sources and the Internet.
- Observation and experimentation.
- Tests and measurement.
- Exploratory experiment group.

#### Tools and devices used

- Medical scale for measuring weight.
- Electronic stopwatch, number (2)
- Pentium electronic calculator 4.
- Laser discs, number (3).
- Panasonic video camera with a speed of 30 frames per second
- Video tape, size (8) mm.
- Obstacles and platforms (of different heights). Number (10).
- Weighted shirt for the torso and weighted belt for the legs, number 9.

- Measuring tape, length 30 m.
- Drawing scale (1 meter).

### Research Tests

#### Long Jump Test from Standing: (Ali Saloum. 2004) [2]

- **Purpose of the test:** To measure the muscular ability of the legs in jumping forward.
- **Necessary tools:** A suitable place for jumping with a width of (1.5) m and a length of (3.5) m, taking into account that it is level, a measuring tape, colored pieces of chalk.

#### Triple jump test from standing

- **Purpose of the test:** To measure the strength index characterized by the speed of the triple jump for the leading and rising leg muscles.
- **Necessary tools:** A suitable place for jumping, including the pit and the running field, a measuring tape.

#### Two-hop and standing jump test

- **Purpose of the test:** An indicator to measure the special strength of the leg rising to the hop in the triple jump.

- **Necessary tools:** A suitable place for jumping, including the pit and the running field, a measuring tape.

#### Step and standing jump test

- **Purpose of the test:** An indicator to measure the strength of the pushing leg muscles in the second stage (the step)
- **Necessary tools:** A suitable place for jumping, including the pit and the running field, a measuring tape.

#### Triple jump test from approach (digital level)

- **Purpose of the test:** An indicator to measure the distance between the rise board and the jumper's landing place.
- **Necessary tools:** A suitable place for jumping, including a pit and a running field, and a measuring tape.

#### Scientific foundations of tests

Stability, validity and objectivity are conditions that every standardized test must have, so the researcher resorted to defining them to be able to apply the test items to the research sample.

**Table 2:** Shows the coefficient of validity, validity and objectivity of the tests

Tests	Validity	Stability	Objectivity
Long jump standing test	0.95	0.91	0.91
Step and jump standing test	0.94	0.89	0.87
Two-hop and jump standing test	0.94	0.90	0.84
Triple jump standing test	0.95	0.92	0.90

### Exploratory experiment

The research conducted an exploratory experiment on (28/5/2024) on a sample of (6) players with the aim of choosing research methods and tools, and applied the tests it developed with the following objectives:

- Verifying the validity of the tools that will be used in the field experiment.
- Verifying the ease of preparing and implementing the tests.
- Identifying the time taken to perform the tests.
- Observing the extent of the testers' response to performing the test.
- Observing the adequacy of the assistant work staff.
- Identifying the extent of the suitability of the tests for the special strength scale.
- Identifying the ability of the video camera to photograph the research sample and the clarity of the image.

### Field experiment

#### Pre-tests

The researcher conducted the pre-tests on the same research sample on (1/6/2024) at the Al-Kut Olympic Club Stadium.

- **First:** Long jump test from a standstill.

- **Second:** Two hops and a jump from a standstill.
- **Third:** Step and jump test from a standstill.
- **Fourth:** Triple jump test from standing.
- **Fifth:** Triple jump test from approach.

A rest period of (8 minutes) was given between one test and another, as the researcher fixed the other conditions for the test in terms of place, time, method and climate so that the same or similar conditions could be created when conducting the post-tests.

#### Videography and measurement of the variable moment of inertia

The researcher filmed the research sample individuals from the moment of rising to the moment of landing in the hole through a video camera fixed vertically at a point located in the middle of the triple jumper's motor performance, which was (4.50) meters away from the rise board. The distance of the camera from the middle of the performance field was (18.16) meters, and the height of the camera lens from the ground was (1.23 m). The drawing scale was filmed at the previous midpoint, and due to the inability to obtain more than one camera, one camera was used, and Figure (1) shows the stages of videography.

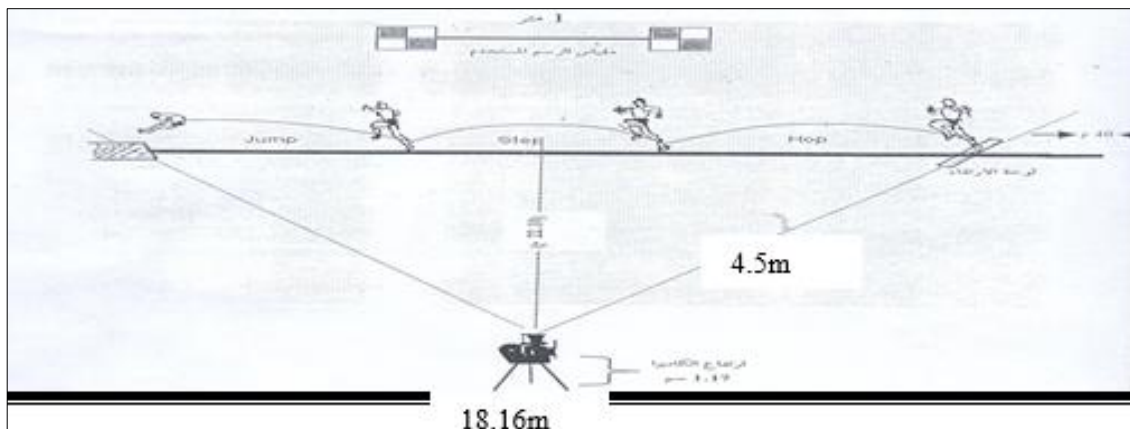


Fig 1: Shows the imaging process

**The training curriculum**

The training curriculum included complementary exercises using the law of moment of inertia by emphasizing increasing the radii of the legs to the highest possible value while performing jumping movements and reducing this value to the lowest possible value on the other hand. Weights were used at a rate of (5-7%) of the weight of the leg and added to the legs and trunk according to the same principle (moment of inertia = mass × square of length) and invested in developing and improving the special strength of the research sample in the triple jump, where the jumper can obtain a positive training effect by increasing the burden on him through jumping exercises using obstacles and stands as well as relative weights added to the leg and arm during training.

The time taken to implement the training unit was (35 minutes) during the systematic lesson, preceded by (15 minutes) for preparatory exercises, warm-up (20 minutes), then giving the basic activity of the lesson, and after that the exercises specific to the research were performed. Implementing the training curriculum stipulated in the research plan took a period of 8 weeks at a rate of three training units per week, and 20 training units were implemented out of a total of 24 training units due to the

interruption of work as a result of the circumstances that the country was going through at that time. The post-tests were conducted in the twenty-fourth unit.

**Post-tests for the research sample**

The researcher conducted the post-tests on his research sample (12/7/2024) using the same method he followed in the pre-tests, after completing the specified period for the experiment, which took 8 weeks. The researcher was keen to find all the conditions for the pre-tests and their requirements when conducting the post-tests in terms of time, place, and testing methods.

**Statistical methods**

The researcher used the statistical package (SPSS):

**Results and Discussion**

**Results**

**Presentation, analysis and discussion of the research results**

**Presentation and analysis of the results of the pre- and post-tests of the research group**

**Presentation and analysis of the results of the long jump from a standstill for the research group**

Table 3: Shows the results of the long jump from a standstill for the research group

Test	Pre-test		Post-test		Standard deviation of differences	Arithmetic mean of difference	T value	Sig
	Mean	Standard deviation	Mean	Standard deviation				
Long jump from standing	2.32	0.17	2.69	0.120	0.34	0.106	14.20	Sig
Two hops and a jump from standing	6.52	0.35	8.63	0.52	2.11	0.35	26	Sig
Step and jump	4.20	0.16	5.50	0.42	0.98	0.25	16.66	Sig
Triple jump from standing	6.24	0.24	7.24	0.30	1.03	0.37	11.89	Sig

The degree of freedom (7) and significance level 0.05. From the above table (2), it is clear that the development was clear and this is due to several reasons, as the level of progress was faster and better than the level of special strength, which means that the training carried out on the members of this group achieved their goal in developing the level of special strength. And the body's resistance to the rotational movements arising from the movements of the legs and the movements of the arms during training had a positive effect on the development of this force when performing jumping exercises, in addition to its positive effect in adopting the correct positions and angles when performing these exercises, and here we can say that the angles achieved in the parts of the body during training

(legs, arms and trunk). This was achieved when performing these physical tests, which have a direct relationship with the triple jump technique, and one of its most important stages is the hop stage by shortening the radii of rotation while performing the hop movements with the legs, which enhanced the increase in the angular velocity of the legs, and this increase in the angular velocity affected the increase in the linear velocity of the center of gravity of the body, considering that the angular velocity has a relationship with the linear (circumferential) velocity if this velocity is linked to a rotating body (Sareeh Abdul Karim, 1997) [3].

The researcher emphasized the importance of flexing the joints of the legs during strength training (to reduce the

moment of inertia of the legs) on the one hand, and on the other hand increasing the extension of these joints during jumping, which means increasing the resistance (increasing the inertia) of the legs by increasing their radii (extension) when performing jumping exercises. The other principle that was emphasized is increasing the mass of the leg, which causes a burden on the jumper when performing jumping exercises (increasing the moment by increasing the mass, which puts the jumper in a position that requires him to increase his muscular feeling to control this added weight so that his performance is under control when performing the performance movements for this test, which means increasing the motor control of the jumper. (Jeak lowe, 2000) [4]. The suggested exercises used in the group curriculum emphasized the importance of the jumper using a larger turning radius, which affected the angular velocity of the legs during performance, and this requires greater effort to move them, and this effort means an increase in the individual's ability to maintain the angular velocity as much as possible for a distinguished performance. Perhaps using different weights relative to the weight of the leg also represents another resistance that requires the individual to exert greater force to move this leg during performance, and this means increasing the moment of inertia of this leg, which requires the jumper to exert greater force to move it during performance.

Thus, all the exercises used in the training curriculum affected the development of strength and the development of performance at the same time. The triple jump test from a standstill means performing a movement through which the jumper aims to overcome his fixed body mass by exerting an appropriate force to give this mass a certain speed, as the body mass represents a great resistance if it is fixed, and what helps him overcome this resistance is the rapid push and achieving the necessary angular torque in the body at the moment of push to give this mass the appropriate speed for the body mass and give it linear kinetic energy to maintain this energy, the jumper must take appropriate positions in the parts of his body by controlling the angles of these parts during the motor performance of the triple jump stages, and this means controlling the moments of inertia of the body during this performance, which indicates the body's resistance to rotational movements during the performance, as this resistance decreases by reducing the radii and increases if these radii increase.

### Conclusion

According to the research results, the researcher reached the

following conclusions:

- The development of the technical performance level (technique) of the research group in the post-tests after using the training curriculum vocabulary, which indicated the effectiveness of this curriculum in achieving a good level of motor coherence.
- The motor flow and its development through the development of the level of achievement in the triple jump in the post-tests means that the movement occurs without stopping and without sharp angles (i.e. a good geometric path) as a result of the proportionality in the movements of the body parts with the exerted force that appeared clearly.

### Recommendations

According to the results reached by the research, the researcher recommends the following:

- Relying on the tests used in the research as an indicator of the development of the strength specific to the performance of the triple jump.
- It is necessary to emphasize taking the appropriate angles in the body parts while performing the stages of the triple jump, whether in tests or in competitions.
- Generalizing training curricula according to other mechanical indicators that reveal weak performance in the physical properties responsible for that performance.
- Seeking to conduct similar research.

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### Appendix (1)

#### Training curriculum used

The week	Unity	Type of exercise	Intensity	Repetition	Rest period between repetitions	Sets	Rest period between sets(minute)	Schemes
First	1	Jump hurdles of different heights 8 hurdles while maintaining an upright body position when jumping low hurdles	90%	10	5 :1	2	3	
	2	Pull the leg out while holding the multitude.		10	5:1	4	3	
	3	Triple jump 3 step approach over inverted hurdles	50% at max power	6	6:1	2	3	
Second	4	Jump over hurdles of different heights 10 hurdles	80%	10	5:1	2	3	
	5	Pull the leg while it is extended with the multitude	90%	10	5:1	4	3	
	6	Triple 3-step jump approach over inverted hurdles	50%	8	6:1	2	3	
Third	7	Jumping over hurdles of different heights while wearing	90%	10	5:1	2	3	

		weighted belts 8 hurdles						
	8	A partridge with weighted belts on marks spaced 15m apart		5	5:1	4	3	
	9	Triple jump 5 steps approach over inverted hurdles	90%	5	5:1	4	3	
Fourth	10	Jumping over hurdles of different heights while wearing weighted belts 10 hurdles		10	5:1	2	3	
	11	Partridges with weighted belts on marks spaced 15m apart	80%	5	5:1	4	3	
	12	Triple 7 Step Jump Approach Over Inverted Hurdles		6	1:6	2	3	
Fifth	13	Jump from a 30cm high platform and then stand on low obstacles without bending your knees when crossing.	90%	10	5:1	2	3	
	14	Triple Jump Standing with Standing Top -Triple Jump Alternating Steps with Standing Top		8 8	10:1 10:1	1 1	2	
	15	Triple Jump 7 Steps Approach Over Inverted Hurdles 2Hop + Jump 3 Hurdles	95%	5For every leg	10:1	1		
Sixth	16	Running in the form of jumps over 8 hurdles 30 cm high and spaced 1.5 m apart		10	10:1	2	3	
	17	Jumping with the feet over high hurdles with the feet together when crossing, and the height of the hurdle is 91 cm	90%	10	10:1	2	3	
	18	Triple jump of 7 steps approaching to cross the platforms		10	10:1	1		
Seventh	19	Running in the form of jumps over 8 hurdles 76 cm high with weighted belts	80%	10	10:1	2	3	
	20	Jumping with the legs over high hurdles with the legs together when crossing, and the height of the hurdle is 91 cm with wearing an additional shirt		10	10:1	2	3	
	21	Triple jump of 11 steps approach	95%	8	15:1	1		
Eighth	22	8jumps with weighted belts	90%	8 partridges	10:1	5	3	
	23	Jump from a 30cm high platform and then stand on low hurdles without bending the knees when crossing while wearing a weighted shirt		21	10:1	2	3	
	24	Full triple jump	90%	10	10:1	1		