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The effect of ability training in the development of horizontal and vertical speed, technical performance, and achievement of the triple jump for young

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Abstract

The importance of this research lies in proposing scientific solutions to address this issue, through designing ability training exercises to enhance horizontal and vertical starting speed, technical performance, and achievement, in accordance with the correct principles of sport training that ensure the sport's development in a manner that aligns with the technical and motor performance of this activity with high efficiency, this could assist coaches and those interested in this activity in elevating the components of this activity in terms of training and technical. The study aimed to prepare ability training for the research sample, as well as to identify the impact of ability training in improving horizontal and vertical speed, technical performance, and triple jump achievement for young male. The researchers used the experimental approach due to its suitability for the nature of the problem, with a design of a single experimental group. The research community was determined from the triple jump players for young male, aged 17-19, and they are 6 players from the clubs of Diyala Governorate registered within the local athletics federation, the research sample was purposefully selected because the research objectives require athletes who are proficient in performing the triple jump. The sample represented 100% of the research community. These exercises were applied as part of the main section of the training unit, taking 40-45 minutes, at a rate of 3 units per week for 8 weeks. As the number of training units was 24 units, and the duration of the training units was 8 weeks, with an average of two cycles and 3 training units in each small cycle. The researchers concluded that muscle ability exercises had an impact in improving the level of kinematic variables, technical performance, and achievement, through the results obtained, the increase in horizontal launch speed was greater than the vertical launch speed. This is because the goal of the triple jump event is to achieve the furthest horizontal distance, hence the horizontal launch speed should be greater than the vertical, and the researchers recommend emphasizing the importance of using muscle strength exercises using various resistances, which play a significant role in developing physical abilities

Keywords | **Ability, horizontal and vertical speed, triple jump**

Introduction:

Athletics is considered one of the activities that are affected by all components of physical fitness, as each event has its own unique specifications and characteristics, making it one of the most varied sports. Each competition presents a different aspect depending on the characteristics of each event. Among the athletics activities is the triple jump, which has become more exciting and suspenseful recently due to the increased level of the players, and the high achievements that have been made are the best evidence of this. As it reflected the extent of the scientific development of sport in general, the athletic achievements of various countries around the world have shown significant progress, especially in the past few years. The levels of high athletic achievement that seemed hard to evolve and achieve in the past have now

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become commonplace and easy to achieve in the present time. Moreover, the number of athletes capable of achieving prominent and distinguished results is continually increasing.

Biomechanics is considered one of the sciences that has addressed the study of movement. It focuses on the development of human motor performance in general and sports performance in particular. It provides optimal movement solutions through the use of motion analysis to achieve the best results in various activities, including athletics events, and the triple jump event comes at the forefront of these games, which have received attention from researchers and analysts in reaching successive models for performing these events. Moreover, the use of kinematic analysis results has become a means to infer weaknesses in physical abilities and movement performance. Based on this, coaches have turned to performing kinematic analysis to identify points of defects and weakness related to the level of physical abilities, especially in athletics events, including the triple jump event.

Muscular ability is a special and active physical ability in most sports activities, which is one of the types of muscular strength. It is a combination of muscular strength and speed (5). This compound is one of the most important physical abilities in the triple jump event, as it is used in all stages of technical performance, which requires rapid strength for the lower limbs to perform these stages. Muscular power is defined as "the maximum force that the muscular system can produce in a case of maximum voluntary contraction and is the decisive factor in sports events that rely on very high resistance," (1). It is also defined as "the ability of the muscular and nervous system to overcome resistance requiring a high degree of speed in muscular contractions," (2). While others see muscular power as "the maximum resistance that can be overcome in the shortest possible time." (3)

Power is the rate of work performed, thus it contains a time element. The maximum power, sometimes referred to as explosive power, is the result of the union or combination of strength and speed.

Muscular ability is one of the essential elements of muscular power, and it is defined as "the ability of the muscle to overcome resistance using high kinetic speed." (4)

(6) believes that muscular ability plays a significant role in determining performance levels in many sports competitions. Therefore, many coaches have focused on developing this important physical characteristic.

The performance of the triple jump requires the availability of physical and technical attributes, in addition to harmony and a sense of movement. The triple jump requires the athlete to maintain balance during flight. As for the physical attributes, they require the development of the distinctive power for speed, which is used in the jump. The triple jump event is one of those activities where the power of ascent must be present.

Through the researchers' review of a range of previous research and studies, and following up their results and analysing their strengths and weaknesses, and monitoring the performance of triple jump athletes in Iraq, the researchers noticed a clear deficiency in skilful performance (technique) and achievement. From the researchers' perspective, this can be attributed to mechanical errors, which in turn affect the numerical level of the triple jump achievement, therefore, it is necessary to enhance the training aspect that has the greatest impact on the development of this level of achievement,

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despite the modest level in this activity that our athletes suffer from compared to the Arab and international level. It is from here that the research problem emerges. For this reason, the researchers are seriously concerned with this subject to develop scientific solutions to address this issue, through designing ability exercises that focus on enhancing horizontal and vertical launch speed, technical performance, and achievement. According to the principles of proper sports training, which ensure the athlete's development in a manner that aligns with the specific technical and kinetic aspects of this activity, as well as being highly cost-effective, this may assist coaches and those interested in this activity in working towards enhancing the components of this activity from both a training and technical perspective.

The study aims to develop ability training exercises for the research sample individuals. It also aims to examine the impact of ability training on the development of horizontal and vertical speed, technical performance, and achievement of the triple jump for young male.

The researchers hypothesize that ability training exercises have an impact on the development of horizontal and vertical speed, technical performance, and achievement of the triple jump for young male. Furthermore, the researchers anticipate the presence of significant differences between the pre-test and post-test in terms of horizontal and vertical speed, technical performance, and achievement of the triple jump for young male.

The Method and Procedures:

The researchers employed the experimental approach to address the nature of the problem by designing a single-group experimental.

The research community was determined from among young male triple jump athletes, aged (17-19), and they are 6 players from the clubs of Diyala Governorate registered within the local athletics federation. The research sample was purposefully selected because the research objectives require athletes who are proficient in performing the triple jump. The sample included 3 players from Diyala Club, 2 players from Baquba Club, and 1 player from Al-Shahid Arkan Club. The sample represents 100% of the research community. The homogeneity of the research sample was conducted as shown in Table (1). The table indicates that the values of the skewness coefficient are limited between (-3) and (+3), indicating the homogeneity of the sample.

Table (1)
Homogeneity of the research sample members

Seq.	Variables	Unit of measurement	Arithmetic mean	Median	Standard Deviation	skewness coefficient
1	Age	Year	17.66	18	1.03	-0.666
2	Mass	Kg	70.66	69.00	4.179	1.313
3	Height	Cm	174.50	175.00	3.619	-1.139
4	Training Age	Year	3.500	3.500	.5477	.000
5	Achievement	Meter	49.56	48.50	2.350	.851

Firstly: Measuring the horizontal and vertical launch speed:

The launch speed of the jumper was measured by filming the achievement test of the sample with the triple jump. A single camera was used, which was installed vertically opposite the jumping board, at a distance of (10 m) and a

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height of (0.95). The purpose of this was to extract the variables of the jump launch speed: -
Launch Speed: The instantaneous launch distance was measured, which is the distance between the hip joint area and the transition point of this point a moment of leaving the jump board, and measuring its time, and extracting the launch speed by dividing the launch distance by its time. The measurement was made using the kinematic analysis program (Kinovea).
As for the vertical launch speed, it was measured by measuring the instantaneous vertical launch distance, which is the distance between the hip joint area and the transition point of this point a moment of leaving the jump board, and measuring its time, or by multiplying the launch speed by the sine of the angle after measuring the launch angle.
And the horizontal launch speed, it was measured by measuring the instantaneous horizontal launch distance, which is the distance between the hip joint area and the transition point of this point a moment after leaving the board, and measuring its time, or by multiplying the launch speed by the cosine of the angle after measuring the launch angle.
Launch Angle:
It is also known as the flight angle; it occurs after the body leaves the ground. It is the angle formed between the horizontal line and the line connecting two points to the body's centre of gravity. The first: (at the last moment when the body touches the ground), and the second: is (immediately after the body leaves the ground). This angle is measured from the front.

Secondly: Evaluating the technical performance of the triple jump:

To evaluate the technical performance of the triple jump event, the two researchers prepared a questionnaire (*) to evaluate the technical performance of the triple jump event, by dividing suitable grade percentages for the technical performance sections, as indicated in the questionnaire, and the form was distributed to a group of experts and specialists (**) and they were asked to give their opinion on any division suitable for evaluating the performance of the event.
The technical performance of the triple jump event for the research sample was evaluated in both the pre- and post-tests through video recording. Each player held a number in front of the camera, and each student performed according to the full technical stages. The best attempt in achievement was chosen to evaluate the technical performance by the experts. This was done using a form specifically prepared for this purpose, where the stages of technical performance are divided, and the score is distributed according to the importance of each stage.

Thirdly: Triple Jump Achievement Test.

The purpose of the test: Measuring the distance of the triple jump (achievement).
The tools used: Stadium field and track, long jump pit, measuring tape, registration form.
Performance description:
All players are tested together to ensure the element of competition. Initially, measurements are taken to set up the approximate run-up. Then, the player runs within the field and performs the stages of the triple jump. Three attempts were given to each player, and the distance is measured from the last mark left by the player inside the pit during the attempts, then the best achievement that the player achieves is recorded in his special registration form (taking the best attempt (achievement) for each player), taking into account the application of the international law for this event.

(*) See: Appendix (2).
(**) The experts who evaluated the technical performance are:
- Prof. Dr. Raja Abdul Karim Hameed Training/ Field and Track College of Physical Education and Sports Sciences- Diyala University

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- Prof. Dr. Emad Kathem Ahmad Rehabilitation/ Field and Track College of Physical Education and Sports Sciences- Diyala University
- Prof. Dr. Waleed Jaleel Ibrahim Disabilities/ Field and Track College of Physical Education and Sports Sciences- Diyala University
- Asst. Prof. Dr. Usman Mahmoud Shehatha Management and Organization/ Field and Track College of Physical Education and Sports Sciences- Diyala University
- Lect. Dr. Omar Abdullah Salama Biomechanics Athletics College of Physical Education and Sports Sciences - Diyala University

Survey Experiment

The first survey experiment related to variable extraction was conducted on Wednesday, 22/12/2021, at the University of Diyala / College of Education and Sports Sciences, using the same research sample.

The second survey experiment related to the training was conducted on Thursday, 23/12/2021, at exactly 9 am at the Diyala Sports Club stadium. Various exercises were performed from several training units included in the training program, and their purpose was the following:

• To identify the suitability of the physical exercises used in the training program for the level of the sample, and to alter difficult physical exercises and replace them with exercises that are more suitable for the research sample.

• To identify the time required to perform each exercise, thereby allowing the researchers to manage the duration of the training units.

Ensuring the ability and efficiency of the support team in implementing the training unit components.

Pre-tests:

The pre-tests were conducted on the research sample, and the conditions related to the implementation of the tests, including sequencing and location, were established. Preparation and readiness of the form for recording the results of the test variables and achievement were also undertaken. In addition, the support team was prepared and familiarized with the test components and task distribution among them. Moreover, the necessary tools and devices for applying the tests were prepared and their validity was ensured, in order to conduct the post-testing, the triple jump test (achievement) was carried out at the stadium of the College of Physical Education and Sports Sciences / University of Diyala. This took place on Sunday, 26/12/ 2021. The test was filmed for the purpose of extracting research variables through kinetic analysis, in addition to measuring the sample's achievement in the triple jump.

The exercises used:

Based on the results of the pre-tests for the research sample, the training program was designed with the benefit of modern scientific resources, and after conducting the analysis process for the variables under study, preparations were made to develop muscular strength exercises. The researchers directly supervised the training of the research sample to overcome obstacles encountered in implementing the exercises. Emphasis was placed on the special preparation phase.

The implementation of the training program began on Sunday, 2/1/2022, and continued until Thursday, 24/2/2022. The training program included the following: -

- A training program was constructed over a period of (8) weeks, with (3) training units per mini training cycle (Sunday, Monday, Thursday), making the total number of training units (24) training units.
- The exercises were distributed only within the main section of the training program, and the researchers did not intervene in the rest of the sections of the training unit (the preparatory

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section and the concluding section). The duration of the training unit was (90 minutes), and the exercises were part of the main section's duration in the training unit, which ranged from (40-45 minutes).

- The method of high-intensity interval training and repetitive training was chosen, with the regulation of training loads and their components (intensity, volume, rest) based on the principle of graduated difficulty and in a way that is appropriate for the age and training status of the research sample, their capabilities, their potential, and the unique nature of the activity. As this activity demands high levels of speed and strength, along with complex and precise technical performance, therefore, the method of high-intensity interval training and repetitive training were chosen, and the intensity of exercise performance was determined from the athletes' best achievements, with adequate rest periods allocated for recovery and a relatively small suitable number of repetitions to align with the high intensity used in the training.
- The weekly training was per iodized with a ratio of (3:1), i.e., three weeks of high load and one week of less load. The load was increased for the first, second, and third weeks and decreased in the fourth week to be an overcompensation phase. The load was again raised in the fifth, sixth, and seventh weeks and then decreased in the eighth week in preparation for the post-tests, then the training load was formed using a (1:2) model, meaning a high load was introduced followed by a higher load and then a lower load.
- Weights, medicine balls, hurdles, boxes, and various resistances were used in implementing the exercises, as well as plyometric exercises were applied.

Post-Tests:

The researchers conducted the post-tests for the research sample on Sunday, 27/2/2022, related to the variables, after the completion of the used training period. The researchers ensured that all the tests were conducted under the same conditions as when the pre-tests were conducted as much as possible, and within the time frame specified for the experiment.

Statistical methods: The researchers used the Statistical Package for the Social Sciences (SPSS) to process the results.

Results and Discussion

Table (2)

It shows the arithmetic mean values and standard deviation in the pre- and post-test for the research variables

Seq.	Variables	Unit of measurement	Test	Arithmetic mean	Standard deviation
1	Launch speed	m/s	Pretest	7.246	0.046
			Posttest	7.564	0.038
2	Horizontal launch speed	m/s	Pretest	6.505	0.317
			Posttest	6.972	0.060
3	Vertical launch speed	m/s	Pretest	3.338	0.118
			Posttest	2.606	0.223
4	Launch angle	Degrees (°)	Pretest	28.400	1.140
			Posttest	21.200	1.304
5	Evaluation of technical performance	Scores	Pretest	15.15	2.116
			Posttest	42.63	3.145
6	Achievement	Meter	Pretest	11.316	0.746
			Posttest	12.133	0.983

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Table (3)
It shows the values of mean differences and their deviations, along with the standard error of means, and the (T) and (Sig) values from the pre- and post-test of the research variables

Seq.	Variables	AMD	SDD	T	Error Rate
1	Launch speed	-0.318	0.072	-9.842	0.001
2	Horizontal launch speed	0.467	0.341	3.351	0.020
3	Vertical launch speed	0.731	0.263	6.791	0.001
4	Launch angle	7.200	1.924	8.370	0.001
5	Evaluation of technical	-27.475	2.976	41.292	0.000
6	Achievement	0.816	0.343	5.832	0.002

Degrees of Freedom = 5.... Significant at (Sig) < (0.05).

It appears from Table No. (3) for the kinematic variables of the final jump stage during the performance of the triple jump event and the calculated (t) values for the sample members under an error level less than (0.05) and under a degree of freedom (5) that there are significant differences, indicating the significance of differences in favor of the post-tests.

The researchers attribute the significant differences in kinematic variables, technical performance, and achievement to specialized training ability, relying on scientific principles that help develop the level of adaptation of the research individuals. He believes (7) that regular training using resistance leads to an increase in specialized muscle strength, especially those exercises that depend on the use of different resistances, and that resistance training leads to an increase in the strength of jumping, highlighting the importance of strength in jumping as in other competitions. Relying on speed alone does not achieve progress in the jump; instead, it is certain that strength and speed go hand in hand, to achieve the concept of the jumper gaining distinctive strength with speed. The integration of physical abilities, represented by the working muscles of the legs, is essential for achieving good results. It is also important to increase the ranges (angles) of motion for each of the hip, knee, and ankle joints at the moment of the jump, as this is a crucial requirement for achieving a good jump (13).

The element of power is more required than speed, and some activities require high power in a very short time in jumping and leaping, to avoid losing horizontal speed on one hand, and to gain an instantaneous push power to reach a higher path of options on the other hand, as the jumper's possession of ability allows the jumper to perform the jump with high propulsive power, and this enables him to maintain his acquired speed as much as possible. (8)

Ability training also contributed to increasing the ability of the working muscles, as the increase in the ability of the muscles to contract at a faster rate occurs when performing successive movements, due to special muscle strength exercises, as well as depends on the adaptation of the motor nerves in reducing the time of the two contractions, as well as producing the highest amounts of strength and speed. (9)

"The development of physical abilities, especially those that combine strength and speed, is essential for sports that require overcoming resistance, speed of transition, and movement, which are achieved through compound and diverse exercises. Additionally, jumping exercises and lateral movements develop strength in the muscle groups involved in the activity, with greater intensity than what the sample individuals are accustomed to. This has had an impact on stimulating the working muscle groups and thus improving performance by increasing the force of pushing to the sides and forward. The coordination within and between muscles helps to increase movement speed." (14)

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"The triple jump event is one of the activities that require special physical abilities aimed at achieving the best performance." (19)
The coach is an artist in choosing the style, training equipment, and means appropriate for the sport he works in, which can be used with the rest of the other methods to develop and improve any element of physical fitness, and to achieve what should be achieved. (15)
"It is possible to see an athlete's movements from any angle, such as the rear, front, and top angles. We can measure the actual angles of any part of the body." (18)
Here, "the emphasis is placed on the kinetic and analytical aspect and identifying the weak points in the values of the biomechanical indicators that affect each other, so that the training programs are programmed in order to achieve their goals as quickly as possible." (20)
The results indicate that there are significant differences in the launch angle, and that there is a decrease in the launch angle, as the jumper resorts to relatively reducing the launch angle, to ensure the achievement of the greatest horizontal distance. (10)
Also, the decrease in the launch angle was compatible with a high launch speed, as (11) indicates the importance of maintaining launch speed, especially horizontal speed, as it is the basis for achieving performance. The greater the horizontal launch speed, the smaller the launch angle.
It is important to achieve a balance between the launch speed and the launch angle to obtain the vertical speed to elevate the jumper's body and achieve the farthest possible horizontal distance. Since the effect of the launch speed is more significant on the horizontal distance, the jumper tends to relatively reduce the launch angle. The launch angle of the body has a significant importance in the long jump activity, and through it, the performance level of the jumper can be predicted, as well as determining the vertical and horizontal components. The appropriate launch angle affects the jumping distance. (12), "It is essential to train athletes on the accuracy of good performance through required variables in the performance (initial speed - launch angle - horizontal and vertical speed) at the moment of jump, in addition to the necessary physical and kinetic abilities for better performance." (16), through the sequence of repetitions of the special exercises that provided high fluidity, as the fluidity of kinetic performance, expressing kinetic compatibility, the body in the first flight stage is subjected to the projectile theory in terms of range and height. (17)

Conclusions and Recommendations

In light of the results obtained by the researchers, the researchers concluded through the analysis of the research findings and discussion that the muscular ability training exercises had an impact on improving the level of biomechanical variables, technical performance, and achievement. From the results obtained, the increase in horizontal launch speed was greater than the value of vertical launch speed. This is because the goal of the triple jump activity is to achieve the farthest horizontal distance, so the horizontal launch speed should be greater than the vertical.
The researchers recommend emphasizing the importance of using muscular ability training exercises with different types of resistance, as they have a significant role in enhancing physical abilities, and the necessity to conduct additional experiments and implement various practical forms to develop other physical abilities such as endurance, and other physical abilities. Moreover, they also stress the need for those responsible for training the young male category to be well-informed. to ensure that their physical training is in line with proper scientific principles and requirements.

Author's declaration:

Conflicts of interest: None

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We confirm that all tables and figures and pictures in this article are ours and written by the researchers themselves.

Ethical-Clearance: this manuscript approved by local ethical committee of physical education and sport sciences college for women on (April /2023)

Author's contributions:

All contributions of this study were done by the researcher (M.M. and K.K) who get the main idea and work on writing and concluding also with number of experts, Muhammed Majeed who made and collect the Statistics, Suaad Sebti in revision, Inaam Ghalib in translating, Ahmed Rajab in proofreading

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Appendix (1)
Training Unit Model

Week/ First **Location: - Diyala Club**
Unit/ First **Unit Time: (40-45 mins)**
Today: **Unit's Objective: - Developing the explosive strength of legs.**
Date/
Notes: - Rest between exercises is 2 minutes.

Exercises:	Intensity	Repetition	Rest between repetitions	Groups	Rest between groups
Staircase exercise (jump with both feet from one step to the other for up to 10 stairs, emphasizing pulling the knees towards the chest and opening the legs shoulder-width apart)	%80	3	2-4 min	1	–
Jumping from Swedish benches 40-50 cm long and landing on the ground with both feet continuously	%80	3	2-4 min	1	–
Jumping in front of the barriers (50) cm with both feet and keeping the body vertical with swinging the arms to gain height	%80	3	2-4 min	1	–
From the starting position, jump up in front, lifting weights on the shoulders, and emphasizing the performance with high speed and strength	%80	3	2-4 min	1	–
Jumping from Swedish benches, landing on both feet with certain weights, and jumping to the other bench	%80	3	2-4 min	1	–

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Appendix (2)
It explains the form for evaluating the technical performance of the triple jump

Player's Name	The technical stages of the triple jump.								Total
	Approach	Pole Vaulting	Flight 1	Step phase	Flight 2	High Jump	Flight 3	landing	

Note:

1- Each student performs one attempt, and the appropriate grade is given for him.
2- Evaluation grades are given for each stage, ranging from (1-10) grades.

تأثير تدريبات القدرة في تطوير السرعة الافقية والعامودية والاداء الفني وانجاز الوثب الثلاثي للشباب

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مستخلص البحث

جاءت أهمية البحث لوضع بعض الحلول العلمية لمعالجه هذه المشكلة من خلال تصميم تدريبات القدرة في تطوير سرعة الانطلاق الافقية والعمودية والاداء الفني والانجاز، ووفقا لأسس التدريب الرياضي الصحيحة التي تكفل للرياضي تطورها بما يتناسب وطريقة الأداء الفني والحركي لهذه الفعالية وباقتصادية عالية ، وهذا قد يساعد المدربين والمهتمين بهذه الفعالية العمل على الارتقاء بمقومات هذه الفعالية من الناحية التدريبية والفنية، وهدفت الدراسة الى إعداد تدريبات القدرة لأفراد عينة البحث ، وكذلك التعرف على تأثير تدريبات القدرة في تطوير السرعة الافقية والعمودية والاداء الفني وانجاز الوثب الثلاثي للشباب، استخدم الباحثين المنهج التجريبي لملائمة طبيعة المشكلة بتصميم المجموعة التجريبية الواحدة وتم تحديد مجتمع البحث من لاعبي الوثب الثلاثي للشباب وبأعمار (17-19) سنة وعددهم (6) لاعبين من لاعبي اندية محافظة ديالى المسجلين ضمن الاتحاد الفرعي لألعاب القوى، وقد تم اختيار عينة البحث بالطريقة العمدية, وذلك لأن أهداف البحث تتطلب رياضيين يجيدون اداء الوثب الثلاثي, وتمثل العينة ما نسبته)100%) من مجتمع البحث، وقد طبقت هذهِ التدريبات ضمن القسم الرئيس من الوحدة التدريبية واستغرقت من 40-45 دقيقة بواقع (3) وحدة في الأسبوع لمدة (8) أسابيع، إذ بلغ عدد الوحدات التدريبية (24) وحدة وتكون مُدّة الوحدات التدريبية (8) أسابيع وبواقع دورتين متوسطتين، و(3) وحدات تدريبية في الدورة الصغرى الواحدة، واستنتج الباحثين الى إن تدريبات القدرة العضلية كانت ذات تأثير في تحسين مستوى المتغيرات الكينماتيكية والاداء الفني والانجاز من خلال النتائج التي تم الحصول عليها كانت الزيادة في سرعة الانطلاق الافقية اكبر من قيمة سرعة الانطلاق العمودية وذلك لان الهدف من فعالية الوثب الثلاثية الحصول على ابعد مسافة افقية لذلك يجب ان تكون سرعة الانطلاق الافقية اكبر من العمودية، ويوصي الباحثين التأكيد على أهمية استخدام تدريبات القدرة العضلية باستخدام المقاومات المختلفة مما لها دور كبير في تطوير القدرات البدنية

الكلمات المفتاحية | **القدرة، السرعة الافقية والعامودية، الوثب الثلاثي**