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Research Article

The Effect Of Special Exercises On Improving Motor Skills, Some Biomechanical Variables, And Developing Numerical Performance Among Young Shot Putters

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Special exercises
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Abstract: The purpose of this research is to examine the influence of certain exercises to enhance the movement trajectory and performance of lower level shot putters. This was done by creating a series of exercises from the thrower's bio mechanical analysis to improve technical efficiency and to minimize movement errors when performing the throw. The training program was applied to several junior shot putters, and several relevant kinematic variables were measured such as the angular speed, the trajectory of the center of gravity, the time that the athlete spends on the surface and the body position during the release phases. The results indicated that the throwers' movement trajectory was an improvement which directly impacted on their performance development and distance thrown. The study found that certain exercises are an effective component in the development of technical performance of the junior shot putters and suggest these exercises be incorporated into the training program for better youth competitiveness and performance in shot put games.

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INTRODUCTION

The field of sports training has undergone remarkable theoretical and practical advancements due to continuous scientific research, studies, and experimental applications that employ modern training methods and technologies. These developments aim to enhance athletes' performance levels in line with contemporary sports training theories and their practical implementation. Consequently, there is an increasing need to reassess and refine scientific training methods and techniques to achieve optimal athletic performance. The development of athletes' physical and technical abilities remains the fundamental basis upon which athletic excellence is built.

Throwing events are among the most technically demanding disciplines in athletics, as performance is highly dependent on the athlete's movement trajectory and body positioning throughout the execution phases. The trajectory of body movement directly influences rotational motion, making proper body alignment and technical execution essential for achieving successful performance. This can be attained through systematic

training and the use of modern equipment and training aids designed to improve technical execution and meet the specific physical requirements of throwers. The significance of this study lies in its focus on enhancing movement trajectory and improving the performance of junior shot put athletes through the application of specialized exercises. The findings may provide practical guidance for improving shot put technique, increasing both accuracy and effectiveness, and consequently enhancing competitive performance. Furthermore, the study contributes to the body of knowledge in sports training by providing valuable data and observations that can assist coaches and athletes alike. The use of specialized exercises and modern training tools can improve physical capabilities and performance levels while offering important biomechanical indicators, such as the center of gravity and optimal movement path, to minimize technical errors and achieve the highest level of performance.

Research Problem: Shot put is a track-and-field event that demands a high degree of motor coordination, precision in movement trajectory, and effective utilization of key bio mechanical variables, including release angle, release velocity, and the force applied during the throw. Through observing the performance of young shot put athletes, the researcher identified deficiencies in movement trajectory and inadequate exploitation of these bio mechanical variables, which negatively affect overall performance outcomes. Accordingly, there is a need to implement specialized training exercises aimed at improving movement trajectory and developing selected biomechanical variables, thereby contributing to enhanced performance among junior shot put throwers.

Research Objectives:

- To identify the effect of specialized exercises on improving the movement trajectory of young shot put throwers.
- To determine the effect of specialized exercises on the development of selected biomechanical variables in young shot put throwers.
- To examine the effect of specialized exercises on enhancing the performance level of young shot put throwers.

Research Hypotheses:

- There are statistically significant differences between the pre-test and post-test measurements in movement trajectory among young shot put throwers, in favor of the post-test measurements.
- There are statistically significant differences between the pre-test and post-test measurements in selected biomechanical variables among young shot put throwers, in favor of the post-test measurements.
- There are statistically significant differences between the pre-test and post-test measurements in performance achievement (throwing distance) among young shot put throwers, in favor of the post-test measurements.

Research Areas:

- Human Area: A group of young shot-put athletes.
- Time Area: From September 4, 2025, to January 7, 2026.
- Location Area: Diyala Sports Club.

Research Methodology: The nature of the research problem and its objectives determine the most appropriate methodology to be employed. Every scientific study requires a research method that is best suited to addressing its specific problem and achieving its objectives. Research methodology can be defined as a systematic approach that relies on observation, hypothesis formulation, experimentation, and logical reasoning—both inductive and deductive, to investigate a particular phenomenon and obtain accurate scientific results[1].

Since the present study investigates the effect of specialized exercises on improving movement trajectory and enhancing performance among young shot-put throwers, the researcher adopted the experimental method. This method is considered one of the most appropriate approaches for studies that seek to determine the influence of specific variables on other variables under controlled conditions. The experimental method involves introducing a deliberate and regulated change in the conditions surrounding a phenomenon and then observing, analyzing, and interpreting the resulting effects to draw scientific conclusions.

Considering the available experimental designs, the researcher selected a one-group pre-test–post-test design. This design involves conducting initial measurements (pre-tests) on the research participants, implementing the independent variable in the form of specialized training exercises, and subsequently conducting post-tests. The comparison between pre-test and post-test results enables the researcher to evaluate

the effectiveness of the training program and determine the extent of improvement in movement trajectory, selected biomechanical variables, and performance levels among young shot put throwers.

Research Sample: Sample selection is a fundamental step in any scientific research, as the nature and objectives of the research depend on identifying a suitable sample to represent the target population. In line with the research topic concerning the effect of specific exercises on improving motor skills and developing performance among young shot putters, the researcher adopted a purposive sampling method to select the individuals most appropriate for the nature of the experiment.

The research sample was selected from young shot putters in Diyala Governorate whose performance fell within a range suitable for the study's requirements. The sample consisted of four athletes. To ensure the homogeneity of the sample in the key variables—age, height, weight, arm length, and arm muscle strength—the researcher used the relative coefficient of variation for each variable individually.

The results of the analysis showed the following coefficient of variation values:

- Age: 4.66
- Height: 2.36
- Weight: 4.44
- Arm length: 2.88
- Arm muscle speed: 6.45

These values—being less than 30%—indicate the homogeneity of the sample members and the absence of significant differences in their physical characteristics, making them suitable for applying specific exercises and monitoring their effect on motor skills and performance.

Research Methods and Tools:

- Tests and Measurements.
- Observation and Personal Interviews.
- Arabic and Foreign Sources.
- Expert Opinion Survey Forms.
- Sony Video Camera (25 frames/second).
- Tripod.
- Video Tape.
- Pentum III Electronic Calculator with Accessories.
- 1-meter Scale.
- Metal Measuring Tape.
- Numbering Board for Determining Player Number and Trial Sequence.
- 5 kg Weight.
- Various Iron Weights.
- Pry Bar for Marking the Field.
- Large Protractor.

Pilot Test:

To assess the adequacy and suitability of the equipment used and to identify any shortcomings or obstacles that might arise during the experiment, the researcher conducted a pilot test with the research sample on Sunday, March 25, 2025, at 6:00 PM at the athletics field in Diyala Sports Club. The objectives of the pilot test were to ascertain the following:

- The suitability of the camera used in the experiment.
- The necessary camera distance and height to cover the field of movement.
- The correct position of the athletes for performing the throwing motion relative to the manufactured equipment.
- The sample's understanding and responsiveness to the test.
- The time required to complete the test.
- The extent to which the team fulfilled their assigned duties.

Based on this pilot test, the researcher formulated the requirements for the main experiment, addressing any errors and obstacles encountered during its implementation.

Tests and Measurements Used

Physical Test Used in the Research: The researcher selected one of the tests to serve as an indicator for controlling and adjusting variables. This ensured the accuracy of the results and the effectiveness of the training program in developing specific abilities, namely the speed and strength of the arm muscles.

The researcher conducted the pre-test on the research sample at 5:00 PM on Wednesday, March 29, 2025, at the Diyala Sports Stadium. All (4) players in the research sample were present. The researcher maintained all other testing conditions, including location, time, method, and climate, to ensure the same or similar conditions were replicated for the post-test.
The researcher conducted the post-test on the research sample at 5:00 PM on Saturday, June 30, 2025. The researcher followed the same method as the pre-test

met in terms of time, location, and equipment. Measuring Speed-Strength and Strength-Endurance Power of the Arm, Shoulder, and Chest Muscles: Objective of the Test and ensured the same conditions and requirements were

Measurement Method: The athlete assumes a prone position with their hands shoulder-width apart on the floor and their body straight. Upon the signal, the athlete begins bending their arms until their chest approaches the floor, then extends them again. The number of correct repetitions is counted within 30 seconds or 1 minute, and the total number of correct repetitions is recorded.

Anthropometric Measurements:

- Body Weight: The subject stands upright on a scale until the needle stabilizes, then the weight is read (in kilograms).
- Body Height: The subject stands upright barefoot in front of a wall-mounted measuring tape and records their height (in centimeters).

Field Experiment Procedure: This included conducting pre- and post-physical tests for the research sample, as well as video recording the sample's execution of the training program under investigation.

Video Recording: The researcher recorded the research sample using a Sony video camera with a frame rate of 25 frames per second.

The video camera was mounted on a tripod, with the lens center 1.38 meters above the ground. The camera was positioned 6.30 meters from the throwing circle, at a perpendicular angle to the circle, and at a point directly in the player's position during the throw. This ensured the complete recording of the throwing motion of the research sample. The researcher also used a 1-meter scale and a numbering board to indicate the sample's attempts. Points were placed on the players' joints to facilitate the identification of these physical points in their logical sequence.

Training Program: The researcher prepared a special training program consisting of 36 training units over 12 weeks, with 3 training units per week. The training program was presented to a number of experts and specialists in the field of physical education to obtain their feedback, address any errors, and correct them. The training units commenced on Saturday, March 31, 2025, and concluded on Thursday, June 28, 2025.

The training program included exercises to develop specific abilities, general preparation and conditioning exercises, as well as exercises specific to the throwing process. Cool-down and relaxation exercises were also included at the end of the training units. The researcher used high-intensity interval training (HIIT) in designing the training units. The required intensity was determined to be between 60% and 80% of the target intensity for developing specific abilities, which the participants performed during the training program. The repetitions and their sums represented the volumes of the training units for the twelve weeks, in addition to the volume of each individual training unit, as detailed in Appendix No. (5). The training program was presented to the experts listed below.

- Post-Test Videography of the Research Sample

Post-test videography of the research sample was conducted on Thursday, June 30, 2025, at 6:00 PM at the Basra Sports Club stadium, under the supervision of the research team. The researcher applied the same pre-testing technique to the research sample.

Research Variables: Throwing Distance Six attempts were made by each athlete to perform the shot put using the push-off technique from inside the circle. The attempts were measured using a tape measure according to the legal formula for the distance achieved, and the best attempt was selected based on the distance achieved. The shot put used was the legal weight of (5) kg, and all participants were subject to the same conditions and requirements specified according to the International Rules of Arbitration for Shot Put Competitions in Athletics.

Launch Angle: This is the angle between the line connecting the center of gravity of the shot put before it leaves the thrower's hand and its position in the first image to its position in the second image (depending on the camera speed used) during its flight, and the horizontal line passing through the center of gravity of the shot put and parallel to the ground.

Launch Speed: This is the distance between the position of the center of gravity of the shot put just before it leaves the thrower's hand at the last point of contact between the throwing arm and the center of gravity in

the immediately following image. This distance is determined based on the camera speed used and the time elapsed between the two images.

Statistical Methods: The researcher used the statistical toolkit (SPSS) to process the research data and extract the results.

RESULTS AND DISCUSSIONS

Presentation, Analysis, and Discussion of Launch Speed Results Table (2) shows that the pre-test mean was (14.22), while it rose to (16.342) in the post-test. Furthermore, the calculated t-value (5.745) was greater than the tabulated t-value (3.18) at a degree of freedom of (3) and a significance level of (0.05). This indicates a significant difference between the pre-test and post-test measurements, favoring the post-test, which demonstrates the effectiveness of the specific exercises in improving performance.

The researcher believes that this improvement in the speed of launch and movement trajectory of novice shot putters is due to a number of factors, most notably:

Developing explosive power through the training apparatus incorporated into the program, in addition to selecting exercises that align with the nature of shot put and structuring them scientifically within the training units, which is considered one of the most important criteria for the success of training programs.

The training apparatus contributed to raising both strength and speed levels. Strength is a key factor in increasing the body's speed during throwing, and this speed increases with the accompanying strength. These two elements (strength and speed) form the basis for giving the thrower the appropriate acceleration to achieve a greater throwing distance.

Sarih Abdul Karim Abdul Sahib (1986) confirmed that strength and speed have a significant impact on all athletic events and that they develop simultaneously when trained together[2]. Also stated that strength alone is insufficient for achieving high performance; it must be combined with speed of execution. The greater the speed at which force is applied, the greater the launch speed, and consequently, the higher the performance.

The research results indicate that the training program contributed to improving motor performance by developing swinging movements and extension of the throwing arm, in addition to proper positioning within the training apparatus, which facilitated the performance of exercises according to the mechanical principles of throwing. Furthermore, the extension of the body's joints and the coordination of the thrust contributed to increasing the launch force and achieving a higher launch speed. State that achieving maximum speed in the throwing arm requires developing the maximum speed of all working muscles simultaneously, and that synchronizing the force action is a fundamental objective in throwing events.

Also indicate that developing the art of motor performance contributes to improving performance levels by lengthening the acceleration trajectory to achieve greater launch speed. This aligns with what Risan Khribat Majid and Najah stated: that power, resulting from both strength and speed, is the most influential factor in launch speed and achieving high performance.

The researcher believes that the training program employed multiple and diverse influences, which resulted in a clear improvement in launch speed due to regular and continuous training. Regular training leads to positive physical and skill adaptations in the athlete. Also confirms that the principle of repetition and organization in training practice is fundamental to consolidating the skill, and that performance becomes consistent if it is repeated continuously, even if it is during short periods of time.

Table (3) shows that the pre-test mean was (29.75) points, while the post-test mean rose to (35.75) points. Furthermore, the calculated t-value (9.83) was greater than the tabulated t-value (3.18) at (3) degrees of freedom and a significance level of (0.05), indicating a significant difference between the pre-test and post-test measurements, favoring the post-test. This improvement is attributed to several factors related to the nature of the training program and the specific exercises used.

The researcher believes that the program played an effective role in improving the launch angle and trajectory of novice shot putters. This apparatus contributed to clear training adaptations by simulating the movement of the basic skill, which led to enhanced control over the trajectory and maintenance of the correct technical structure during throwing. Repeated attempts within the training apparatus also helped stabilize performance and improve control over the ideal launch angle, which was positively reflected in the post-test results. state that training using only the throwing tool is insufficient to achieve optimal results.

Therefore, auxiliary tools and equipment are used to compensate for deficiencies in the athlete's skill or physical abilities.

Also emphasizes the importance of adopting modern methods and diverse educational tools in the training process to increase its effectiveness and accelerate learn

Table 1: Shows the means and standard deviations for the variables of height, weight, age, arm length, and specific arm strength for the research sample members

Variables	Mean	Std	Value of the relative coefficient of variation %
Height/cm	182.75	4.322	2.36
Weight/kg	81.75	3.631	4.44
Age/years	17.75	0.828	4.66
Arm length/cm	75	2.1602	2.88
Special ability	11.285	0.729	6.45

Table 2: Shows the mean, standard deviation, standard error, and calculated and tabulated t-value for launch speed of the research sample

Variable	Pre-Mean	Post-Mean	Std. Diff.	Standard error	(T)Value	(T) Tabulated	Result
Launch speed m/s	14.22	16.342	0.738	0.369	5.745	3.18	Sig.

Table 3: Shows the mean, standard deviation of the differences, standard error, and the calculated and tabulated (t) value of the starting angle for the research sample

Variable	Pre-Mean	Post-Mean	Std. Diff.	Standard error	(T)Value	(T) Tabulated	Result
Starting angle/degree	29.75	35.7	1.22	0.61	9.83	3.18	Sig.

Table 4: Shows the mean, standard deviation of the differences, standard error, calculated t-value, and tabulated numerical achievement of the research sample

Variable	Pre-Mean	Post-Mean	Std. Diff.	Standard error	(T)Value	(T)Tabulated	Result
Digital achievement	29.46	32.68	0.5	0.25	12.88	3.18	Sig.

Table 5: Shows the mean, standard deviation of the differences, standard error, and calculated and tabulated t-value for the specific arm strength of the research sample

Variable	Pre-Mean	Post-Mean	Std. Diff.	Standard error	(T)Value	(T) Tabulated	Result
Arm muscle strength	11.28	14.58	0.4	0.2	16.45	3.18	Sig.

Table 6: Shows the calculated and tabulated value of (r) and the sample size between muscular power and starting speed among the research sample

Variables	Launch speed m/s	Sample size n – 2	tabulated value (r)	Result
Arm muscle strength	0.98	2	0.95	Sig.

Table 7: Shows the calculated and tabulated value of (r) and the sample size between specific ability, starting speed, and starting angle with achievement

Variables	Digital level	Sample size n – 2	tabulated value (r)	Result
Arm muscle power	0.96	2	0.95	Sig.
Launch speed (m/s)	0.957	2	0.95	Sig.
Launch angle (degrees)	0.97	2	0.95	Sig.

Table 8: Shows the contribution of starting speed, starting angle, and performance power

Dependent variable	Independent variable	Contribution percentage
	Launch speed (m/s)	84.3
Digital level	Launch angle (degrees)	94.1
	Specific power	94.3

Table 9: Shows the pre- and post-test mean and the difference for the research variables and the level of development

Variables	Pre-Mean	Post-Mean	Differences	development rate%
Launch speed (m/s)	14.2	16.34	2.14	15.07
Launch angle (degrees)	29.75	35.75	6	20.16
Muscular power	11.28	14.58	3.3	29.25
Digital level	29.64	32.68	3.04	10.25

Points out that auxiliary tools, such as wooden blocks weighing 2.5–3 kg and measuring 65 cm in length, are important for developing strength and skill. These tools force the thrower to extend their throwing arm backward during rotation, a fundamental requirement for technical performance in throwing events. Based on the above, the researcher believes that the specific exercises and equipment used in the program effectively contributed to improving the launch angle and trajectory. This directly impacts the performance of young shot put throwers by enhancing their technical and physical control and providing a more precise and effective

- Presentation, analysis, and discussion of the results of the achievement distance

training environment. Table (4) shows that the mean value of the pre-test measurement was (29.46) meters, while it was (32.68) meters in the post-test measurement. The calculated (t) value was (12.88), which is greater than the tabulated (t) value of (3.18) at a degree of freedom of (3) and a level of error of (0.05). This indicates a significant difference between the pre-test and post-test measurements, favoring the post-test measurement. The researcher attributes this improvement to a number of reasons, the most important of which is the improvement in the speed and angle of release of the tool. The training device played an important role in developing these two variables, which was clearly reflected in the increase in the throwing distance. Mention that there are three factors affecting performance: the angle of release, the speed of release, and the height of release. Regarding the starting angle, there are differing opinions on its ideal value for achieving the objectives of the activity (38). The researcher believes that the reason for the improved performance is due to the training program, the way its components are formulated, and the mechanism for organizing training loads according to the different training phases. The specifications of the training program were aligned with the individual characteristics of the trainees, in addition to the good planning of the training units, the organization of training loads, and the ability to employ modern training methods widely used in contemporary training. This contributed to creating a kind of functional adaptation, as adaptation processes do not occur randomly but rather result from the good organization of the training program through alternating between maximum and sub-maximal training loads, relying on the principle of active rest, and using special exercises aimed at improving the movement path and developing the performance of young shot putters.

This is what Mufti Ibrahim confirmed, stating that one of the trends in modern development in sports training processes is the utmost attention to planning the relationship between load and rest in light of the maximum possible extent and using modern methods and equipment to achieve the highest recovery rates (53:27).

The targeted effect of raising the level of physical and skill performance through intensive exercise requires that periods of rest and load be alternated in accordance with the desired effect. Rest is of great importance for returning to normal after the load, as it leads to an increase in the degree of stimulation and effectiveness within the body's organs, making it ready for the next load. (47:112)

Rissan Khribat and Ali Turki emphasize that the demands of modern training, with its high training loads and high percentage of intensity training, have added further difficulties to the possibility of regulating the work and rest system ideally for each of the different training doses. Such difficulties can be overcome through two interrelated approaches: the optimal planning of different training units for different training loads and the ability to direct the planning of the various recovery methods used in modern training. (9:262)

State that load structuring is planning the method of alternating between load and rest. Proper timing between fatigue and recovery is crucial. Therefore, when designing training loads, the appropriate timing between load and rest should be considered within the training session, the weekly load cycle, and the annual cycle. (29:69)[3].

States that the principle of rest can be applied within a small training cycle by varying the intensity of the load throughout the week. In other words, training during the week should vary between maximum and light to moderate loads. (2:32)

The researcher believes that one of the effective factors that led to the improvement in the performance of the sample group was the psychological impact. This had a significant effect on raising and developing the level of achievement. The athletes' feeling of being cared for and supported by the researcher led to an increase in certain psychological and personality traits, which helped them perform the training sessions correctly. This, in turn, helped them achieve the necessary adaptation to the training tasks and subsequently raise their performance level.

- Presentation, Analysis, and Discussion of the Results of the Muscular Strength Test for the Arms

The results shown in Table (5) show that there are differences between the means and standard deviations

of the differences between the pre-test and post-test for the research sample. The mean for the pre-test measurement was (11.28) meters, while it was (14.38) meters for the post-test measurement. The calculated (t) value was (16.45), which is greater than the (t) value of the gondola measurement of (3.18) at a degree of freedom of (3) and an error level of (0.05). This indicates a significant difference between the pre- and post-tests, favoring the post-test. The researcher attributes this improvement to several factors, most notably the effectiveness of the exercises used in the training program. These exercises contributed to the development of speed ability through the use of unconventional training methods, thus increasing the efficiency of athletes' utilization of their physical capabilities. This aligns with what Risan Khribat pointed out: that improving athletic performance requires increasing the training load, both quantitatively and qualitatively, to a level that compels the athlete to adapt physically and psychologically to the demands of the load, thereby achieving a balance between training requirements and performance capacity (7). The researcher also believes that the improvement in specific ability stems from the use of resistance exercises targeting specific muscle groups. This led to neuromuscular coordination by linking strength and speed within a harmonious movement framework. This is consistent with what Sarih Abdul Karim stated, quoting Qasim Hassan Hussein, that focusing on exercises that utilize the same muscle groups involved in athletic activity is more effective and beneficial (16). The researcher also believes that the gradual increase in resistance through increased training volume contributed to stimulating a greater number of muscle units. The kinetics involved in performing the motor task aligns with what Abu Al-Ala (1997) stated: that the participation of motor units in muscle contraction depends on the amount of resistance. The participation of motor units and muscle fibers increases as the intensity of the load increases, leading to the production of the force necessary to confront or overcome the resistance (1). Furthermore, the researcher's role in applying sound scientific principles in constructing the training dose and determining its degree of difficulty in terms of intensity and volume had a clear impact on achieving this development. Expert opinions confirm that a training program leads to improved performance if it is based on sound scientific principles in organizing the training process, using appropriate and progressive intensity, and adopting optimal repetitions while considering the shooters' abilities and potential. This is consistent with what Abdul Ali Nassif and Qasim Hassan Hussein (1987) indicated: that rapid strength develops with a systematic increase in the intensity of exercise performance, reaching high intensity (41: 147).

- Presentation, Analysis, and Discussion of Correlation Coefficient Results

Table 6 shows that the calculated value of (r) is (0.98), which is greater than the tabulated value of (r) of (0.95) at a significance level of (0.05). This indicates a positive correlation between specific ability and explosive power, due to the following reasons:

The researcher agrees with the opinions of other researchers and specialists regarding the concepts of explosive power and explosive force, considering them to be essentially the same, even though they differ in the methods and techniques used to implement exercises that align with the characteristics and phases of the skill performance. Explosive power, which means exerting maximum force in a single burst over a short period, requires the maximum output of explosive force, which depends on the duration of force exertion.

The explosive characteristic of explosive power is the exertion of maximum force in a single burst. Qasim Hassan Hussein and Iman Shaker (1998) state that every movement requires a force, whether internal or external; otherwise, the movement would not occur. The magnitude of the movement is proportional to the applied force; the greater the force, the greater the movement. Naturally, the direction of the movement is in the direction of the applied force, meaning that the acceleration of the body is directly proportional to the applied force, and the movement occurs in the direction of the force (39:244-245).

The level of influence of power on movement and the level of influence of speed on movement are relative, especially since both variables depend on each other in the final outcome of the movement. A rapid force requires a certain level of speed and a certain level of power, proportionate to the degree required to achieve the objective of the movement or test. Therefore, the speed achieved at the end of the movement results from the application of a force of a certain magnitude to the body of the thrower and then to the tool. Thus, we observe the direct, reciprocal, and interdependent relationship between the two variables.

The relationship between the research variables and performance is addressed in Table (7), where we observe

that the calculated value of (r) is greater than the tabulated value of (r) at a significance level of (0.05) for all variables, thus proving their relationship to performance. This indicates a significant positive correlation between all research variables and performance, which can be attributed to the following: Performance in throwing events depends on a set of variables. When these variables work together, the thrower can achieve the optimal throwing distance. As their athletic abilities develop, they can achieve the best possible level in mechanical, physical, or functional variables. This is directly reflected in the achieved throwing distance. Therefore, the correlation between mechanical or physical variables and performance distance is not a new finding, but it demonstrates that the research results are proceeding in the correct scientific direction. It also highlights the researcher's success in selecting the variables, the designed equipment, and the requirements of the training program, which aimed to elevate the level of the variables according to the specialized training approach. Projectiles are greatly affected by their launch speed, which is one of the most important factors influencing the distance traveled. Since launch speed is related to the force exerted, the greater the speed, the greater the distance. Similarly, the launch angle affects the horizontal distance traveled. The interaction between launch speed and launch angle on the throw distance is linear. Therefore, it is crucial to enhance the physical capabilities that enable the shooter to achieve the maximum possible launch speed. (38:339)

States that the importance of force in throwing events plays a significant role in the speed of the projectile's flight, impacting performance. He also highlights the importance of force level by comparing the distance achieved with the shooter's force level. A strong correlation has been established between force and distance; the greater the force, the greater the distance. Thus, performance in throwing events is closely linked to the level of speed. (48:465-466)

Presentation, analysis and discussion of the results of relative importance (contribution ratio)

Table (8) shows that the contribution of starting speed to performance was (84.3%), the contribution of starting angle was (94.1%), and the contribution of specific force to performance was (94.3%). Based on the above, we can summarize the following:

Specific force and starting angle significantly impacted performance, to a greater extent than starting speed. The starting speed deviated considerably from the ideal value, while the starting angle remained within its ideal range. It should be noted that a direct correlation was observed among the participants between specific force and starting speed, but this correlation was stronger in the direction of force than speed. This leads us to establish a fundamental fact: the proposed device, designed to address the research problem, was specifically designed to enhance specific force and starting angle. Their greater impact on performance distance compared to starting speed was demonstrated, despite the development of force. This is reflected in the level of development of the research variables, as shown in Table (9).

We observe that the percentage improvement in launch speed reached (15.07%), the percentage improvement in launch angle reached (20.16%), and the percentage improvement in specific strength reached (29.25%). Therefore, the researcher can demonstrate that his device is a means of developing specific strength and launch angle.

This leads us to conclude that the device, as a training tool, should only be used for specific training times and according to the objective set in the training unit, which emphasizes developing the launch angle or specific strength. Accordingly, the muscles involved must operate at maximum contraction in a coordinated mechanical movement similar to the nature of the movement, so as not to make the angles of muscular action involved in executing the required movement routine. This routine would reduce the amount of movement achieved during the throw, swings, or rotations.

CONCLUSIONS

In light of the research results obtained through the application of the specific exercises and the use of appropriate statistical methods, the following conclusions can be drawn:

- The specific exercises had a positive and effective impact on improving the movement trajectory of the tool for novice shot putters.
- The specific exercises used contributed to the development of several important biomechanical variables, particularly the launch angle, launch speed, and specific strength of the arm muscles.
- The research results showed statistically significant differences between the pre- and post-test measurements in performance, favoring the post-test measurement for the research sample.
- The results demonstrated significant correlations between specific strength and launch speed,

reflecting the integration of the physical and mechanical components of performance.
- A significant correlation was found between performance and each of the following: movement trajectory, launch angle, launch speed, and specific strength.
- Some biomechanical variables, particularly the launch angle and specific strength, showed a greater contribution to the development of performance compared to other variables.

Recommendations:

- Utilize specific exercises within training programs to develop the movement trajectory of young shot putters, ensuring coordinated and precise performance during the throw.
- Utilize assistive devices and tools during training to teach and adjust the launch angle within the optimal range, contributing to improved technical performance and performance.
- Develop specific arm muscle strength through progressive and comprehensive training programs, as this is a fundamental factor in increasing throwing effectiveness and improving performance.
- Focus on developing launch speed, given its significant and direct impact on increasing throwing distance and achieving better performance for young athletes.
- Integrate specific exercises with fundamental biomechanical components, such as specific strength, launch angle, and launch speed, to maximize the benefits in improving movement trajectory and performance.
- Encouraging coaches to adopt scientific training methods based on organizing the training load and gradually increasing intensity and methods, in a manner appropriate to the individual characteristics of young athletes to ensure optimal physical and technical adaptation.

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