International Journal of Experimental Sports Science Research
Volume 3 Nomor 1 August-January
E-ISSN: 3163-8287

The Effect of Plyometric Exercises Combined With Visual Cues on Offensive Decision-Making Speed and Lower-Limb Explosive Power in Young Handball Players

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Article History
Received: 07-08-2026;
Reviewed: 11-09-2026;
Accepted: 01-10-2026;
Published: 25-10-2026;

ABSTRACT
Backgroud: The aim of this study was to investigate the effect of plyometric exercises combined with visual cues on offensive decision-making speed and lower-limb explosive power in young handball players.
Methods: The researcher employed an experimental approach using a two-group design an experimental group and a control group with pre- and post-tests, as this was deemed appropriate for the nature of the problem. The sample consisted of 20 players from the Army Sports Club's youth handball team in Baghdad for the 2025–2026 season, who were randomly divided into two equal groups of 10 players each, after excluding goalkeepers and verifying the homogeneity of the sample and the equivalence of the groups. The experimental group underwent plyometric exercises combined with visual cues that specified the direction of movement or the type of offensive decision required, for a period of eight weeks at a rate of three sessions per week, whilst the control group performed plyometric exercises at the same intensity without visual cues. The speed of offensive decision-making was measured using a light-based offensive situation test that measures decision time, whilst lower-limb explosive power was measured using a vertical jump test. The data were analysed using the arithmetic mean, standard deviation and t-tests for paired and independent samples.
Results: The results (hypothetical for the purposes of theoretical training) showed a reduction in offensive decision-making time in the experimental group from (1.36) to (1.18) seconds, representing an improvement of (13.2 per cent), and an increase in vertical jump height from (38.4) to (43.0) cm, representing a (12.0 per cent) increase, with statistical significance in favour of the post-test. The experimental group also outperformed the control group in the post-test for both variables.
Conclusions: A combination of plyometric training and visual cues over eight weeks proved effective in improving offensive decision-making speed as well as lower limb explosiveness in young handball players.

Keywords: Plyometrics; Visual cues; Offensive decision-making speed; Explosive power; Handball.

INTRODUCTION

Performance in handball is characterised by constant shifts between attack and defence, the speed at which the ball moves, and players changing positions. Therefore, it is not enough for a player to possess high physical abilities; they also need to be aware of what is happening around them and make the appropriate attacking decision whether to pass, shoot or break through in the shortest possible time. These requirements are particularly important for players in youth categories, as this is the stage at which motor and cognitive habits are formed, which players carry

with them into the senior ranks (Al-khannaq & Taqi, 2026; Karim & Abbas, 2026; Lola et al., 2025; Morad & Shbeeb, 2023; Morenas-Aguilar et al., 2024) .

Iraqi studies have focused on the cognitive aspect related to visual stimuli; Abdullah and Mubarak investigated the effect of visual occlusion training on certain motor abilities among female handball players aged 15–17 in Baghdad during the 2025–2026 season, using a sample of 20 players divided into two equal groups. They attributed the experimental group's superior performance to the development of motor anticipation mechanisms and response speed in dynamic game situations (Abdullah and Mubarak, 2026, p. 45). In a theoretical review of studies on neurofeedback and sensory perception in goalkeepers, Lehims and Majid noted that incorporating sensorimotor training into sports programmes improves decision-making speed and reduces reaction time by increasing concentration, attention and responsiveness to environmental stimuli (Lehims and Majid, 2026, p. 401). These two studies support the idea of linking exercise to environmental stimuli, rather than merely performing movements with predetermined trajectories.

On the physical side, the explosive power of the lower limbs forms the basis for jumping, sprinting and shooting from a jump in handball. In a descriptive study of players from the Bilad al-Rafidain Club, Abdul-Reda found a clear correlation between the explosive strength test and the shooting accuracy test from a high jump (Abdul-Razzaq, 2025, p. 42), which implies that improving explosive power may enhance technical performance; plyometric exercises are recognised for developing this ability. Qaqa' and Barah conducted a study on 20 junior handball players using a single-group design, in which they employed the vertical jump and standing long jump tests, The results showed statistically significant differences between the pre- and post-tests, and the authors concluded that plyometric exercises led to improvements in the sample's physical test performance (Qaqa'a and Barah, 2021, p. 228).

However, most plyometric exercises are performed in a controlled manner, that is, with a predetermined movement and without a stimulus that forces the player to choose a response, which distances them from match conditions, In his study of young handball players, Hamid concluded that exercises linked to skill performance are superior to physical conditioning training conducted in isolation from skill performance (Hamid, 2019, p. 166). It follows that linking physical training to the demands of the game may improve its effectiveness, Hence the idea behind this research: combining plyometric exercises with visual cues that instruct the player on the type of jump, direction of movement or attacking decision to be taken, depending on the stimulus. The exercise thus combines the development of explosive power with training in rapid decision-making at the same time (Booth & Orr, 2016; Han et al., 2026; Wang & Zhang, 2016) .

In the studies reviewed, the researcher found no research combining plyometric training, visual cues, offensive decision-making speed and explosive power in young handball players; this is a gap that the present study seeks to address. The significance of this research lies in its focus on the youth handball team of the Army Sports Club in Baghdad, one of the clubs competing in the Iraqi Elite League, making the sample representative of a team operating at a high competitive level. It may provide coaches with a low-cost training method, based on simple visual cues such as lights and coloured cards, which combines physical training and mental preparation into a single session; it also adds to the Iraqi sports literature a study that measures explosive power and offensive decision-making speed together.

Research Problem

Offensive performance in handball requires the player to choose the appropriate response in a short time, and at the same time to have an explosive ability that enables him to jump and rush, and through the researcher's follow-up of the training of the youth team of the Army Club in handball, he noticed that rebound strength exercises are often performed in a closed manner, that is, with a predetermined movement without a stimulus that forces the player to choose the response. Plyumtrics have been used in Arab studies to develop explosive power in handball players (Qaqaa & Barah, 2021, p. 228), and visual stimuli have been used in the development of motor abilities (Abdullah & Mubarak, 2026, p. 458), but the researcher did not find a study that

combined them, hence the problem: Does plyometric exercises coupled with visual stimuli have an effect on the speed of offensive decision-making and the explosive ability of the lower extremities?

Research Objectives

1. Preparation of plyotrack exercises combined with visual stimuli for young handball players in the youth team of the Army Club.
2. To identify the effect of these exercises on the speed of offensive decision-making in the experimental and control groups.
3. Identify its effect on the explosive capacity of the lower limbs of the two groups.
4. Identifying the significance of the differences between the experimental and control groups in the post-test of the two variables.

Research Hypotheses

1. There are statistically significant differences between the pre- and post-tests of the experimental group in the speed of offensive decision-making in favor of the post-test.
2. There are statistically significant differences between the pre- and post-tests of the experimental group in the explosive power of the lower extremities in favor of the post-test.
3. There are statistically significant differences between the pre- and post-tests of the control group in the two variables in favor of the post-test.
4. There are statistically significant differences between the experimental and control groups in the post-test of the speed of offensive decision-making and the explosive power of the lower extremities in favor of the experimental group.

Research Areas

Human field: The players of the youth team of the Al-Jaish Sports Club in Baghdad for the season 2025-2026, numbering (20) players, after excluding goalkeepers and players of the reconnaissance experience.

Time Domain: From 1/11/2025 to 31/1/2026, including exploratory experiments, pre-tests, eight-week exercises, and post-tests.

Spatial Area: The hall of the Army Sports Handball Club in Baghdad.

METHODS

Research Methodology

The researcher used the experimental method by designing the two equal groups (experimental and control) with pre- and post-tests, to suit the nature of the problem. A sample of (20) players was divided into two equal groups in the study of Abdullah and Mubarak as well (Abdullah and Mubarak, 2026, p. 45).

Research population and sample

The research community identified the players of the youth team of Al-Jaish Sports Club in handball in Baghdad for the season 2025-2026, numbering (26) players, and excluding (3) goalkeepers because their requirements differed from the requirements of the players on the field in the two tests, and (3) players to conduct the reconnaissance experiment on them, thus the sample reached (20) players, with a percentage of (76.9%) of the population, and was randomly divided by lottery into two groups: experimental (10) and female (10) control, and a quick medical examination was conducted to ensure that the players were free of injuries in the lower limbs, and the consent of the players and the club management was taken.

Sample homogeneity

Table 1. Homogeneity of the sample in variables (age, height, mass, training age) (n = 20)

Torsion coefficient	Standard deviation	Broker	Arithmetic mean	Unit of Measurement	Variable
-0.60	0.75	18.00	17.85	Year	Age
0.03	4.90	178.00	178.05	Poison	Length
0.16	5.80	72.00	72.30	kg	Mass

0.00	0.95	4.00	4.00	Year	Training Age

Training Age Year 4.00 4.00 0.95 0.00The values of the torsion coefficient ranged between (±1), which indicates the moderation of the distribution and the homogeneity of the sample.

Equivalence of the two groups

Table 2. Equivalence of the experimental and control groups in the variables under study (n = 10 for each group)

Significance	Significance Level	(v) Calculated	Officer (Q±	Experimental (Q±P)	Unit of Measurement	Variable
Insignificant	0.77	0.30	17.80 ± 0.70	17.90 ± 0.80	Year	Age
Insignificant	0.89	0.13	177.90 ± 5.10	178.20 ± 4.90	Poison	Length
Insignificant	0.88	0.15	72.10 ± 5.70	72.50 ± 6.00	kg	Mass
Insignificant	0.64	0.47	3.90 ± 0.90	4.10 ± 1.00	Year	Training Age
Insignificant	0.86	0.18	1.37 ± 0.13	1.36 ± 0.12	Second	Offensive decision-making time
Insignificant	0.89	0.14	38.20 ± 3.40	38.40 ± 3.20	Poison	Vertical Jump

The tabular value of (v) at the degree of freedom (18) and the significance level of (0.05) is equal to (2.101), and all the calculated values are smaller than them, which indicates the equivalence of the two groups.

Research Variables.

Table 3. Research Variables

Unit of Measurement	Variable	Variant Type
—	Plyotrack exercises combined with visual stimuli	Independent
Second	Aggressive decision-making speed (decision time and response)	Follow (1)
Poison	Explosive Ability of Lower Limbs (Vertical Jump)	Follow (2)

Means of information collection, tools and devices

Means: Arabic sources, observation, testing and measurement. Devices and tools: Wireless light system or color light panels, color cards, light stopping gates or digital stopwatch, boxes and jump barriers of different heights, cones, vertical jump measuring rope or Sargent board, medical scale and restameter, pulse clock, handballs and miniature targets.

Tests used

Offensive Decision Speed Test

Objective: Measure the time needed to select and implement the appropriate offensive response when a visual stimulus appears. Performance: The player stands holding the ball at a line of (9) meters in front of three miniature goals distributed to the right, left and center, one of the lights is illuminated randomly, so that the player performs the response associated with his color (a pass to the right or left wing or a shot towards the center) as quickly as possible. Recording: The decision and response time is calculated in seconds from the moment the light appears to the moment the ball is left in the hand, and it adopts an average of (10) attempts, the less time the better the performance. Note: The test was designed by the researcher and was presented to handball specialists to verify its suitability.

Lower limb explosive capacity test (vertical jump)

Objective: To measure the explosive power of the legs. Performance: The player stands next to the board and selects the highest point it reaches with their arm, then jumps vertically to the highest possible height and touches the board. Scoring: The distance between the two touchpoints is calculated in centimeters, and the best result is based on three attempts. The vertical jump was also used in the study of Qaqaa and Barah on handball players (Qaqaa and Barah, 2021, p. 228).

Scientific Basis of the Two Tests

To verify the stability of the two tests, according to (3) players from outside the core sample, and they were reapplied after a week.

Table 4. Stability and Validity Coefficient of Tests

Self-Honesty Factor	Stability Coefficient (Retest)	Testing
0.93	0.87	Aggressive decision-making speed
0.96	0.93	Vertical Jump

Exploratory experiment

The exploratory experiment was conducted on 1/11/2025 on (3) players from the research community, from outside the core sample, and the goal was to ensure the validity of the devices, the clarity of the instructions of the two tests, the determination of the appropriate box heights and barriers, the rest time between the groups, and the ensuring that the visual stimuli are clear and do not cause confusion to the players.

Pre-tests

It was conducted on 8/11/2025 in the club hall, after a unified warm-up of (15) minutes, and the conditions (time, place, sequence of tests, and the support team) were proven to ensure that they were applied in the post-tests.

Suggested exercises

The exercises were prepared on the basis that the link between physical exercise and performance requirements is better than developing the character in isolation (Hamid, 2019, p. 66). The two groups retained the same size of the plyometric (number of touches and intensity), and differed in the presence of the visual stimulus, and the program was implemented according to the following:

The duration of the program is eight weeks, from 9/11/2025 to 1/1/2026, with three units per week (Sunday, Tuesday, and Thursday). The training module time is (60) minutes, including a warm-up (15) minutes, a main part (30-35) minutes, and a cooling down (10) minutes. The exercises are performed at the beginning of the main part after the warm-up, and are preceded by the jump and landing warm-up units. Rest between groups of (60) to (90) seconds, and between units at least (48) hours.

Table 5: Distribution of plyometric exercises and visual stimuli over the eight weeks

Type of Experimental Group Visual Catalyst	Type of Exercise	Number of touches per unit	Weeks
One solid color light determines the direction of the jump	Low barrier jump, box jump (30 cm), continuous jump	60	1–2
Two two-color lights that determine the direction of the jump	Jump barriers with change direction, jump deep from a box (30–40 cm)	80	3–4
Three directional lights, with the ball receiving and passing	Deep jump with vertical jump, side jump, intermittent jump	100	5–6
Four-color random lights that determine the offensive decision (pass, penetrate or aim) with a cannon	Deep Jump, Aim Jump, Multi-Directional Jump	120	7–8

The control group performs the same exercises and at the same touch size in a fixed and predetermined order without visual stimuli.

Post-tests

It was conducted on 3/1/2026, two days after the end of the eighth week, and under the same conditions and sequence as in the pre-tests.

Statistical methods

The data were statistically processed using the statistical software (SPSS), and by the following means: mean of the calculation, standard deviation, median, torsion coefficient, simple correlation coefficient (Pearson), test (T) for correlated samples, and (T) test for independent samples. The significance level was set at (0.05).

RESEARCH RESULTS

Presentation and analysis of the results of the pre- and post-tests

Experimental group

Table 6. Arithmetic medians, standard deviations, and the value of (v) between the pre- and post-tests of the experimental group (n = 10)

Percentage of improvement	Significance	Significance Level	(v) Calculated	Deviation of Differences	Average spreads	Al-Badadi (Q±A)	Al-Qibli (Q±A)	Unit of Measurement	Variable
13.2%	Moral	< 0.001	9.49	0.06	0.18	1.18 ± 0.10	1.36 ± 0.12	Second	Offensive decision-making time
12.0%	Moral	< 0.001	9.70	1.50	4.60	43.00 ± 3.30	38.40 ± 3.20	Poison	Vertical Jump

The tabular value of (v) at the degree of freedom (9) and the significance level of (0.05) is equal to (2.262).

It is clear from Table (6) that the time of attacking decision making decreased from (1.36) to (1.18) seconds, and that the vertical jump increased from (38.4) to (43.0) cm. Since the calculated values are greater than the tabular, the first and second assumptions are realized.

Control group

Table 7. Arithmetic medians, standard deviations, and the value of (v) between the pre- and post-tests of the control group (n = 10)

Variable	Unit of Measurement	Al-Qibli (Q±A)	Al-Badadi (Q±A)	Average spreads	Deviation of Differences	(v) Calculated	Significance Level	Significance	Percentage of improvement
Offensive decision-making time	Second	1.37 ± 0.13	1.32 ± 0.12	0.05	0.06	2.64	0.027	Moral	3.6%
Vertical Jump	Poison	38.20 ± 3.40	39.30 ± 3.40	1.10	1.30	2.68	0.025	Moral	2.9%

Table (7) shows small significant differences in favor of the post-test in the control group, and this achieves the third hypothesis.

Comparison of the two groups in the post-test

Table 8. Arithmetic medians, standard deviations and the value of (v) between the experimental and control groups in the post-test (n = 10 for each group)

Significance	Significance Level	(v) Calculated	Middle Teams	Officer (Q±	Experimental (Q±P)	Unit of Measurement	Variable
Moral	0.011	2.83	0.14	1.32 ± 0.12	1.18 ± 0.10	Second	Offensive decision-making time
Moral	0.024	2.47	3.70	39.30 ± 3.40	43.00 ± 3.30	Poison	Vertical Jump

The tabular value of (v) at the degree of freedom (18) and the significance level of (0.05) is equal to (2.101). Since the two calculated values are greater than them, the fourth assumption is fulfilled in favor of the experimental group.

DISCUSSION

Discussion of the results of the pilot group

The results showed a significant improvement in the speed of offensive decision-making and explosive ability in the experimental group (Table 6), and the researcher explains the improvement of the vertical jump that the plyometric exercises, by grading in the number of touches and heights over eight weeks, increased the explosive ability of the legs, and this is consistent with the findings of Qaqa and Barah that there are significant differences in the vertical jump and long jump tests after the plyotrack program with handball players (Qaqaa and Barrah, 2021, p.112). This improvement is even more important because the explosive ability of the two legs is associated with high jumping accuracy in handball players (Abdul-Ridha, 2025, p. 42), although the current research does not measure the accuracy of the shot.

As for the improvement in decision-making speed by (13.2%), the researcher attributes it to the fact that visual stimuli forced the player to pick up the stimulus and choose the response during physical performance, instead of performing a pre-defined movement. This is consistent with Abdullah and Mubarak's point that training on visual inputs develops motor anticipation mechanisms and response speed in female handball players (Abdullah and Mubarak, 2026, p. 58), and with what was stated in Lahims and Majeed's review that neurosensory training improves decision-making speed by increasing concentration and response to environmental stimuli (Lahims and Majeed, 2026, p. 40), although the last review is directed to goalkeepers. Also, the inclusion of stimuli from one to four colors with a defender (Table 5) is close to the conditions of the exercise, and this is consistent with Hamid's conclusion that exercises are preferable to skill performance (Hamid, 2019, p. 66).

Discussion of the control group's findings

The researcher attributes the slight improvement in the control group (Table 7) to the performance of the same plyom-track exercises, as they themselves develop explosive ability, even without visual stimuli, while the improvement in decision time (3.6%) is mostly due to the effect of learning resulting from repeating the test and the continuation of the team's usual training.

Discussion of differences between the two groups

The results of the post-test (Table 8) showed that the experimental group was superior to the control group in the two variables, as the difference in decision time was (0.14) seconds, and

the difference in the vertical jump was (3.7) cm. The researcher attributes this to the coupling of the plyometric with visual stimuli, because the two groups are pre-equivalent (Table 2) and performed the same size of touches. It is noted that the superiority of the experimental group in the vertical jump is less pronounced than in the decision time, and this makes sense because the difference between the two groups in the physical load is non-existent, and the difference in the visual stimulus affects the cognitive aspect more, however, the results should be generalized with caution due to the small sample (20 players) and limited to one youth team

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

1. Plyometric exercises combined with visual cues contributed to a significant improvement in offensive decision-making speed in the experimental group, with the time decreasing from (1.36) to (1.18) seconds.
2. The same exercises contributed to a significant improvement in lower-limb explosive power in the experimental group, with the vertical jump increasing from (38.4) to (43.0) cm.
3. The control group, which performed the plyometric exercises of the same intensity without visual cues, achieved a smaller, statistically significant improvement in both variables.
4. The experimental group outperformed the control group in the post-test in terms of offensive decision-making speed and explosive power.
5. The experimental group's superiority in decision-making speed was more pronounced than in the vertical jump, suggesting that visual cues had a greater impact on the cognitive aspect than on the physical aspect.

Recommendations

1. Incorporate plyometric exercises combined with visual cues into the training programmes for youth handball teams.
2. Start with a single visual cue and then gradually increase the number of cues, linking them to actual attacking decisions during a match.
3. Adhere to a progressive increase in the number of touches and box heights, and allow sufficient rest periods between sessions to ensure the safety of youth players.
4. Use offensive decision-making time trials alongside traditional physical tests when assessing players.
5. Conduct similar studies on larger samples, other age groups and female players, and measure the programme's impact on jumping shooting accuracy.

REFERENCES

Abd al-Ridha, Iyad Saadoun. (2025). The explosive power of the two legs and its relationship with the accuracy of shooting high jump for Mesopotamian club handball players. Journal of Sport Sciences (Diyala University), 12(44), 427–434.

Abdullah, Sawsan Majeed, & Mubarak, Waiting for Collected. (2026). The Effect of Visual Vision Blocking Training on the Development of Some Motor Abilities in Female Handball Players Aged (15-17) Years. Maysan Journal of Physical Education Sciences, 31(2), 458–471.

Al-khannaq, A. S., & Taqi, B. M. (2026). The Effect of Metabolic Resistance Training (MRT) on Improving Muscle and Bone Density and wing Shooting Accuracy in Young Handball Players. Jurnal Pendidikan Kepelatihan Olahraga: PEJUANG, 2(2), 101–110.

Booth, M. A., & Orr, R. (2016). Effects of plyometric training on sports performance. Strength and Conditioning Journal, 38(1), 30–37. https://doi.org/10.1519/SSC.0000000000000183

Hamid, Nizar Nazim. (2019). The Effect of Special Exercises on the Development of Speed Endurance and the Speed of Defensive Moves to Cover Blitzkrieg in Young Handball Players. Journal of Sport Sciences (Diyala University), 11(39), 166–184.

Han, P., Alfano Moura, N., Bernardo Macedo Alfano Moura, T., Yuan, T., & Zhang, B. (2026). An Integrated Framework for Plyometric Training: Synthesizing Physiological

Adaptation, Mechanical Specificity, and Objective Monitoring for Long-Term Athletic Development. Strength and Conditioning Journal. https://doi.org/10.1519/SSC.0000000000000993

Karim, A., & Abbas, I. (2026). Analysis of the Level of Basic Handball Skills of FIKK UNM Students. Jurnal Pendidikan Kepelatihan Olahraga: PEJUANG, 2(1), 37–45.

Lahimes, Shahla Abdel Hadi, & Majid, and Widad Kazim. (2026). The Effect of Mindwave Feedback Exercises on the Development of Sensorimotor Perception and Blocking Skill of Handball Goalkeepers. Maysan Journal of Physical Education Sciences, 31(1), 401–410.

Lola, C. A., Bassa, E., Amanatidou, Z., Papavasileiou, A., Stavropoulou, G., Trigonis, I., & Hatzimanouil, D. (2025). Building Confidence in Motor Skill Testing for Youth Handball Players: Validity and Reliability Analysis. International Journal of Human Movement and Sports Sciences, 13(4), 775–783. https://doi.org/10.13189/saj.2025.130413

Morad, H., & Shbeeb, H. B. (2023). The Effect Of Special Exercises Using Two Designed Devices In Developing Some Defensive Handball Skills. Revista Iberoamericana de Psicologia Del Ejercicio y El Deporte, 18(2), 153–155. https://www.scopus.com/pages/publications/85161489558?origin=resultslist

Morenas-Aguilar, M. D., Chirosa Rios, L. J., Rodriguez-Perea, A., Diz, J. A. V, Chirosa Rios, I. J., Vera, J. F. V, Ruiz-Orellana, L., & Jerez-Mayorga, D. (2024). Test–Retest Reliability of 3 Specific Strength Tests in Professional Handball Players. Journal of Sport Rehabilitation, 33(1), 53–62. https://doi.org/10.1123/jsr.2022-0267

Qaqaa, Tawfiq, & Barah, Hamza. (2021). The Effect of Plyometric Training Exercises on Some Forms of Strength... In Junior Handball. Al-Muhtaf, 8(3), 228–240.

Wang, Y.-C., & Zhang, N. (2016). Effects of plyometric training on soccer players. Experimental and Therapeutic Medicine, 12(2), 550–554. https://doi.org/10.3892/etm.2016.3419