



The Effect of HIIT Training on Developing Key Physical Attributes and Fast Break Performance in Handball for Youth Players

Ahmed Salman Jasim⁽¹⁾, Zeyad Aneed Salman⁽²⁾, Husham Hameed Hashlm⁽³⁾

Corresponding Author, E-mail: ahmed94salman0@gmail.com

^{1,2}General Directorate of Education in Babylon / Ministry of Education, Iraq.

³General Directorate of Education in Karbala / Ministry of Education, Iraq.

Abstract

The objectives of the research were manifested in preparing HIIT training to develop the most important physical attributes and fast break performance in handball for youth players, and to identify the superiority of the effect between the two groups (experimental and control) in the post-tests of the research sample. As for the research method, the researcher used the experimental method with the approach of equivalent groups (experimental and control) with pre- and post-tests. Regarding the research population and sample, the research population was identified as the players of the Handball Talent Center for the season (2024–2025), numbering (16) players, and each group consisted of (8) players. The data were presented, analyzed, discussed, and statistically processed using the SPSS statistical package. Through the results, the researcher reached several conclusions, the most important of which is the superiority of using HIIT training over the control group training in the variables (man-to-man defense and fast break). The study recommended the use of HIIT training within handball training units due to its importance in preparing players for participation in championships and sports competitions. Through the researcher's observation, being a teacher and a former handball coach, and his involvement in most of the training units of the Talent Center for youth players, a sudden decline in physical performance was observed, especially in the final minutes of the match, which leads to early fatigue, lack of concentration, and a decrease in the level of performance effectiveness. This is reflected in random play, dispersion of balls, and excessive passing in a non-ideal manner, which are intercepted by the opponent. The researcher addressed this problem by preparing training using a modern method to identify its effect on the functional, physical, and skill aspects.

Keywords: HIIT Training; Physical Attributes; Fast Break Performance; Handball; Youth Players.

Introduction:

Sports activities, including team sports, have become one of the modern manifestations that reflect the progress and advancement of a country. Among these games is handball, which is considered one of the most important team sports in the world. High-Intensity Interval Training (HIIT) is one of the modern training methods that has great importance in improving the efficiency of both muscular and respiratory work through the alternation between periods of maximum effort and periods of rest. It is one of the fastest and most effective methods in developing physical attributes, as it directly affects the heart muscle and blood vessels through short periods of high-intensity effort followed by rest periods. With continuous and gradual performance of high-intensity interval training, the body adapts to these exercises and improves its performance. These exercises increase the body's ability to consume oxygen, improve breathing quality, enhance lung strength and its capacity to receive oxygen and distribute it throughout the body. This is reflected in the improvement of other physical abilities specific to the football player. Offensive performance is considered one of the important aspects that a handball player must possess with specific performance characteristics, as the player covers varying distances, which requires the availability of high levels of physical and functional efficiency. These are associated with the improvement of basic skills and physical abilities due to their effective role in performing offensive and defensive tactical aspects during the match, and they must be developed due to their impact on executing duties in competitions.

The importance of the research lies in preparing HIIT training and identifying its effect on the most important physical attributes and the effectiveness of fast break performance in handball for youth players, in the hope that this study will serve the scientific progress of coaches and players.

Research Problem:

The primary and main objective of the training process is to bring players to the highest levels of physical, skill, psychological, and tactical condition in order to present their best performance in all matches in which they participate. This is achieved through keeping pace with the development occurring in handball in terms of fast performance and transition toward the opponent's goal. Through the researcher's observation of the matches of the Handball Talent Center, it was noted that there is a variation in match results from one match to another and a gradual and clear decline in performance level, especially in the second half of each match. This may negatively affect the performance of all team players, making it difficult for them to finish the attack in the correct manner and with the required accuracy. This prompted the researcher to address this problem by preparing training using modern training methods (HIIT) to solve this issue, which may contribute to developing the most important physical attributes and the effectiveness of fast break performance for all players, which is reflected in raising the player's ability to complete the match at the best level.

Research Objectives:

- To prepare training using the (HIIT) method for the players of the Handball Talent Center for youth.
- To identify the effect of training using the (HIIT) method on the most important physical attributes and fast break performance in handball for youth.
- To identify the superiority of the effect between the research groups (experimental and control) in the post-tests and measurements of the research sample.

Research Hypotheses:

- There is a positive effect of training using the (HIIT) method on the most important physical attributes and fast break performance in handball for youth.
- There is a superiority of the experimental group (HIIT) over the control group in the most important physical attributes and fast break performance in the post-tests and measurements of the research sample.

Research fields:

Human field: Players of the Handball Talent Center in Karbala Governorate (youth category) for the 2025–2026 season

Time field: From 1/8/2025 to 1/11/2025.

Spatial field: The Olympic Hall (Annex / Karbala Governorate).

Definition of Terms:

1- HIIT method: It is one of the modern training methods that has spread in recent times and is given to players in the form of regular exercises but with a different execution style, characterized by high intensity and short rest periods (Zuhl, Kravitz, 2012).

2- Research Method and Field Procedures

Research Methodology and Field Procedures:

Research Method:

The method is the path through which the required objective is achieved, and it is one of the essential matters that should be considered. Therefore, the researcher used the experimental method because it is suitable for the nature of the research problem, using the approach of equivalent groups (an experimental group and a control group) with pre- and post-tests, as shown in Table (1).

Table (1) Shows the experimental design in the research

Group	Pre-tests	Experimental design	Post-tests
Experimental	Test of the most important physical attributes. Fast break performance	Training using the HIIT method	Test of the most important physical attributes Fast break performance
Control		Coach’s method	

Research Population and Sample:

The research population was determined from the players of the Sports Talent Center in Karbala in handball for the season (2025–2026), numbering (20) players. After excluding goalkeepers, who numbered (4) players, the research sample was selected using the comprehensive enumeration method, numbering (16) players, and they were randomly divided equally into two groups (experimental and control), with (8) players in each group. In order to obtain homogeneity among all individuals of the research sample (height, mass, training age), the researcher used the (Levene) test before starting the application of the main experiment on the two research groups (experimental and control), as shown in Table (2).

Table (2) Shows the homogeneity of the research sample

No	Variables	Unit of measurement	Levene test		Level of sig	Sig level
			Calculated			

1	Height	cm	0.196	Random	Random	Sig
2	Mass	kg	0.428	0.659	Random	Sig
3	Training age	year	1.260	0.297	Random	Sig

In order for the researcher to control the variables and determine the differences in the results of the post-tests and the extent of their influence by the experimental variable, the researcher conducted equivalence between the experimental and control groups using the (T) test, as shown in Table (3).of the research sample in these variables.

Variables	Unit of measurement	Control group		Experimental group		Calculated (T)value	Level of sig	Type of sig
		Mean	Standard deviation	Mean	Standard deviation			
Strength	meter	4.15	0.92	4.33	0.39	0.43	0.086	Not sig
Speed	second	2.733	0.272	2.768	0.244	0.270	0.791	Not sig
Fast break	number	1,12	0,04	1,16	0,09	1,538	0,082	Not sig

Tools, Devices, and Equipment Used in the Research:

Data collection methods:

- Observation.
- Personal interviews.
- Questionnaire.
- Tests and measurements.

Devices and Equipment Used in the Research

- 1- Electronic height and weight measuring device (1).
- 2- Electronic stopwatch (Chinese type) (4).
- 3- Sony video camera (2).
- 4- Whistle (2).
- 5- Training cones (4).
- 6- Official handball court.
- 7- Measuring tape (cloth).
- 8- Training poles (4).
- 9- Camera tripod (2).
- 10- Laser discs (3).
- 11- Adhesive tape.
- 12- High stand (2).
- 13- Iron stand (2).
- 14- Medicine balls (2).
- 15- Graduated board fixed on the wall.
- 16- Handballs (6).

Field research procedures:

Determining the variables and tests used in the research

After reviewing scientific sources and references and consulting with experts in sports training and handball, in order to determine the research variables according to their importance, a questionnaire form was prepared to determine the tests of the most important physical attributes and the effectiveness of fast break performance, and it was presented to experts and specialists, as follows:

- The most important physical attributes include (Speed , Strength

Description of the tests:

1- 20 m sprint test from a modified flying start: (Saleh,2013)

Purpose of the test: Measuring speed in handball

Tools: Measuring tape, adhesive tape, timing device, whistle.

Test administration: Timer, recorder, starter.

Performance description: Three parallel lines are drawn on the ground, with the distance between the first and second lines (10 m) and between the second and third lines (20 m). The timing device gates are placed on the second and third lines. The participant stands behind the starting line, and from a high start, upon the signal, the participant runs. At the start line, the participant crosses the first gate with his body and continues running to cross the second gate at the third line (finish line), as shown in the following figure(1).

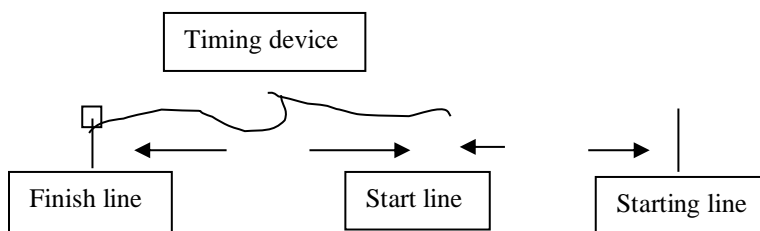


Figure (1) 20 m sprint test from a modified flying start test

2- Explosive strength of the arms and legs:

Medicine ball throw test for the farthest possible distance.

Purpose of the test: Measuring shooting strength at low effort.

Tools used: Two medicine balls weighing (1000 g) with the same size as a legal handball, measuring tape, a flat ground area not less than 40 m in length.

Performance specifications: The player stands on the starting line of the throwing area without touching the line, with both feet at the same level, holding the ball with both hands. Upon the start signal, the participant moves the medicine ball to the throwing arm and holds it with one hand (the same way as holding a handball), takes a step with the opposite foot, and throws the medicine ball as far as possible within the throwing area, provided that the throw is directed toward a transverse line 4 m away from the player's pivot point during the throw.

Scoring: The throwing distance is calculated to the nearest 10 cm. The participant is given two attempts, and the best one is recorded, provided that the ball lands within the designated throwing area.

3- Sargent vertical jump test.

Purpose of the test: Measuring explosive strength of the legs.

Tools: Graduated board fixed on a wall.

Performance specifications: The participant holds a piece of chalk, faces the wall, and makes a mark with the fingertips at the maximum height he can reach. Then he stands sideways to the wall with the shoulder of the dominant arm facing it, swings the arms downward with partial knee flexion, then swings them upward while extending the knees vertically to jump upward and make another mark with the hand closest to the wall at the highest point the fingers can reach. Each player is given three attempts, and the best one is recorded, with emphasis on not lifting the heels during the first mark.

Scoring: The distance between the first and second marks is recorded, representing the participant's score in this test.



Figure (2) Shows the vertical jump test

4- Fast break test in handball: (Al-Lami, 2007):

Purpose of the test: Measuring the speed of individual fast break in handball.

Tools: Handball court, handballs (6), stopwatches (4), cones, adhesive tapes, whistle, measuring tape.

Test field: Two zones are defined, one called zone (A), which is running without the ball, and the other zone (B), which is the ball reception zone, as shown in Figure (3).

Performance method: A starting area is determined for the player at a distance of (1 m) from the goal line and (1 m) from the sideline. The participant stands at the starting point, and the ball is with the goalkeeper. Upon hearing the whistle, the participant runs at maximum speed until reaching the midline. The goalkeeper starts passing the ball, ensuring that the participant's running path is diagonal toward the goal, as shown in Figure (3). When the participant passes the mark on the ground, which represents the end of zone (A), the first stopwatch is stopped. When the participant receives the ball, the second stopwatch is stopped, and the distance of the reception point in zone (B) is determined.

Scoring: The unit of measurement used in the test is (m/s).

- The first speed is calculated from the moment of starting until crossing zone (A), by calculating the time taken to cover the distance.

- The second speed is calculated from the distance between the end of zone (A) and the point of receiving the ball in zone (B), as well as the time calculated by taking the difference between the first and second stopwatches.
- For the purpose of excluding the effect of the goalkeeper's throw, as it may vary from one participant to another when dealing with samples, the arithmetic mean of the second speed ratio for each participant is taken by dividing the total speed by the first speed for each participant. Then, the arithmetic mean is added to the first speed, and thus the individual fast break speed in handball is obtained.

Conditions:

A- A successful attempt is the one that ends with scoring on the goal without considering the accuracy of scoring.

B- Three attempts are given for each participant, and the fastest attempt is adopted.

C- The attempt is considered unsuccessful:

- 1- When receiving the ball in zone (A).
- 2- When the goalkeeper fails to deliver a correct pass.
- 3- When the participant fails to receive the ball.

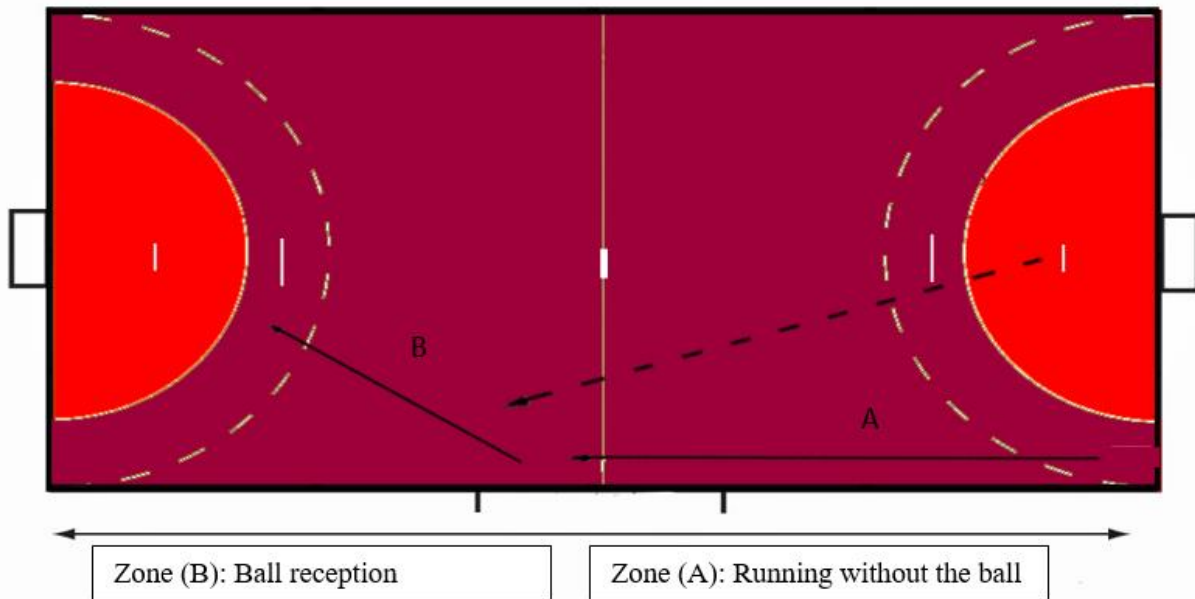


Figure (3) shows the individual fast break test in handball

Exploratory Experiment:

The exploratory experiment is considered one of the important matters, as it represents the situation through which the researcher can eliminate the negatives that may face him during the application of the tests, whether pre-tests or post-tests, or during conducting the main experiment, in order to avoid and overcome them. In addition, it ensures the validity of the tools and devices used in the research during the tests, identifies the surrounding conditions, and records various observations on the tests if any, as well as extracting the scientific bases of the tests. Therefore, the researcher, with the assistance of the supporting work team, conducted the exploratory experiment on a group of players numbering (5) players. The objectives of the experiment were as follows:

- 1- To identify the players' ability and the efficiency of the supporting work team in conducting the tests.
- 2- Practical training for the researcher and the supporting work team to identify the difficulties that may accompany the implementation of the tests in terms of requirements, tools, and devices, and to overcome them.
- 3- Preliminary identification of the time required for the tests used in the research.
- 4- To determine the suitability of the field for the tests.

Scientific bases of the tests:

It is considered one of the important and essential matters for conducting any research to apply the scientific bases of the tests, because using any test and applying it in the field on the research sample without the availability of several conditions according to the scientific bases of each test will not make it valid for measurement. The more evidence of these calculated characteristics that indicate its accuracy and its ability to measure what it was designed to measure, the more confidence can be placed in measuring the trait it was prepared for. Therefore, the efforts of those interested in measurement have focused on increasing the accuracy of the scientific bases that can be indicators of its precision in measuring what it was designed for and conducting the measurement process with the least possible errors. Measurement scientists have emphasized that validity and reliability are among the most important characteristics of measurement, as without them it is not possible to trust the ability of the tool to measure what it was designed to measure, nor the accuracy of the results obtained when using it" (Al-Khaikani, Al-Jubouri, 2016).

Validity:

Validity is considered one of the most important criteria of test quality, as it refers to the truth or the degree of accuracy with which the measurement tool measures the thing or phenomenon it was designed to measure. Validity does not mean the correlation of the test with itself as in reliability, but rather it means the correlation between the test and some external criteria that are independent of the test or the measurement tool (Jasim, 2019).

Reliability:

Reliability is considered one of the important factors that must be provided in the test due to its dependence on the consistency and accuracy of the results, without which the test results cannot be relied upon. The test must have high accuracy. "A test that is characterized by reliability is one that gives the same results if it is repeated on the same individuals under the same conditions. The test must be reliable in order to be valid, and a reliable test is the one that measures the intended skill consistently" (Mahmoud, 2011).

In order to ensure the reliability of the results that will be obtained from the tests, the researcher extracted reliability using the test-retest method by conducting the test on a sample of (8) handball players representing the research population, then reapplying the test after (7 days), taking into account the same conditions under which the first test was conducted. After that, the researcher used the simple correlation coefficient (Pearson) to determine the reliability of the tests, where the results should show high correlation coefficients through the significance values that will appear, which are less than the significance level (0.05). This confirms that the test has a high degree of reliability, as shown in Table (4).

Objectivity:

Objectivity is considered one of the important aspects that must be available in most scientific research. Although the tests in this research are clear and understandable, it is preferable to establish the objectivity of the tests, through which subjective judgment by evaluators is reduced and differences among them in evaluating the player's performance are minimized. "Objectivity

of the test means the absence of differences among evaluators in judging a particular thing or subject” (Bahi, Omran, 2007).

Therefore, objectivity for the results of the studied variables was calculated using the simple correlation coefficient (Pearson) between the scores of the first evaluator and the second evaluator. The results will be obtained as shown in Table (4), and the degree of objectivity is considered high the closer it is to (± 1).

Table (4) Shows the reliability and objectivity coefficients for the research variables

No	Variables	Reliability coefficient	sig	Objectivity coefficient	sig
1	Speed	0.898	0.000	0.899	0.000
2	Strength	0.901	0.000	0.902	0.000
3	Fast break	0.899	0.000	0.811	0.000

Pre-tests:

The researcher conducted the pre-tests on Friday, corresponding to 8/8/2025, for the most important physical attributes and fast break performance for the research sample in the Olympic Hall / Karbala Governorate. The researcher adopted appropriate conditions related to the tests in terms of place, time, tools used, method of implementation, and the assisting work team in order to ensure that the conditions are as similar as possible when conducting the post-tests. Before the field application of the tests, the researcher explained the tests in a detailed, clear, and understandable manner to the research sample, then applied the test to make it clearer for the sample. Before starting the test, the players were given an opportunity to warm up and avoid injuries that might occur as a result of the high effort exerted by the players. Then, the results were recorded according to a specific recording method for each test.

Main Experiment (Application of HIIT Training):

The researcher reviewed scientific sources, references, and previous studies related to the research topic, and HIIT training was prepared and organized based on scientific sources as well as the researcher’s experience in order for the training to be beneficial for the players and aimed at developing the most important physical attributes and fast break performance in handball for the players of the Sports Talent Center, raising the efficiency of the player and enabling him to give his best through improving the level of the research variables. The researcher ensured that the training is compatible with and similar to the conditions of a handball match. The training was applied as follows:

- 1- (24) HIIT training sessions were prepared, arranged from easy to difficult to reach the best readiness level for the player.
- 2- The exercises were given during the special preparation period and at the beginning of the main part of the training unit.
- 3- The exercises were distributed as (3) exercises per training unit.
- 4- The total time of the exercises ranged from (25–40) minutes within the training unit.
- 5- Consideration was given to the formation of the training load in terms of (intensity, volume, rest, density).
- 6- The training units were distributed as (3) units per week on (Friday, Monday, Wednesday).
- 7- The total number of training units was (24) units distributed over (8) weeks.
- 8- The control group followed the program prepared by the coach, which was applied on the same days as the experimental group training.

Post-tests:

After completing the application of HIIT training, the post-tests were conducted with the assistance of the supporting work team on Friday, corresponding to 10/10/2025, for the most important physical attributes and fast break performance in handball for the research sample in the Olympic Hall / Karbala Governorate, taking into account the same conditions under which the pre-tests were conducted.

Statistical Methods:

The researcher used the statistical package (SPSS) to analyze the results, relying on the following statistical methods:

- 1- Arithmetic mean.
- 2- Standard deviation.
- 3- Levene test.
- 4- (t) test for paired and independent samples.
- 5- Pearson simple correlation coefficient.
- 6- Chi-square.

Presentation, Analysis, and Discussion of Results:

This chapter includes the presentation, analysis, and discussion of the results obtained from the research sample after applying HIIT training to them, and then identifying its effect on the most important physical attributes and fast break performance in handball. Several results appeared, most of which were in favor of the experimental group that was affected by the independent variable. After the data were statistically processed and presented in tabular form to facilitate observing differences and comparing the results of the pre- and post-tests of physical, skill, and performance effectiveness for both research groups, as well as the differences between the two groups, they were then discussed in order to achieve the objectives of the research and test its hypotheses.

Presentation and Analysis of the Results of the Pre- and Post-tests for the Two Research Groups and Their Discussion:**Presentation of the results of the pre- and post-tests for the two research groups and their analysis:**

For the purpose of testing the first hypothesis, the researcher used the (T) test for paired samples to determine the significance of differences between the results of the pre- and post-tests for the two research groups, as shown in Tables (5, 6).

Table (5) Shows the arithmetic means, standard deviations, calculated (T) value, and the level and type of significance for the control group in the pre- and post-tests

Variables	Unit of measurement	Pre-test		Post-test		Calculated (T)value	Sig Level	Type of sig
		Mean	Standard deviation	Mean	Standard deviation			
Speed	Sec	2.733	0.272	2.656	0.269	9.228	0.000	sig
Strength	Sec	7.528	0.675	6.660	0.639	0.868-	0.121	sig
Fast break	Sec	6.21	0.09	7.01	0.17	9.57	0.000	sig

Table (5) shows the statistical indicators of the test results in the pre- and post-measurements of the research variables to which the individuals of the control group were subjected. The results showed that the values of the arithmetic means for all variables were better in the post-test than in the pre-test. The results indicated that the arithmetic means of the variables (speed, strength, fast break) were lower in the post-test than in the pre-test, and a significant difference occurred between the two tests in favor of the post-test, as the measurement is inverse, meaning that the lower the arithmetic mean, the better the level. This is indicated by the levels of significance,

which were less than the significance level (0.05), indicating the presence of significant differences between the two tests.

Table (6) Shows the arithmetic means, standard deviations, calculated (T) value, and the level and type of significance for the experimental group in the pre- and post-tests

Variables	Unit of measurement	Pre-test		Post-test		Calculated (T)value	Sig Level	Type of sig
		Mean	Standard deviation	Mean	Standard deviation			
Speed	Sec	2.768	0.244	2.198	0.164	5.537	0.001	sig
Strength	Sec	7.528	0.675	6.660	0.639	0.868-	0.121	sig
Fast break	Sec	6.25	0.12	7.48	0.33	8.93	0.000	sig

Table (6) shows the statistical indicators of the test results in the pre- and post-measurements of the research variables to which the individuals of the experimental group were subjected. The results showed that the values of the arithmetic means for all variables were better in the post-test than in the pre-test. The results indicated that the arithmetic means of the variables (speed, strength, fast break) were lower in the post-test than in the pre-test, and a significant difference occurred between the two tests in favor of the post-test, as the measurement is inverse, meaning that the lower the arithmetic mean, the better the level. This is indicated by the levels of significance, which were less than the significance level (0.05), indicating the presence of significant differences between the two tests.

Discussion of the Results of the Pre- and Post-tests for the Two Research Groups:

With regard to the control group, the development that occurred in the most important physical attributes and fast break performance resulted from the continuity of training with the use of training methods that support this, as well as training in an integrated manner that improves skill performance. In addition, the organization of these exercises and their application within the training units by qualified specialized coaches contributed to this development, as they worked on organizing training for the studied variables in line with the desired goal and the principle of progression from easy to difficult and from simple to complex. It is stated that “the principle of progression helps in coordinating and systematically linking the exercises used in the training unit with the gradual increase in their intensity and volume according to the level of the player in training” (Hussein, 1998). Also, continuity and regularity in structured training “lead to the development and improvement of skill, reaching correct tactics, automation in performance, and the ability to recognize and identify errors” (Mahjoub, 2001).

As for the experimental group, the development that occurred in the tests of the studied variables between the pre- and post-tests is attributed by the researcher to the adopted HIIT training, which works significantly on the most important physical attributes and fast break performance and depends on them simultaneously. The nature of the exercises used in the training units was similar to the studied dependent variables (somewhat similar to the movement paths), in addition to the intensity and volume used in the training program, as they were similar to and higher than those used in the actual performance of those attributes. It is stated that “specific exercises that resemble the movements of skill performance, using the same muscle groups and in the same

general direction of performance of the game, lead to reaching a high level” (Riyadh, 2000). Also, continuity in training “plays an important role in reaching a high level of skill performance in terms of technical execution, accuracy, integration, and stabilization of the high-level performance mechanism” (Mahmoud, 1994).

Furthermore, organized sports training leads to an increase in the efficiency of the functional systems, especially the nervous and muscular systems, which is directly reflected in the muscles’ ability to produce force with increased speed of muscular contraction, as “organized sports training leads to an increase in the efficiency of the functional systems, especially the nervous and muscular systems, and this is directly reflected in the muscles’ ability to produce force with increased speed of muscular contraction, all of which serves the effectiveness of performance” (Allawi@ Abdel Fattah, 1984). These prepared exercises also contributed to the development of the studied variables in a manner similar to performance, as (Droge, 2002) indicated that preparing the player in physical aspects, especially speed, helps the player to perform defensive skills effectively.

Presentation and analysis of the results of the post-tests for the two research groups and their discussion:

Presentation of the results of the post-tests for the two research groups and their analysis:

Table (7) Shows the arithmetic means, standard deviations, calculated (T) value, and the level and type of significance between the results of the post-tests for the two research groups

Variables	Unit of measurement	Control group		Experimental group		Calculated (T)value	Sig Level	Type of sig
		Mean	Standard deviation	Mean	Standard deviation			
Speed	Sec	2.656	0.269	2.198	0.164	4.101	0.001	sig
Strength	Sec	6.660	0.639	7.049	0.647	1.351	0.193	sig
Fast break	Sec	7.01	0.17	7.48	0.33	3.27	0.007	sig

Table (7) shows the arithmetic means, standard deviations, and the significance of differences between the results of the post-tests for the control and experimental groups. Upon reviewing the test results obtained, it is clear that there are significant differences between the post-test measurements in favor of the experimental group, as the values of the significance level were less than the error level (0.05), and this is consistent with what was stated in the second hypothesis of the research.

Discussion of the results of the post-test measurements for the two research groups:

The variables will be discussed as follows:

Speed:

The researcher attributes the improvement in the speed attribute to the application of HIIT training, with full emphasis and sufficient time allocated to selecting this type of training appropriate for serving both defensive and offensive tasks during training units. The success of defensive strategies is achieved through the effort exerted during defensive movements, which is the attribute that gave this superiority to the research sample. Handball is characterized by intense and continuous performance; therefore, rapid transition and movement indicate that the player must perform quickly while maintaining performance efficiency without a decline in level, resisting fatigue resulting from high intensity and prolonged duration within the anaerobic energy system.

Speed is considered a very important attribute to be developed because handball players perform continuous and successive skillful and physical movements at high intensity to maintain performance efficiency and capability. These exercises contributed to the development of transitional movement speed during the performance of motor skills, whether in defense or offense. The researcher also ensured that these exercises were performed in multiple directions with variation in movement, as this increases the player's ability to perform skills more effectively. Specialized training, as well as variation and transition in play from one situation to another, whether defensive or offensive, requires the player to possess a high level of speed. Specialists indicate that “handball is a game characterized by rapidly changing situations” (Dabour, 1996).

Accordingly, the researcher focused on HIIT training in developing the speed component. Thus, the exercises prepared by the researcher effectively contributed to improving different types of speed, as it is one of the fundamental factors for successful motor performance. This is supported by what experts stated: “the performance of skills or tactical duties occurs first cognitively and then physically, which leads to executing the task quickly in the shortest possible time.” Therefore, HIIT training, which integrates physical exercises with skill-based training, showed statistically significant differences because it “combines physical and skill abilities simultaneously during performance” (Hussein, 1998). Speed is also defined as “the ability to move or transition from one place to another at maximum possible speed, meaning overcoming a certain distance in the shortest possible time” (Rashid & Haidan, 2011).

Strength:

The researcher attributes the improvement in the strength attribute to the effectiveness of the exercises designed within the experimental program, which relied on strength training through muscular contractions, as well as the continuous training of the players, their commitment, and discipline in performing strength exercises according to correct performance and established scientific and practical training principles. Such training plays a significant role in developing this attribute in handball players.

The researcher also considered the principle of progression in training load components, including intensity, repetitions, and rest intervals, in addition to variation in exercises, which is of great importance and has high specificity in training. Research has shown that the neuromuscular system responds more effectively when it is stimulated in a continuously varied manner. The neuromuscular system needs to be challenged in order to adapt, which means performing different types of exercises over several days and varying the number of repetitions, intensity, and types of exercises from one day to another (Faraj, 2012).

The researcher also took into account, within the training program, the proper and integrated sequencing of training units by providing sufficient rest between sessions that involved maximal intensities, in order to prevent the player from becoming fatigued and to ensure that the nervous system remains in its optimal state. This also allows for the restoration of muscle energy stores. This is consistent with what was stated by (Faraj, 2012), who indicated that when performing maximal intensity exercises, the athlete requires between (36–48) hours of rest or low-intensity training before repeating such exercises. The reason for this is to restore the energy stores necessary for performing these exercises, which require maximal or near-maximal intensity, as well as to allow recovery of the central nervous system, which bears the greatest load during such training.

Moreover, organized sports training leads to an increase in the efficiency of functional systems, particularly the nervous and muscular systems. This is directly reflected in the muscles' ability to

produce force, along with an increase in the speed of muscular contraction (Allawi & Abdel-Fattah, 1984).

The researcher also attributes this improvement to the specific training exercises based on muscular contractions, which contributed to the development of the strength attribute examined in the study by enhancing the contraction force of the targeted muscle groups. This improvement resulted from the development of nervous system functions through increased intensity and volume of neural impulses, leading to changes in muscular performance through the recruitment of a greater number of motor units. This, in turn, led to an increase in the produced muscular force as well as an increase in the speed of muscular contractions.

This is consistent with what, citing Sale, stated: “the development of muscular strength is accompanied by several important functional adaptations, such as increased neural activity through the recruitment of the largest possible number of motor units, in addition to the synchronization of the contraction of these units and an increase in neural excitability within muscle fibers” (Al-Ramli, 1993). also confirmed that “the degree of muscular contraction increases as a result of increased stimulation of motor neurons, and this increase does not only involve the recruitment of new motor units, but also an increase in the frequency of neural impulses directed to smaller motor units” (Abdel-Fattah, 2000).

On the other hand, the strength training used by the researcher contributed to improving the efficiency of the nervous system, which is responsible for sending signals to the working muscles to act at the appropriate and precise time with a very high level of motor coordination. This means activating only the primary muscles responsible for the movement, without involving other muscles that do not contribute to the action, through coordination among the different muscle groups involved in the motor performance, as well as coordination among motor units within the same muscle.

This is supported by, citing Whitney and Smith, who stated that “increasing the strength of the muscles involved in a specific performance leads to executing that performance more quickly regardless of the type of strength training used, and that improving neuromuscular coordination increases the speed of specific movements because all the muscles involved in the task become better coordinated, thus enabling faster overcoming of external resistance (Helmy & Jaber, 1997).

It is also worth noting that the function of the nervous system is divided into two aspects: improving internal coordination among motor units within the same muscle, and improving external coordination among different muscles. Furthermore, the muscle must be prepared to perform such contractions in terms of its ability for rapid initiation or acceleration, which largely depends on coordination among motor units and neural reflexes within the muscle itself and among the working muscles. The ability of a muscle or group of muscles to contract at maximum speed, in addition to its capacity for relaxation and elasticity, is an important factor in achieving high speed and effective performance (Al-Sukari, 1993).

This is confirmed by, who stated that “coordination within and between muscles helps to increase movement speed, as when muscles work in a coordinated manner, their efforts combine to overcome external resistance more quickly (Helmy & Jaber, 1997).

The aim of most of the prescribed exercises is to increase muscular capacity through contraction and extension at different speed rates when performing successive movements. The greater the muscular strength, the more the handball player is able to control the movements performed at high speed, which allows for performing an effective movement, and this is reflected in the player’s performance of the required skills.

It is believed that each set of exercises should be designed in a way that provides an effective impact in developing the specific abilities related to the type of activity practiced (Abdel-Basir, 2000).

Fast Break:

The researcher attributes the improvement in fast attack performance to the fact that HIIT training for handball players develops their ability to perform high-intensity movements throughout the duration of the match. It is important to note that interval training is considered the most effective method for developing this ability. Based on this principle, handball players perform training that includes powerful and fast movements of high intensity (running, jumping, and side stepping) with high repetitions and relatively short rest periods, in addition to linking them with movements similar to actual gameplay. The best team is the one that performs at high intensity throughout the match, and the most physically fit player is the one capable of sprinting, jumping high, and shooting quickly throughout the match duration (Cardinale, 2006).

The researcher also attributes the improvement to the fact that successful attempts in applying some individual defensive skills often led to the defending team gaining possession of the ball, which increases the opportunity to implement a fast attack. Defense has a major advantage, as when a team successfully defends and gains possession of the ball, it first prevents the opponent from scoring and then initiates an attack to score against the opposing team. Thus, the use of individual defensive skills in an appropriate manner helps to significantly raise the level of performance during matches in terms of fast attack. This is consistent with what indicated: “Coaches should give greater importance to defense than offense, because when a team improves its defense and gains possession of the ball, it can attack with stability and speed, preventing the opponent from quickly returning and organizing their defensive formation” (Oreibi, 2004).

also confirmed that “when any defender gains possession of the ball, it marks the beginning of multiple attacking phases, which involve numerical superiority of attackers over defenders within a short period, requiring attackers to finish their attack as quickly as possible (fast attack) at the earliest opportunity before the defending team can compensate for the numerical deficit and organize appropriate defensive formations” (Ali, 1986).

This emphasizes the importance of effective defense and its investment in fast attack to score goals, as it has a direct impact on match outcomes. It also reflects the strong relationship between individual defensive skills and methods and their role in achieving quick and simple goals through fast attack before defenders return to their defensive positions and form their defensive structure. This is supported by, who stated that “the fast attack phase begins as soon as the defending team transitions into an attacking team, and at this moment the team that gains possession of the ball must think as quickly as possible about the means to reach the opponent’s goal in the shortest time and with the least effort” (Dabour, 1996), thereby achieving the research objectives.

The researcher believes that HIIT training contributes significantly to the development of sports activities in general and handball in particular, due to the demands of the game, which require the involvement of many muscle groups for extended periods and at high intensity in many situations. This, in turn, requires high efficiency of functional systems. In recent years, handball has witnessed significant development, and a team cannot reach a high level of performance and strong competition without continuous and intensive training based on modern scientific and physiological principles in order to keep pace with global development.

Conclusions:

- HIIT training contributes to the development of the most important physical attributes and the fast break in youth handball players.
- HIIT training contributes to the development of varied defensive and offensive movements in youth handball players.
- HIIT training has a better effect than conventional training methods in developing the most important physical attributes and the fast break in youth handball players.
- HIIT training showed superior effectiveness in the experimental group compared to the control group in developing the most important physical attributes and the fast break in youth handball players.

Recommendations:

- Greater attention should be given to HIIT training for youth handball players.
- Greater attention should be given to HIIT training for advanced levels and other age groups in handball.
- Greater attention should be given to HIIT training in other sports, especially basketball, volleyball, and football.
- HIIT training should be used to develop certain defensive and offensive skills.
- It is necessary to use HIIT training to develop the most important physical attributes and the fast break.
- Similar studies should be conducted on different levels of players to examine the effects of HIIT training on them and on other sports.

References:

- Abdel-Basir, A. (2000). *Biomechanical analysis of human body movements* (1st ed.). United Printing Center.
- Abdel-Fattah, A. A. (2000). *Biology of sport and athlete health*. Dar Al-Fikr Al-Arabi.
- Ali, I. H. (1986). *Phases of attack for Iraqi Premier League handball teams* (Master's thesis). University of Baghdad.
- Al-Khaikani, A. S., & Al-Jubouri, A. H. (2016). *Guide to writing theses and dissertations* (1st ed.). Dar Al-Diya.
- Al-Lami, H. A. (2007). *The effect of maximum speed training and creatine phosphate on developing some biochemical variables and individual fast break in handball* (Unpublished master's thesis). University of Al-Qadisiyah.
- Allawi, M. H., & Abdel-Fattah, A. A. (1984). *Physiology of sports training*. Dar Al-Fikr Al-Arabi.
- Al-Ramli, A. A. (1993). *Fencing (foil weapon)*. Dar Al-Fikr.
- Al-Sukari, A. (1993). *Fencing guide*. Alam Al-Maaref.
- Bahi, M., & Omran, S. (2007). *Tests and measurements in physical education* (1st ed.). Anglo Egyptian Library.
- Cardinale, M. (2006). *Performance in handball: Physiological considerations*. Scientific Sports Journal.
- Dabour, Y. M. H. (1996). *Modern handball*. Al-Maaref Establishment.
- Droge, W. (2002). *Free radicalism and physiological control of function*. American Physiological Society.
- Faraj, J. S. (2012). *Strength, power, and modern sports training* (1st ed.). Dar Dijla.
- Helmy, E., & Jaber, M. (1997). *Sports training: Principles, concepts, and trends*. Al-Maaref Establishment.

- Jassim, A. S. (2019). *The effect of anaerobic exercises, curcumin, and ginseng extract on some oxidative stress indicators and performance endurance in handball players* (Doctoral dissertation). University of Karbala.
- Mahjoub, W. (2001). *Learning and scheduling of training*. Dar Al-Awael.
- Mahmoud, H. (1994). *Football coach* (1st ed.). Dar Al-Fikr Al-Arabi.
- Oreibi Ouda, A. (2004). *Handball and its basic elements* (2nd ed.). Dar Al-Salam.
- Rashid, I. H., & Haidan, H. M. (2011). *Future trends in sports training*. Central Printing Press.
- Riyadh, O. (2000). *Sports medicine and handball*. Dar Al-Fikr Al-Arabi.
- Saleh, H. A. J. (2013). *The effect of special strength exercises using various methods on developing some types of speed and skills of youth handball players* (Doctoral dissertation). University of Babylon.
- Zuhl, M., & Kravitz, L. (2012). HIIT vs. continuous endurance training of the aerobic titans. *IDEA Fitness Journal*.