Modern Sport

Volume 25 | Issue 1 Article 9

3-30-2026

Effect of Transition and Fast-Break Training on Fatigue Delay, Blood Lactate Levels, and Offensive Skill Performance in Young Basketball Players

Omar Mohammed Majid Saud
College of Physical Education and Sport Sciences, University of Baghdad, omar.m.m@cope.uobaghdad.edu.iq

Recommended Citation
Saud, Omar Mohammed Majid (2026) "Effect of Transition and Fast-Break Training on Fatigue Delay, Blood Lactate Levels, and Offensive Skill Performance in Young Basketball Players," *Modern Sport*: Vol. 25: Iss. 1, Article 9.
DOI: https://doi.org/10.54702/2708-3454.2117

MODERN SPORT 2026;25:89–101

ORIGINAL STUDY

Effect of Transition and Fast-Break Training on Fatigue Delay, Blood Lactate Levels, and Offensive Skill Performance in Young Basketball Players

Omar Mohammed Majid Saud

College of Physical Education and Sport Sciences, University of Baghdad

Abstract

Basketball is defined as a high intensity sport which significantly depends on an anaerobic energy system, specifically its phosphagen and lactate components, especially during very fast transitions from the offensive phase to defensive failure and vice versa. These scenarios involve continuous accelerations/decelerations coupled with accurate actions under time constraints. The relevance of these requests is even higher for under-18 players, as they are at a special stage (against the above-mentioned physical and physiological development) directly affecting the capacity to resist fatigue and keep performance levels in the 2nd half during competition. This accumulation of lactic acid leads to an erosion in muscle strength, transition time and technical accuracy. The inclusion of ball transition and fast break type drills as part of training sessions is thought to be appropriate for improving anaerobic capacity, cardiorespiratory efficiency, basic offensive skills (dribbling, passing and shooting), lactic acid release/accumulation and delaying the appearance of metabolic shutdown (physiological fatigue). Research has also shown that this type of training lends itself to the production of concurrent gains in both physical and technical performance, thus aiding young players in generating and maintaining high levels of play at various moments in the game — particularly when it counts most on offense, and this achieves one of the sustainable development goals of the United Nations in Iraq which is (Good Health).

Keywords: Basketball, Anaerobic endurance, Ball transition, Fast break, Lactic acid, Physiological fatigue

1. Introduction

Basketball is a sport of high intensity that demands players execute simultaneous physical and technical actions in an environment with fast transitions from offensive to defensive situations, as well as between periods of high and low intensity of effort during the game (Abdel-Fattah, 2012). There is a heavy reliance on the anaerobic energy system in basketball, especially during short-intense periods of exercise i.e., dribble to transition and fast break play that required rapid decelerations and acceleration (Alghamdi, 2019).

These requirements are amplified among the younger than 18 years old players, since they find themselves in an important period of growth of their physical and technical abilities (Allawi & Abdel-Fattah, 2000). At this specific level, lactic tolerance and levels of physiological fitness largely determine the players' capacity to keep up their techniques over the full duration of the match in which they participate (particularly during the second period) (Al-Moussawi, 2015). From a physiological perspective, it has been suggested that fatigue is associated with the accumulation of lactic acid in muscles, which leads to reduction of the explosive muscular power, reduced speed in motor response and loss of dynamic balance between velocity and accuracy when performing offensive technical skills (Maggioni et al., 2019).

Ball transition and fast-break drill workouts are new training methods that concentrate on replicating actual game conditions. These exercises are progressively arranged in order to improve speed-strength, anaerobic endurance, cardiorespiratory endurance and to develop technically such skills as dribbling,

Received 23 January 2026; revised 25 February 2026; accepted 26 February 2026.
Available online 30 March 2026

E-mail address: omar.m.m@cope.uobaghdad.edu.iq (O. M. M. Saud).

https://doi.org/10.54702/2708-3454.2117

passing, shooting and receiving the ball under time constraints. Evidence has shown that when using this type of training in basketball programs (Chamari et al., 2018), there is a positive influence on physical performance and technical execution as the same can effectively improve markers of resistance and delay the appearance of perceptible fatigue, attenuating indecision in lactic acid production during high intensity actions or after them (Sánchez-Pay, 2021).

For instance, Maggioni et al. (2019) reported that RSP programs combined with ball-specific drills produced increases in basketball fitness and technical performance. Furthermore, these treatments induced reduced post-exercise lactic acid concentrations after repeated high intense efforts, which indicates an increased resistance to fatigue during short and intense recovery periods. Substantial increases in dribbling, passing, defensive rebounding and offensive transition skills were also documented following eight weeks of structured practice in the investigation (Maggioni et al., 2019).

Furthermore, Arab sports science has also established that the employment of special exercises based on training of anaerobic energy, plays a role in fostering the formation and development of physiological indices amongst players at an early age through stimulating the body's adaptive mechanisms to repeated muscular effort, thereby delaying accumulation of chemical fatigue contaminants within muscles. This finding was established based on the lower lactic acid values pre-test compared to post-test among subjects in an experimental training program (Alghamdi, 2019).

According to the aforementioned considerations, it is necessary that sports training programmes for players younger than 18 made games become a tool of special significance in which structured situations of a predictable nature are deliberately created based on specific competition demands, thus facing real competition-related problems (Hussein, 2004). This is an attempt to optimise both improved physiological fitness and delayed fatigue development, and better attacking skill performance. This piece of science enables players to continue performing at an elite level throughout the full duration of a game, whether it's clinching the match or just maintaining accuracy during key plays.

Accordingly, the present study aimed to:

1. Identify the effect of ball transition and fast-break exercises on delaying the fatigue index and improving selected offensive skills in basketball players under 18 years of age.
2. Determine the effect of ball transition and fast-break exercises on lactic acid levels and the performance of selected offensive skills in basketball players under 18 years of age.

The researcher also hypothesized that:

1. There are statistically significant differences between pre-test and post-test results in delaying the fatigue index and reducing lactic acid levels.
2. There are statistically significant differences between pre-test and post-test results in the performance of selected offensive skills among basketball players under 18 years of age.

1.1. Research problem

Basketball is a sport that demands a high level of physical and technical performance, with players alternating between periods of high and low exertion throughout a game. Despite significant advancements in training strategies, many players under 18 years of age face a real challenge: a lack of physical endurance during matches, leading to a decline in skill performance at crucial moments. A major contributing factor to this decline is the accumulation of lactic acid in the muscles due to intense physical exertion. This leads to premature fatigue and increased recovery time between periods of exertion, reducing players' ability to execute offensive skills such as passing, shooting, and dribbling under pressure (Maggioni et al., 2019).

Thus, the problem of the study is to improve the known weakness of under-18 basketball players' resistance to bring about fatigue caused by lactic acid build-up during games and performance of offensive technical skill. Accordingly, the purpose of this study is to investigate the impact of ball transition and fast break drills on enhancing physical endurance and delaying fatigue as well as experiencing significant improvements in offensive skill performance (Passing, dribbling, shooting kicks under pressure). There are important implications of this research in terms of designing training programmes that improve players' ability to sustain high intensity efforts repeatedly throughout a match.

2. Methodology

The researcher used a single-group experimental design, as it was suitable for the nature of the research problem. The experimental method is one of the approaches that helps solve many problems related to sports and educational research in a scientifically accurate manner, especially in the field of physical education, where it allows for examining the effect of training exercises on improving physical and technical performance. This method allows for the objective

Table 1. Anthropometric measurements of the research sample.

Measurement	Mean	Standard Deviation	Skewness	Median
Height (cm)	176.00	5.50	−0.15	176
Weight (kg)	72.00	6.00	−0.25	72
Age (years)	16.00	1.20	0.05	16
Training Age (years)	2.50	1.00	0.30	2.0

measurement of the effect of variables such as physical training or tactical training through comparison between single groups (Ali, 2019). Furthermore, the single-group design ensures the balance of differences and this enhances the reliability of the results as shown in Table 1.

2.1. Research population

The study sample included the members of the players in Al-Adhamiya Basketball Club, they were 12 players. The sample comprised underage players who have an age-limiting factor and was a crucial stage of development for significant physical and skill improvements. At this years age, they start taking more advantage of improving relevant physical quality during the competition. This period is often viewed as an opportune time for enhancing sport-related motor skills, such as those for basketball because of the requirement to achieve precision and coordination in controlling the ball during swift offensive and defensive movements performed during play.

2.2. Research sample

Sampling procedure The sample of the study was purposive one; it included 12 basketball players representing Al-Adhamiya Basketball Club in Maysan governorate for the sport season 2024–2025.

2.3. Instruments and tools used in the research

Data Collection Methods
Research Tools

1. Basketball court.
2. Stopwatch.
3. Basketballs (25).
4. Measuring tapes (2).
5. Whistles (4).

2.4. Research equipment

A set of sports and physiological devices was used during the study to assess the physical and technical variables of the participants. The equipment included the following:

1. **Height Measurement Device (Stadiometer):**
   – Utilised to directly record the height of all players. Stature measurement is an essential anthropometric index for evaluation of overall body build of players.
2. **Weight Measurement Device (Digital Weighing Scale):**
   – High Accuracy Used to measure weight with precision easy. Body weight is a significant variable for examination of body composition such as fat mass and muscle mass.
3. **Blood Lactate Analyzer (Lactate Analyzer):**
   – An instrument for blood lactate measurement in connection with physical activity. This apparatus helps assess the lactic acid accumulation post high intensity exercise.
   – Brand example: Parvo Medics TrueOne 2400.
4. **High-Definition Video Camera:**
   – For measuring technical skills such as dribbling, passing and shooting to analyze speed of execution and accuracy of motor skills.

2.5. Data collection

1. Arabic and foreign scientific references.
2. Physical and skill-based tests.

2.6. Tests used in the research

First: Fatigue Index and Maximum Anaerobic Power Test

Anaerobic Sprint Test Using the Power Formula (Fatigue Index Test)

Purpose of the Test:

This test is used to assess anaerobic power and fatigue index. It is possible to determine multiple variables, including peak power, minimum power, mean anaerobic ppower and the fatigue index.

Test Requirements:

An indoor hall, two markers (cones), a stopwatch, two assistants, a standardized recording sheet, and a whistle.

Test Description:

It is a protocol of 6 all-out sprints of 35 m with 10 seconds rest between running. The assistant-I measures and records the body mass of athlete. The athlete replicates a standardized warm up for 10 minutes. A line is delineated by cones and is straight 35 meters. Each assistant has a stopwatch.

The athlete performs six maximal 35 m sprints with 10–sec rest:

The athlete begins in a standing position once the whistle is blown. The first assistant measures the time of the 35m sprint by stopping a stopwatch when the athlete's upper body passes through the finish line, and records this time. The 10 second recovery interval

is also kept track of by the first assistant. The second assistant times each force application over 10 s, and signals the runner to sprint after the rest of 10-s period. This reverse stagger continues until all 6 have been performed.

Calculation Method:

The athlete's body mass (kg) and the recorded times for each of the six 35-meter sprints are entered into a specific equation to calculate anaerobic power.

From the six repetitions, the calculated power values reflect each athlete's level of anaerobic fitness and are represented by the following variables:

- **Maximum Anaerobic Power:** The calculated value corresponding to the fastest 35-meter sprint time.
- **Minimum Anaerobic Power:** The calculated value corresponding to the slowest 35-meter sprint time.

Fatigue Index:

Fatigue Index = (Highest Power Value − Lowest Power Value) ÷ Total time of the six sprints.

The fatigue index reflects the rate of decline in anaerobic power during repeated efforts; the lower the value, the higher the athlete's anaerobic efficiency.

- **Mean Anaerobic Power:** The sum of the power values from the six repetitions divided by six.

A fatigue index value of **10 W·s^{-1} or higher** indicates a need for further development of the athlete's anaerobic capacity.

Receiving and High Dribbling Ending with a Two-Handed Chest Pass Test

Purpose of the Test:

To measure the player's ability to receive the ball, perform high dribbling, and execute a two-handed chest pass accurately.

Required Equipment:

A basketball court, two markers, two accuracy-measuring targets, four official basketballs, a 20-meter leather measuring tape, adhesive tape, an electronic stopwatch, three chairs, and a whistle.

Test Procedures:

- A central reference point is marked beneath the basket and used to determine key measurement points.
- Two accuracy-measuring targets are positioned laterally at a distance of 8 meters from the central point and 1.50 meters from the sideline, facing the first volleyball court line beyond the midcourt area.
- A volleyball court layout is marked within the basketball court.
- Two additional points are marked directly behind the line: the first at a distance of 3 meters from the first volleyball court line, and the second at a distance of 9 meters from the center line. These points represent the first and second standing positions of the tested player.
- At each of these positions, a member of the research team stands at a distance of 4.60 meters from the tested player, holding a basketball at each point (*).
- Two markers are placed on the first line of the volleyball court beyond the center line, aligned along both sides of the center circle, representing the permitted boundaries for task execution.

2.7. Performance description

- The tested player stands at the first designated point located at the center and marked behind the midcourt line. Simultaneously, a member of the research team stands to the player's left side holding a basketball.
- Upon the start signal (whistle), the research team member at the first point delivers the ball to the tested player using a two-handed chest pass. The player immediately performs ball reception followed by high dribbling toward the first volleyball court line beyond the midcourt line, then executes a two-handed chest pass toward the accuracy-measuring devices alternately. The player then sprints back to the same point to repeat the attempt and subsequently sprints to the second point to perform the same sequence twice.
- The four attempts are divided into two attempts starting from the first point toward the first volleyball court line beyond the midcourt line, as described in step (1), and two attempts starting from the second point toward the same line, as described in step (2).
- Speed of execution is emphasized, and the tested player is verbally guided (prompted) to perform the four attempts from their designated positions. The tested player is allowed to cross the first volleyball court line beyond the midcourt line after executing the two-handed chest pass, provided that execution remains within the area defined by the two markers. Each player is permitted only two incorrect attempts. We observe from the Fig. 1.

2.7.1. Test administration

- **Timer:** Responsible for giving the start signal and recording the total time required to complete the test.

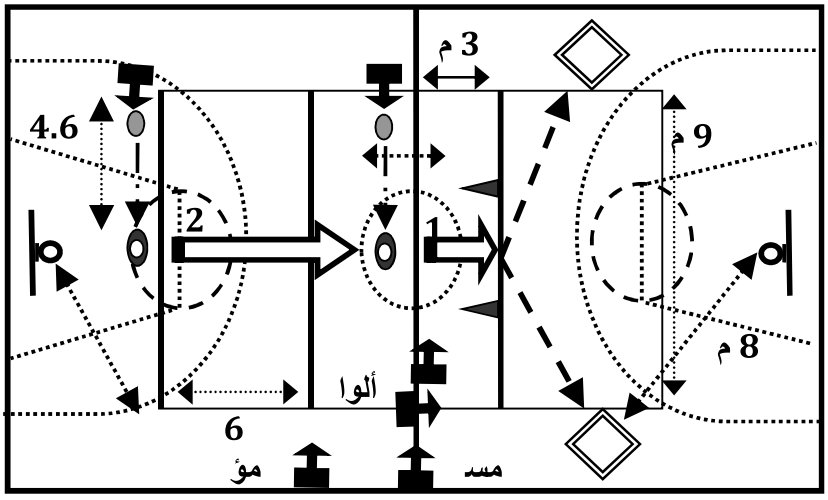

Fig. 1. Composite offensive skill tests – receiving and high dribbling ending with a two-handed chest pass.

- **Caller:** A member of the research team calls out the colors corresponding to the four attempts on the accuracy-measuring devices.
- **Recorder:** Calls out the players' names and records both the colors achieved and the time.

2.7.2. Scoring method

- Time is calculated from the moment the tested player receives the ball until the completion of the fourth attempt, after the ball makes contact with the net of the accuracy-measuring device.
- The recorded time is converted into seconds (60 s) (*).
- Scoring is awarded as follows: 3 points for the red color, 2 points for the blue color, and 1 point for the green color.
- Mixed-color scores are calculated as follows (**):
  - Four mixed squares: (sum ÷ 4).
  - Red and blue: 2.5 points (sum ÷ 2).
  - Blue and green: 1.5 points (sum ÷ 2).
  - Half blue: 1 point.
  - Half green: 0.5 points.
  - Half blue and half green: 0.75 points (sum ÷ 2).
- **Final Score:** The total accuracy score is divided by the total execution time.

2.8. Pilot study

The pilot study is an important tool in the research process as it enables investigators to identify potential flaws and set things right before commencing with the actual main study. Based upon observation data, the researcher has a way to make course corrections and thereby enhance both validity and reliability of findings, as well as methodological grip.

Pilot Study A sample of 12 players was tested in the pilot study on January 12, 2025. The aims of the pilot study were:

1. Verifying the accuracy and suitability of the data collection instruments for the studied variables.
2. Ensuring that the selected research methodology is appropriate for effective data collection and analysis.
3. Identifying factors that may influence the main experiment and ensuring appropriate control during implementation.
4. Improving procedures by refining the methodology and practical steps based on preliminary observations.
5. Identifying any problems or difficulties that the researcher may encounter during the main experiment.

2.9. Pre-test

The pre-test is a basic process to test the response of the reference sample submitted for measurement with respect to the indicated tests, making it possible to avoid wasting time and money. With the pre-test we make sure that in the main research the target population completely understands implements the tests.

The prescreening test took place on Wednesday, January 15, 2025 at 4:00 PM.

2.10. Training program

2.10.1. General objective of the training program

The purpose of the training program was to contribute improvement on ball transition and fast break skills in U-18 basketball players, by delaying the

fatigue index and decreasing lactic acid accumulation to improve offesinve performance. The program was created and implemented by the course of 8 weeks assembles for practice, with parts divided into 24 training units within three sessions a week. The program focused on training designed to develop fitter and more resilient athletes with a focus on the performance of offensive skills.

2.11. Structure of the training program

Total duration of the training program: 8 weeks
Total number of training units: 24 training units (3 units per week)

2.11.1. Week one

Training Unit 1:

- **Objective:** Improve ball transition and fast-break performance.
- **Training Content:** Advanced drills focusing on ball dribbling and rapid transitions between offense and defense.
- **Specific Objective:** Increase the ability to move the ball quickly without time loss.
- **Details:** Individual drills including speed dribbling and movement between players during offensive play.

Training Unit 2:

- **Objective:** Develop physical endurance and delay the onset of fatigue.
- **Training Content:** Intermittent running exercises with short recovery periods to stimulate cardiorespiratory endurance.
- **Details:** Progressive repetition of running at varying speeds to reduce the negative effects of fatigue on performance.

Training Unit 3:

- **Objective:** Improve selected offensive skills such as shooting and rapid passing.
- **Training Content:** Shooting drills from various distances during fast-break situations.
- **Details:** Enhancing shooting performance in dynamic game-like situations with an emphasis on rapid ball movement.

2.11.2. Week two

Training Unit 4:

- **Objective:** Improve rapid response during offensive and defensive transitions.
- **Training Content:** Fast-break drills following ball recovery from the opponent.
- **Details:** Training players to transition from defense to offense within three seconds.

Training Unit 5:

- **Objective:** Develop fast dribbling techniques to escape defensive pressure.
- **Training Content:** Speed dribbling drills combined with rapid ball movement exercises.
- **Details:** Enhancing ball control under pressure and increasing movement speed.

Training Unit 6:

- **Objective:** Improve ball control during transitions between offense and defense.
- **Training Content:** Fast-break drills incorporating quick passes and changes of direction.
- **Details:** Increasing transition speed from defensive to offensive situations while maintaining passing accuracy.

2.11.3. Week three

Training Unit 7:

- **Objective:** Improve shooting performance under pressure during fast-break situations.
- **Training Content:** Shooting drills performed under defensive pressure and following high-speed running.
- **Details:** Enhancing shooting accuracy in situations requiring both speed and precision.

Training Unit 8:

- **Objective:** Improve tolerance to physical exertion and delay the fatigue index and lactic acid accumulation.
- **Training Content:** Endurance-focused drills with short recovery intervals.
- **Details:** Repeated running drills over specified distances with rapid stops to facilitate lactic acid clearance.

Training Unit 9:

- **Objective:** Enhance rapid shooting skills while maintaining efficiency under pressure.
- **Training Content:** Shooting and fast-break drills that optimize offensive opportunities.
- **Details:** Emphasis on improving long-range shooting performance.

2.11.4. Week four

Training Unit 10:

- **Objective:** Improve flexibility and agility.
- **Training Content:** Rapid non-linear movement drills incorporating dribbling.

- **Details:** Exercises designed to enhance rapid response and ball control.

Training Unit 11:

- **Objective:** Improve the speed of ball movement during fast-break play.
- **Training Content:** On-court drills emphasizing rapid shooting and accelerated execution.
- **Details:** Short-distance drills aimed at increasing speed and fast-break efficiency.

Training Unit 12:

- **Objective:** Improve offensive performance while maintaining physical capacity under lactic acid stress.
- **Training Content:** Offensive drills involving shooting while in motion.
- **Details:** Reducing the impact of fatigue on players during fast-break execution.

2.11.5. Weeks five to eight

The training phase was followed by more challenging exercises to enhance stamina (resistance to fatigue after high intensity effort). Intermittent running plays, rapid passing actions and evolved fast-break skills were integrated into small-sided games (scrimmages). The emphasis was on increasing ball control, quick shooting execution and lactic acid reduction in muscles.

2.12. Post-tests

The post-test is a primary evaluation that takes place at the end of all training and speaks to how well the established goals or outcomes for the training were met.

- Following the implementation of the training units, post-tests were conducted on the research sample on **Sunday, March 16, 2025**.
- The post-tests were administered under the same conditions as the pre-tests in terms of timing, equipment, and testing location to ensure consistency and accuracy when evaluating the effects of the training program.

2.13. Statistical methods

Methods of collection and analysis are research methods that the researcher uses to filter information into a few single points that can be inferred about the entire population from where an individual sample was taken. The researcher adopted the Statistical Package for Social Sciences (SPSS) coupled with various statistical methods to analyze the research data and generate useful findings, such as:

1. **Arithmetic Mean:** To calculate the overall average and determine central tendency.
2. **Standard Deviation:** To assess data dispersion and variability around the mean.
3. **Paired Samples t-Test:** To examine differences between pre-test and post-test measurements for the same sample.

3. Results

3.1. Discussion

In light of the statistical analysis results, which showed statistically significant differences between the pre- and post-tests in lactic acid levels ($t = 53.7$, $Sig = 0.000$), it can be concluded that the training program based on ball-handling and fast-paced attacking drills had a clear physiological effect on the muscular and energy systems of the experimental group. The high t-test value with a very low significance level indicates that the improvement was not random but rather a result of a genuine effect of the training program.

Physiologically, lactic acid is a natural byproduct of anaerobic glycolysis, and its concentration increases with high-intensity exercise and insufficient oxygen supply. Therefore, the decrease in its accumulation after training reflects an improvement in the efficiency of energy production systems, whether through enhanced aerobic function or increased muscle capacity to process anaerobic metabolic byproducts. High-intensity interval training (HIIT) contributes to raising the lactate threshold, the point at which lactate begins to accumulate rapidly in the blood, allowing athletes to perform at higher intensity before reaching fatigue. These results are shown in the Table 2.

This improvement can also be explained by increased oxidative enzyme activity within the mitochondria, increased mitochondrial density, and improved oxygen transport efficiency through increased heart rate and enhanced blood flow to working muscles. These adaptations lead to a greater reliance on the aerobic system during repeated exertion, thus reducing over-reliance on rapid lactate-producing anaerobic breakdown. Powers and Howley (2018) indicated that regular, high-intensity training improves the body's ability to clear lactate and reuse it as an energy source, rather than allowing it to accumulate within muscle fibers. These results are shown in the Table 3.

Furthermore, the intermittent and variable-intensity nature of ball-handling and fast-paced drills aligns with the performance demands of basketball.

Table 2. Arithmetic means, standard deviations, calculated t-values, and significance of differences for the experimental group in the pre-test and post-test results of the fatigue index test.

Variable	Pre-Test Mean	Pre-Test SD	Post-Test Mean	Post-Test SD	Mean Difference	SD of Difference	Significance
Mean time of first repetition	4.4800	0.07000	2.4300	0.09000	2.0500	0.15000	0.000
Mean time of second repetition	4.5200	0.08000	2.3000	0.08500	2.2200	0.17500	0.000
Mean time of third repetition	5.1100	0.02500	3.1100	0.03500	2.0000	0.04000	0.000
Mean time of fourth repetition	5.1800	0.03000	3.1900	0.02500	1.9900	0.03700	0.000
Mean time of fifth repetition	5.2700	0.02800	3.1200	0.04500	2.1500	0.05500	0.000
Mean time of sixth repetition	5.4400	0.03200	3.4700	0.06000	1.9700	0.07000	0.000

Note: *t*-values are statistically significant at $\mathbf{p \leq 0.05}$.

Table 3. Arithmetic means, standard deviations, calculated t-value, and significance of differences for the experimental group in the pre-test and post-test results of the blood lactate test.

Variable	Mean	Standard Deviation	Mean Difference	SD of Difference	Calculated *t*	Sig. (p)	Significance
Blood Lactate (Pre-Test)	7.6667	.65134	4.16667	1.52753	9.449	0.000	Significant
Blood Lactate (Post-Test)	3.5000	1.16775					

Note: The differences between pre-test and post-test measurements are statistically significant at $p \leq 0.05$.

This type of training enhances neuromuscular adaptation, improves the efficiency of fast-moving motor units, and increases the muscles' resistance to acidosis caused by the accumulation of hydrogen ions associated with lactic acid production. It also improves the membrane transport systems for lactic acid (MCT1 and MCT4), accelerating its excretion or recycling within the body.

In practical terms, reduced lactic acid accumulation means a delayed onset of muscle fatigue and improved ability to sustain high-intensity exertion during a match, particularly during rapid transitions from defense to attack. This aligns with the findings of Gibala et al. (2012) regarding the effectiveness of high-intensity interval training (HIIT) in improving metabolic adaptations and increasing fatigue resistance. Furthermore, a study by Helgerud et al. (2007) demonstrated that HIIT improves aerobic efficiency and reduces blood lactate concentration at the same intensity level, reflecting an improvement in the economy of physical exertion. Therefore, it can be concluded that the training program based on ball transfer and fast attack exercises has effectively contributed to improving the biochemical indicators related to performance, especially reducing lactic acid buildup after exertion, which positively impacts the endurance of technical and tactical performance in basketball, and enhances the players' ability to maintain a high level of physical efficiency throughout the game.

4. Discussion

The results of the statistical tests showed maximum effect in mean time ($t = 2.0500$, $sig = 0.0000$) of the first repetition which decreases from (4.4800 ± 0.07000) to and lower one of mashing by a fraction due to first repitition with help of this proposed technique is calculated as (2.4300 ± 0.09000). This suggests that ball transition and fast-break drills significantly shortened the time to complete the first trial of the test.

Ball transition and fast-break drills were significant contributed to elevate their ability of endurance except rich execution speed under multiple training, which was demonstrated in basketball game aspects. This effect of the exercises was replicated across all repetitions, indicating that the training program is effective in delaying fatigue and improving offensive skill performance. These results are shown in the Table 4.

This enhancement suggests an improved ability of the players to perform movements faster and more accurately. This improvement can be accounted for by the specificity of ball transition and 3-transition exercises that modifies the ability to transit fast between game situations and also develop the ability to recovery speed after fatigue. Furthermore, such exercises help anaerobic endurance development during short recovery periods between repetitions (as part of a compound skill), also resulting in less time needed to perform each repetition of the skill. These results are shown in the Table 4.

Furthermore, it must be emphasized that what was observed as a decrease in the duration of time to reach hospital reflects an evident gain in terms of efficiency from the anaerobic energy system, where athletes start being able to utilize energy more and better. According to (Powers & Howley, 2018) fast-breaking actions can increase anaerobic metabolic efficiency which in turn improves movement speed.

Inter-individual statistical analysis also revealed improvements in the mean time of the following

Table 4. Arithmetic means, standard deviations, calculated t-value, and significance of differences for the experimental group in the pre-test and post-test results of the receiving and high dribbling ending with a two-handed chest pass test.

Variable	N	Mean	SD	Mean Difference	SD of Difference	Calculated *t*	Sig. (p)	Significance
Receiving and High Dribbling Ending with a Two-Handed Chest Pass (Pre-Test)	12	13.0	0.53	5.5	0.51	39.2	0.000	Significant
Receiving and High Dribbling Ending with a Two-Handed Chest Pass (Post-Test)	12	18.5	0.53					

Note: Differences are statistically significant at $p \leq 0.05$.

repetitions as execution time exponentially decreased. This demonstrates the value of ball transition and fast-break drills to improve repeatability of performance at maximal efficiency.

In the second repetition, for example, the mean time reduced from 4.5200 (±0.08000) to 2.3000 (±0.08500), accompanied by a computed t-value of 2.2200 with significance level at (sig = 0.0000). There was also a trend for the rest of the repetitions to get faster, however all other repetitions were significantly faster.

This change suggests an increase in general physical performance and recover faster after extreme exertion. These findings suggest an enhanced ability of players to preserve speed-of-movement and offensive skills throughout the 2013 shift, which is crucial for basketball, a game characterized by intermittent high velocity attacks interspersed with other specific activities.

It is however important to note that this enhancement indicates that training contributed to less fatigue causing the players to be able better tolerate anaerobic load and tolerance lactic acid build-up as result of continuous exercising making the maintenance of performance quite high by not increasing much in fatigue. These results were in agreement with that of Gibala et al. (2012), who also showed that short-term sprint training enhances the performers ability to make rapid and repeated movements for a prolonged period.

Statistical analysis confirmed also significant improvements in fifth and sixth repetition, with a highly reduction in their to be executed time. This indicates an improved capacity to sustain high speed also in late running. For example in the 5th repetition, there was a reduction in mean time from 5.2700 (±02800) to 3.1200 (±04500), with t-value of 2.1500 and (sig =.0000). In the sixth repetition, a similar decline in time was observed (from 5.4400 ± 0.03200 to 3.4700 ± 0.06000; t = 1.9700, sig = 0.000).

This change is indicative of players being able to adapt and tolerate ongoing physical stress, where the ability to maintain speed execution later in a sequence has been reported as one of the strongest mediators of player efficiency during longer more physically taxing matches. Such improvement could be due, above all, to the physiological adaptation produced by continuous exertion; players may learnt to clear the lactic acid more quickly and to switch more easily to aerobic energy system. Powers and Howley (2018) stressed that high-intensity training trains athletes' means of controlling anaerobic metabolism and to allow the return to aerobic energy systems after intense periods of effort.

Moreover, the results of statistical analysis showed significant difference between pre-test and post test blood lactate level. The t-value computed was 53.7 and its significance value (Sig = 0.000) that indicates difference between both the tests has been found significant in favour of post-test. This result implies that ball transition and fast-break drill resulted in decreasing of lactic acid concentration after the exercise session.

The affect of such exercises in reducing muscular lactate after work is obvious. It is generally known that lactic acid is produced in the muscles during anaerobic training and when there is not enough oxygen to supply the energy needs during hard efforts. It builds up, leading to the feelings of fatigue and weakness that inhibit an athlete's ability to perform adequately.

The application of the high-intensity interval training can be seen to have had a positive effect with regards to reducing this accumulation. The mean lactate level also fell from 1.08 in pre-test to 8.06 in post-test, indicating that the training program raised the body's efficiency in eliminating anaerobic metabolism and muscular acidity after exercise.

From the point of view of the body physiology, this improvement may be explained by the possibility to train higher and higher depending on aerobic energy production with less development of lactate by-products. High-intensity interval training with ball transition and fast-break tasks help to enhance the economy of aerobic metabolism, as well as increase muscular tolerance to anaerobic energetic conditions.

Furthermore, this kind of training improves anaerobic endurance that allows competitors to work at a higher level for longer before the build-up of lactic acid becomes intolerable which in turn reduces feelings of tiredness and fatigue towards the end of

competition. Powers and Howley (2018) supported that high intensity training mitigates lactate accumulation and enhances the aerobic energy system.

Furthermore, the increase in lactate index score is also an indication of the effectiveness provided by training program concerning to players' adaptation to continuous and hard physical efforts. This is all the more significant in sports like basketball where quick transitions and fast attacks are key.

According to these findings, it can be inferred that ball transition and fast-break drills largely enhanced players' capability of repeated actions throughout competition without a premature fatigue caused by lactic acid deposition. This training also enables players to keep up their performance during the whole match, also in later stages.

These are similar to what has been reported by Gibala et al. (2012) who agreed that ball transition and fast break drills increase the body's lactic acid tolerance, retaining in turn the anaerobic endurance for better overall performance. Similarly, Helgerud et al. (2007) also found that high-intensity interval training decreases blood lactate concentration, and enhances both the tolerance to and utilization of high-anaerobic exercise.

Through the statistical analysis it was also shown a significant difference in the indices of performance of the receiving and high dribbling finishing with two-handed chest pass, from pre-test to post-test, proving the effectiveness of training exercises performed. The researcher is of the opinion that these improvements may be credited to the training intervention with its apparent influence on ball control, accurate reception and dribbling as well as faster executive speed together with chest pass performance. This is interesting, since it indicates a marked progression in neuromuscular coordination and that high intensity interval training enhances the muscular efficiency during complex movement patterns.

The Receiving Skill and Dribbling Task, The high dribble with chest two handed pass to the partner during receiving is considered as one of basic skills that requires accurate ball handling and the level of motor coordination between lower body- upper body. This skill is performed under high physical stress and relies on muscle groups of the upper body, for example, shoulders, pectoral muscles and arms.

High-intensity interval training has been shown to enhance neuromuscular coordination and the athlete's ability to execute movements in a high-intensity (dribbling and receiving) fashion (Powers & Howley, 2018). Thus the performance improvement can be attributed to better between the nervous system and the major muscles that perform these functions.

To this we must also add that ball control and high dribble improvement is closely related to increased muscular tolerance and better coordination to movement (complexities) while performing them at high speeds. This increase is signal that this new kind of aerobic exercise could increase muscular economies and might affect force production or motor control.

The increase in the average performance score from 13.0 to 18.5 revealed that experimental group exercises based on interval training were effective for enhancement of physical performance levels and therefore served to encourage players who execute movements with speed and precision in competitive game situations.

The findings from the current study support previous work, as also high-intensity interval training significantly affects enhancement of athletes' ability to perform repeated motor skills. Gibala et al. that HIIT enhances the athletes' endurance capacity and technical performance in complex actions, such as receiving and dribbling were documented Similarly, Helgerud et al. (2007) observed players undertaking high-intensity training display better levels of neuromuscular coordination which can lead to improved team sport performance, and specifically basketball performance.

Catch and throw require the synchronized action of arms, shoulders, and upper-body musculature, while these skills are coordinated with the neuromuscular control of signals from the brain to the muscles. This serves to increase the speed of response to the ball and lower the time required for execution. Repeated practice-based training also enhances the ability to produce fast movements in an economic manner, and stimulates muscle flexibility and motor coordination.

5. Conclusions

1. Findings indicated that sprint and fast break trainings have significant effect on physical performance of basketball players in terms of such changes observed in the endurance capacity, speed and agile movement as well as enhanced quick reaction between offensive move and defensive response.
2. Post-test findings indicated that training exercises based on fast-break play and ball transition were effective in delaying the onset of fatigue and reducing blood lactate levels among players. A clear reduction in blood lactate concentration was observed compared with pre-training levels.
3. The training program contributed to improvements in offensive skills such as shooting, passing, and dribbling under pressure. Players were able to enhance both speed and accuracy in

executing offensive actions, thereby increasing their effectiveness during matches.
4. The results revealed improvements in cardiorespiratory endurance as a result of the specialized training program, which enabled players to maintain high performance levels throughout the duration of matches without being adversely affected by fatigue or performance decline.
5. The research supports the idea that a quick transition from offense to defense is an important aspect of playing basketball. The practical tasks caused a significant improvement in the players to adapt rapidly from attacking situation to defensive postures whist maintaining a good technique.

6. Recommendations

1. It is suggested that such exercises, which involve rapid ball transition and fast-break play, should continue to be integrated into training programmes as a fundamental part of their content since they potentiate changes in physical condition and improve the efficiency of actions carried out both on attack and defence.
2. The development of training programs specifically designed to improve endurance and reduce the impact of lactic acid on athletic performance is advised, particularly through the inclusion of intermittent running and muscular endurance exercises.
3. Future training programs should place greater emphasis on improving rapid passing and shooting under fatigue-induced pressure, as these skills are essential for achieving effective outcomes in competitive matches.
4. Strategic rest intervals should be systematically organized between periods of intensive training to minimize the effects of lactic acid accumulation on performance, allowing players to sustain consistent levels of efficiency.
5. It is recommended that continuous monitoring of fatigue and blood lactate levels during training sessions and official games are used to evaluate possible effects on player's health and performance in order to make timely, well-informed adjustments.
6. According to the results of this study, training with this approach might be used for older ages to increase their physical and tactical abilities.

Conflict of interest

None.

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

Ethical clearance

This manuscript approved by Omar Mohammed Majed.

Author contributions

All contributions of this study were done by the researcher omar mohammed majed who get the main idea and work on writing and concluding also with number of experts, **Prof. Dr. Hussein Abdul-Zahra Abdul-Yemah** in Statistics, **Mohammed Hassan Jasim** in revision, **Asst. Lect. Inam Al-Azzawi** in translating.

Facilitate the task

This study was supported by College of Physical Education and Sport Sciences, University of Baghdad.

Funding statement

This research received no external funding.

Data availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

References

Abdel-Fattah, A. A. (2012). *Physiology of sports training*. Cairo, Egypt: Dar Al-Fikr Al-Arabi.

Alghamdi, M. (2019). The effect of basketball transition drills and fast break strategies on improving physiological indicators in youth athletes. *Journal of Sports Science and Medicine, 18*(2), 89–98. https://doi.org/10.1016/j.jsms.2018.11.005.

Ali, M. (2019). The role of experimental research in improving physical education training. *Journal of Sports Science & Technology, 10*(2), 123–136. https://doi.org/10.1016/j.jst.2019.01.010.

Allawi, M. H., & Abdel-Fattah, A. A. (2000). *Physiology of training and sport*. Cairo, Egypt: Dar Al-Fikr Al-Arabi.

Al-Moussawi, S. J. (2015). *Physiology of physical exertion*. Baghdad, Iraq.

Chamari, K., Hachana, Y., & Habboubi, K. (2018). Effectiveness of plyometric training on agility and sports performance in young athletes. *European Journal of Sports Science, 18*(3), 354–360. https://doi.org/10.1080/17461391.2017.1391401.

Gibala, M. J., Little, J. P., Macdonald, M. J., & Hawley, J. A. (2012). Physiological adaptations to low-volume, high-intensity interval training. *Journal of Applied Physiology, 113*(1), 136–145. https://doi.org/10.1152/japplphysiol.00162.2012.

Helgerud, J., Høydal, K., Wang, E., Karlsen, T., Berg, P., Bjerkaas, M., & Hoff, J. (2007). Aerobic high-intensity intervals improve VO_2max more than moderate training. *Medicine & Science in*

Sports & Exercise, 39(4), 665–671. https://doi.org/10.1249/mss.0b013e3180304570.

Hussein, Q. H. (2004). *Physiology of sports training*. Baghdad, Iraq: Dar Al-Hikma.

Maggioni, M. A., *et al.* (2019). Effect of repeated-sprint ability training in improving anaerobic capacity and lactate thresholds in basketball players. *Journal of Strength and Conditioning Research*, *33*(1), 47–55. DOI: 10.1123/ijspp.2018-0433.

Powers, S. K., & Howley, E. T. (2018). *Exercise physiology: Theory and application to fitness and performance* (10th ed.). New York, NY: McGraw-Hill.

Sánchez-Pay, A. (2021). Impact of aerobic training on lactate concentration and performance in young basketball players. *International Journal of Sports Physiology and Performance, 16*(4), 477–484. https://doi.org/10.1123/ijspp.2021-0147.

تأثير تدريبات الانتقال السريع والهجوم السريع على تأخير التعب ومستوى اللاكتات وتطوير الأداء الهجومي للاعبي كرة السلة الناشئين

عمر محمد مجيد سعود

كلية التربية البدنية وعلوم الرياضة ، جامعة بغداد

المستخلص

تعد لعبة كرة السلة من الألعاب الرياضية التي تكون ذات شة عالية واعتمادها الكبير على النظام اللاهوائي ، وخاصة عند الانتقال السريع من الهجوم الى الدفاع او العكس التي تتطلب تغيّرًا مستمرًا في السرعة والاتجاه مع أداء مهاري دقيق تحت الضغط الزمني. وتزداد أهمية هذه المتطلبات لدى لاعبي الفئات العمرية دون 18 سنة، إذ يكون اللاعبون في مرحلة نمو بدني وفسيولوجي تؤثر بشكل مباشر في قدرتهم على مقاومة التعب والمحافظة علمستوى الأداء اثناء المباراة. أن توظيف تمارين الانتقال بالكرة والهجوم السريع ضمن البرامج التدريبية يُعد من الأساليب الفعالة لتحسين التحمل اللاهوائي، والكفاءة القلبية التنفسية، وتطوير المهارات الهجومية الأساسية مثل المراوغة والتمرير والتصويب، إضافة إلى تقليل تراكم حامض اللاكتيك وتأخير ظهور التعب الفسيولوجي. كما أظهرت نتائج البحوث أن هذه التمارين تسهم في رفع مستوى الأداء البدني والمهاري بصورة متكاملة، مما يعزز قدرة اللاعبين الشباب على الاستمرار في الأداء خلال مختلف مراحل الموسم الرياضي وهنا تجدر الإشارة الى ان هذا البحث سيوفر السلامة والصحة الجيدة للاعبين, وهذا ما يحقق احد اهداف التنمية المستدامة للامم المتحدة في العراق (الصحة الجيدة).

الكلمات المفتاحية: التحمل اللاهوائي، الانتقال بالكرة، الهجوم السريع، حامض اللاكتيك ، التعب الفسيولوجي.