

A study of the effect of targeted training units on physiological fatigue, anaerobic capacity, and physical and skill variables in basketball players

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ABSTRACT

Original research paper

This research aims to study the effect of directed training units on physiological fatigue, anaerobic capacity, and some physical and skill variables among young handball players at the College of Physical Education and Sports Sciences - University of Baghdad. The researcher used the experimental method to suit the nature of the study, as the research sample included (12) players who were randomly selected from the original community.

Pre- and post-tests were conducted to measure fatigue indicators, anaerobic capacity, and a number of physical and skill characteristics. The data were analyzed using appropriate statistical methods..

The results showed that there were statistically significant differences between the pre- and post-measurements in favor of the post-measurement, indicating the effectiveness of the training program in improving the indicators under study..

The researcher concluded that the proposed training program contributed to improving the levels of physiological fatigue, anaerobic capabilities, and physical and skill qualities of the players.

Accordingly, the researcher recommends applying similar training units to different age groups, with the aim of developing levels of physical and skill performance in general.

Keywords: physiological fatigue, anaerobic capacity, physical attributes, basketball.

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1. Introduction

1.1 The importance of research

The world today is witnessing rapid development in various areas of life, including sports. This requires researchers and trainers to keep pace with this development by adopting advanced training methods that contribute to enhancing players' skill performance. In light of this reality, the need has emerged to design targeted training programs that take into account the nature of the game and its requirements, as well as the physical and psychological characteristics of the target group.

Significant advances in training methods, particularly the use of modern technologies such as digital simulation and multimedia, have opened new horizons for coaches to improve the efficiency of athletic performance. Preparing a player capable of responding to the demands of competition

and training requires scientific training programs based on precise methodological foundations.

Based on this, the importance of this research lies in its attempt to determine the effect of using targeted training modules on developing indicators of physiological fatigue, anaerobic capacity, and some physical and skill characteristics among youth handball players. This may contribute to building an effective training base that can be used in preparing sports teams in the future.

1.2 Research problem

Despite the progress made in the field of training in recent decades, the practical reality indicates ongoing challenges in developing the skill performance of youth handball players. Through his field observations, the researcher observed that some players suffer from a clear weakness in executing basic skills during training sessions and matches. This reflects

shortcomings in the approved training programs and their unsuitability for the requirements of the modern game..

This reality raises an important question about the effectiveness of using targeted training modules, built on scientific principles and based on the characteristics of the target group, in improving physical and skill performance, reducing signs of physiological fatigue, and enhancing anaerobic capacity in players.

1.3 Research objectives

This research aims to achieve the following objectives:

1. Statement on the effect of using targeted training modules on reducing physiological fatigue indicators and enhancing anaerobic capacity in youth handball players.
2. To determine the effectiveness of these training units in developing some basic skills and physical qualities of players.
3. To identify differences in the level of physical and skill performance between players who underwent the proposed training program and those who did not.

1.4 Research hypotheses

In light of the research problem and objectives, the researcher put forward the following hypothesis:

1. There are statistically significant differences at the level of (0.05) between the results of the individuals of the experimental group and the control group in the dimensional measurements of the physiological fatigue index, in favor of the experimental group..
2. There are statistically significant differences at the level (0.05) between the results of the individuals of the two groups in anaerobic capacity in the post-tests, in favor of the experimental group.
3. There are statistically significant differences at the level of (0.05) in the selected physical characteristics between the two groups in the dimensional measurements, in favor of the experimental group..
4. There are statistically significant differences at the level of (0.05) in the selected basic skills between the two groups in the dimensional measurements, in favor of the experimental group.

1.5 Research areas

To ensure that the research objectives are achieved and its hypotheses are tested within a precise scientific framework, the following areas have been identified:

1.5.1 Human domain

It represents the players of the youth handball team at the College of Physical Education and Sports Sciences - University of Baghdad.

1.5.2 Spatial domain

The research procedures were carried out in the gymnasium of the College of Physical Education and Sports Sciences - University of Baghdad.

1.5.3 Time domain

The research period extended from November 8, 2024 From 3 March 2025m.

2. Theoretical Framework and Previous Studies

2.1 fatigue index

Fatigue is one of the most important physiological phenomena associated with physical activity, as it has a direct impact on the efficiency of athletes' motor performance. This is attributed to the central nervous system's reduced ability to efficiently transmit nerve signals to working muscles, which negatively impacts the efficiency of motor and physical responses.⁽¹⁾

Fatigue often results from repeated physical activity without adequate rest periods, leading to the accumulation of metabolic waste within the muscles. This accumulation affects the effectiveness of the nervous and muscular systems, resulting in a decline in the ability to maintain physical performance at the required efficiency, particularly in activities that require high effort for repeated long or short periods.

2.2 anaerobic capacity

Anaerobic capacity is the body's ability to produce the energy needed for high-intensity activities carried out over short periods of time, without relying on oxygen as a direct source of energy. This capacity is a vital characteristic that plays a pivotal role in athletic activities that require strength and speed, such as jumping, sprinting, and shooting in team sports, most notably handball.

Anaerobic capacity is based on an energy system that relies on the breakdown of chemical compounds within the muscles, such as creatine phosphate and glycogen, which produces rapid but time-limited energy. Anaerobic capacity is divided into four main types.⁽²⁾

1. Maximum anaerobic capacity: the highest amount of energy that can be produced in a very short time.
2. Anaerobic endurance: refers to an athlete's ability to resist fatigue during high effort.
3. Speed: It means the ability of muscles to contract quickly to perform repetitive movements in a short time.
4. Lactic acid system: This is the system responsible for producing anaerobic energy in the absence of oxygen. It causes lactic acid to accumulate, leading to signs of fatigue.

2.2.1 Respiratory circulatory system

The circulatory-respiratory system is a vital physiological system that plays a fundamental role in supporting physical activity. It is responsible for transporting oxygen from the lungs to the body's cells and removing carbon dioxide produced by metabolic processes. These functions are

(1) Shaalan Hussein Shaalan (2008). Analysis of the effectiveness of physical and functional performance of some physiological indicators. p. 38.

(2) Fadel Ammar, Scientific Perspective. (2008). Functions of the muscular, respiratory, and blood systems in athletic performance. p. 67.

essential for maintaining sustained motor performance, particularly in sports that require high and sustained physical effort.

The more efficient this system is, the greater the body's endurance and resistance to fatigue. This is due to the increased amount of oxygen supplied to the muscles during physical activity, which contributes to delaying the onset of fatigue and improving athletic performance. The importance of the circulatory-respiratory system is particularly evident in high-intensity activities, such as handball, which require sustained physical effort and rapid motor response.⁽³⁾

2.3 Physical characteristics

Physical attributes are the cornerstone of athlete development, representing a set of physical abilities that contribute to improved motor and skill performance. These attributes include strength, speed, flexibility, endurance, agility, and balance. Developing these attributes is essential to enhancing a player's efficiency, particularly in team sports that require dynamic interaction with constantly changing situations.

The results of many studies have shown that physical qualities play an effective role in achieving athletic achievement, as they are closely related to the extent of the player's ability to perform basic skills efficiently, and to resist fatigue during repeated or intense performance.⁽⁴⁾ Therefore, developing these qualities is a major goal in modern training plans.

2.4 Basic Basketball Skills

Basic basketball skills are the foundation upon which players' technical and tactical performance is built, and include passing, dribbling, shooting, receiving, and individual and team defense. Mastering these skills is essential for effective performance during matches and achieving positive results at the team level.

2.4.1 Shooting skill and accuracy

Shooting is a crucial skill in basketball, used to score points and is the ultimate goal of offensive play. The effectiveness of shooting depends on several factors, including balance, focus, proper body position, and the angle at which the ball is launched.

There are several types of shooting in basketball, depending on the player's movement and position, the most prominent of which are:

1. Shooting from a standstill Set Shot).
2. Jump shooting Jump Shot).
3. Aim while advancing (Lay-Up).
4. Long distance shooting Three-Point Shot).

Shooting accuracy is an important indicator for assessing a player's skill level, as it directly affects the results of matches.⁽⁵⁾

(3) Shaalan Mohammed Lazem (2006). The effectiveness of some functional indicators in the performance of female handball players. pp. 16–38.

(4) Mansour Ali and Shaalan Hussein Shaalan. Analysis of the effectiveness of physical and functional performance. p. 67

(5) Attia Falah, and Alaa Amer (2005). The effect of physiological variables on the physical performance efficiency of handball players. pp. 81-85.

2.4.2 Defensive Skills

Defensive skills are essential for stopping attacks and preventing the opposing team from scoring points. These skills include proper positioning, pressuring the ball carrier, defensive switching, intercepting passes, and blocking shots. These skills require a high level of physical fitness, focus, and attention, as well as quick decision-making. Studies indicate that many defensive failures in basketball are due to weak defensive fundamentals or poor decision-making during defensive play.⁽⁶⁾

3. Research Methodology and Procedures

3.1 Research Methodology

The researcher adopted the experimental approach using an equivalent-groups design, given its suitability to the nature of the research problem and its objectives. This approach helped identify differences between the dependent variables resulting from the use of targeted training modules, and evaluate their impact on physiological fatigue, anaerobic capacity, and some physical and skill characteristics of young basketball players.

3.2 Research sample

The research sample consisted of the youth basketball team players at the College of Physical Education and Sports Sciences - University of Baghdad. The sample number was (12) players, who were divided into two equal groups with (6) players for each group, which is equivalent to 50% of the original research community, and the selection was done randomly.⁽⁷⁾

3.3 Search Tools

The researcher used the following tools to implement the experiment and measure the variables:

- Survey form.
- Measuring tape.
- Digital stopwatch.
- Video recording device.
- Basketball training bag.
- Regular basketballs.

3.4 Tests used

The researcher adopted a set of appropriate tests to measure fatigue indicators, anaerobic capacity, and some physical and technical skills in basketball:

3.4.1 Fatigue Index Test

This test measures the extent to which physical performance is affected by fatigue by running 35 meters sprinting using a timing tape and two start and finish signals. The time taken by each athlete is recorded over three attempts, with the best time used as the performance indicator.

(6) Khalif Shaalan Yaqoub (2009). Developing defensive responses among handball players. p. 31.

(7) Ammar, Fadhel. (2008). Functions of the muscular, respiratory, and blood systems in athletic performance and physical tests. Baghdad: Dar Al-Shu'un Al-Riyadhiyah. pp. 68, 69, 71.

3.4.2 Short Anaerobic Capacity Test

This test is used to measure maximum anaerobic capacity, where the player is asked to run at maximum speed for a distance of 50 meters, and the time is calculated with complete accuracy from the start until the end of the distance⁽⁸⁾.

3.4.3 Speed-Power Shooting Test (Arms)

The player is required to make jump shots towards the basket from a specified distance (usually 4.5 metres), as fast as possible within a specified time period (e.g., 30 seconds), and the number of successful shots is counted.

3.4.4 Speed Power Shooting Test (for men)

It is measured by the player's ability to perform a vertical or horizontal jump accurately and powerfully, and linking it to the shooting location (e.g., shooting after take-off), with the number of successful attempts being counted within a specified period.

3.4.5 Defensive Movement Skill Accuracy Test

The player is asked to perform a set of defensive exercises (such as lateral movement, change of direction, defensive positioning), and performance is evaluated according to an assessment form that includes the following elements: positioning, timing of movement, response, and preventing progress or shooting.⁽⁹⁾

3.5 Field Procedures

3.5.1 Exploratory experiment

The pilot study was conducted on November 23, 2023, on a group of basketball players outside the primary sample, with the aim of verifying the validity of the tools and the accuracy of the tests used.

3.5.2 Main experiment

The main experiment was conducted on the members of the basic research sample, according to the specified training program, inside the gymnasium of the College of Physical Education and Sports Sciences - University of Baghdad.

3.5.3 Pre-test

The pre-test was conducted on 11/25/2023 to measure the initial values of the research variables (fatigue index, anaerobic capacity, shooting skills, defensive movement, etc.), using the same tools and tests mentioned above.

3.5.4 Post-test

The post-test was conducted on 1/26/2024 after the completion of the training program, using the same tools, and on the same sample members.

3.6 Statistical methods

Statistical software was used. SPSS for data analysis and results processing. The processing included the following:

- arithmetic mean
- standard deviation
- Coefficient of skewness
- a test (T) for linked samples

4. Presentation and Discussion of the Results

4.1 Presentation and discussion of the fatigue index test results

Table No. (1)

It shows the values of the arithmetic means and standard deviations before and after, and the calculated and tabulated t-test values for the research sample for the fatigue index variable.

variable	Pre-test		Post-test		t-value (calculated)	T-value (table)
	S	A	S	A		
fatigue index	5.61	1.89	7.54	1.03	2.98	2.01

The results of the fatigue index test showed statistically significant differences between the results of the pre- and post-tests in favor of the post-test among the research sample members, indicating the effectiveness of the training program in reducing the manifestations of physiological fatigue.

The arithmetic mean in the pre-test was (5.61) with a standard deviation of (1.89), while the mean in the post-test rose to (7.54) with a standard deviation of (1.03). The calculated (t) value was (2.98), which is higher than the table value at a significance level of (0.05) and a degree of freedom of (5), indicating the presence of significant differences in favor of the post-test.

This improvement is attributed to the effectiveness of the targeted training program that focused on improving endurance and reducing fatigue accumulation during performance, which is consistent with what was indicated by Researchers ⁽¹⁰⁾Structured training programs contribute to enhancing players' resistance to fatigue.

4.2 Presentation and discussion of the results of the short anaerobic capacity test

Table No. (2)

It shows the values of the arithmetic means and standard deviations before and after the test, and the calculated and tabulated t-values for the short anaerobic capacity of the research sample.

(8) Ammar, Fadel. (2001). Principles of Scientific Research in Physical Education. Dar Al-Manahj, p. 26.

(9) Attia Falah, and Alaa Amer. (2005). The effect of physiological variables on the efficiency of physical performance of handball players. p. 85.

(10) Fadel Mahfouz. (2004). The effect of functional efficiency and some physical characteristics on skill performance in handball. Journal of Field Studies in Physical Education, Issue 18, pp. 11-12.

variable	Pre-test		Post-test		t-value (calculated)	T-value (table)
	S	A	S	A		
short anaerobic capacity	12.70	0.48	14.13	0.39	9.86	2.01

The results of the short anaerobic capacity test revealed statistically significant differences between the pre- and post-tests, in favor of the post-test. This indicates an improvement in the players' ability to perform high-intensity exercises in a short period of time without relying on oxygen.

The arithmetic mean in the pre-test was (12.70) with a standard deviation of (0.48), and it increased in the post-test to (14.13) with a standard deviation of (0.39). The calculated (t) value was (9.86), which is statistically significant at the (0.05) level.

This improvement is attributed to the specific exercises targeting the anaerobic system, which were an essential part of the training program, which was reflected in the efficiency of anaerobic performance.

4.3 Presentation and discussion of the results of the speed-specific shooting test (arms and legs)

Table No. (3)

It shows the values of the arithmetic means and standard deviations before and after, and the calculated and tabulated t-test values for the speed-characterized strength of the arms and legs in the research sample.

variable	Pre-test		Post-test		t-value (calculated)	T-value (table)
	S	A	S	A		
Speed-specific strength of arms	9.00	0.63	9.66	0.51	3.16	2.01
The distinctive speed power of the legs	17.83	1.32	19.33	0.51	3.50	2.01

First: arms

The results showed a clear improvement in the ability to aim using the arms, as the arithmetic mean increased from (9.00) in the pre-test with a standard deviation of (0.63), to (9.66) in the post-test with a standard deviation of (0.51). The calculated (t) value was (3.16), which is statistically significant.

Second: The two men

The test also showed an improvement in the speed-specific strength of the two men, as the average in the pre-test was (17.83) with a standard deviation of (1.32), and it increased in the post-test to (19.33) with a standard deviation of (0.51). The value of (t) was (3.50), which is also statistically significant.

These results indicate that an intensive training program on dynamic shooting and jumping associated with offensive and defensive performance in basketball contributed to the development of strength and speed, as confirmed by Researchers⁽¹¹⁾.

5. Conclusions and Recommendations

5.1 Conclusions

In light of the results obtained through the analysis of statistical data, the following conclusions can be drawn:

1. The research results showed a significant improvement in the physiological fatigue index among youth basketball players at the College of Physical Education and Sports Sciences at the University of Baghdad. This indicates the effectiveness of the targeted training program in enhancing the players' ability to resist fatigue.
2. The results revealed a clear improvement in the sample's short-term anaerobic capacity, which enhances the effectiveness of exercises that target anaerobic system activation in improving the ability to perform intense effort in short periods.
3. Performance test results showed significant improvements in speed-specific strength for both arms and legs, reflecting the impact of specific exercises used to enhance strength and muscle explosiveness associated with skill performance in basketball.
4. There was a clear improvement in the accuracy of the kinetic shooting skill, demonstrating that the systematic and gradual training, based on simulating realistic playing situations, contributed effectively to developing the players' offensive skill performance.

5.2 Recommendations

Based on the previous conclusions, the researcher recommends the following:

1. Adopting targeted, scientifically based training programs to prepare youth basketball players, given their proven effectiveness in developing physical, skill, and physiological abilities.
2. Using periodic standardized tests to assess the development of players' physical, skill, and physiological indicators, to ensure the effectiveness of training programs is measured and optimally directed.
3. Providing appropriate nutritional support and comprehensive recovery programs that include adequate rest periods ensures that players respond to training and reduces the signs of fatigue or injuries resulting from overload.

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