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The Effect of Hot Weather on the Level of Blood PH – Lactic Acid and the Performance of Some Offensive Skills in Basketball among Students of the Faculty of Physical Education and Sport Sciences

Ahmed Hassan Yas

College of Physical Education and Sport Sciences / Al-Mustansiriyah University

yasahmedhasan@uomustansiriyah.edu.iq

ABSTRACT

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The aim of this study was to evaluate the effect of training in hot and dry (45°C) compared to cold and moderate climates (19°C) on the level of blood pH and lactic acid concentration, and the performance of some offensive skills (peaceful shooting, high patting, chest handling) in basketball players.

The researcher used the experimental method by designing the pre- and post-measurement for a sample of 30 students from the Faculty of Physical Education and Sport Sciences. The results showed that there were statistically significant differences between the pre- and post-measurements of all variables.

In hot weather, the blood pH level decreased significantly while the concentration of lactic acid increased significantly and skill performance was negatively affected, as the accuracy of peaceful aiming decreased, and the performance time of both the high typing test and the pectoral pass increased.

These results are attributed to the increased reliance on the anaerobic system to produce energy under heat stress, resulting in the accumulation of hydrogen and lactic acid ions, causing a state of metabolic acid. This, in turn, negatively affects muscular function, neuromuscular coordination, and mental concentration, and the study reached several conclusions, including that the application of practical lessons in basketball in hot and dry climates leads to heat stress, especially without sufficient hydration, and thus the high level of lactic acid, as the researcher recommended important recommendations based on the results of the research, including working to provide air-conditioned or shaded indoor halls for practical lessons during peak times of heat.

Keywords:
Heat stress , blood pH, lactic acid, skill performance, hot weather, basketball offensive skills.

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1-Introduction and Importance of the Research:

Basketball is a sport that requires high-intensity physical effort, combining periods of fast running, jumping, and repetitive defensive and offensive movements. These high-intensity activities lead to significant muscular and physiological stress, the most prominent manifestations of which is the accumulation of lactic acid and low blood pH, which negatively affects the efficiency of muscular and neurological functioning.

Environmental conditions, especially high temperatures, pose a significant challenge to athletic performance at both the functional and physical levels. Heat stress is one of the most prominent of these challenges, as exposure to high heat during physical activity leads to an imbalance in the body's thermal balance. This imbalance results in high physiological responses such as increased heart rate and decreased plasma volume, with the aim of dissipating internal heat and maintaining the body's core temperature within safe limits Casa, 1999 .

When applying scientific lessons in closed halls with poor ventilation, or in outdoor courts with insufficient hydration for players or students, it significantly affects the performance of basic basketball skills . "Training in such hot conditions leads to heat stress which causes a decrease in the efficiency of functional systems (heart and respiratory systems), and consequently a decrease in the level of physical performance, thus negatively affecting the accuracy and efficiency of learning and performance of the basic skills of the game" (Gonzalez-Alonso et al., 2008).

Exercise in harsh environmental conditions, especially hot and dry conditions. It weakens the body's ability to regulate internal temperature, which increases the burden on the cardiovascular system and speeds up the anaerobic metabolism, thus increasing the accumulation of lactic acid and lowering the pH of the blood at faster rates compared to temperate climates.

This research highlights the importance of this research in studying the dual effect of heat stress and physical stress in hot and dry conditions on biophysiological indicators (blood pH, lactic acid) and its relationship to the level of performance of some basic offensive skills (such as shooting, tapping and handling) in advanced basketball players. This provides information for coaches to develop training programs that adapt to different environmental conditions and maintain The level of technical performance under these conditions.

Research Problem:

Basketball teams in many regions face the need to train or play matches in hot conditions, especially during the summer or in tournaments held in countries with hot climates. Through practice, a noticeable decline in the accuracy of the performance of some offensive skills and decision-making has been observed at the end of training periods or in the second half of matches held in such hot and dry climates.This decline is often attributed to physical and thermal stress, but there is a lack of local studies that quantify this effect by linking it to direct physiological indicators such as blood pH and lactic acid level. Therefore, the research problem begs the following question: How much does the application of basketball lessons in hot and dry (45 degrees Celsius) affect compared to moderate (18-22 degrees Celsius) at the pH level Blood, lactic acid concentration, and performance of some offensive skills in advanced basketball players after high-intensity workouts?

Research Objectives:

1. **To identify the** effect of hot weather compared to moderate weather on the level of (blood pH and lactic acid concentration) in the blood of ocular individuals.
2. **Identifying the Effect** of Hot Weather on the Performance of Some Offensive Skills in Sample Members

Research Hypotheses:

1. There are statistically significant differences between the pre- and post-measurements of blood pH level in the sample in hot climates compared to the temperate climates.
2. There are statistically significant differences between the pre- and post-measurements of the level of lactic acid concentration in the sample in hot climates compared to the temperate climates.
3. There are statistically significant differences between the pre- and post-tests of thelevel of performance of some offensive skills in basketball among the sample members in hot climates compared to moderate climates.

Research Areas :

1. Human Field: Students of the Fourth Stage, Faculty of Physical Education and Sport Sciences, Al-Mustansiriya University.

2. Spatial Field: Al-Mustansiriya University's Outdoor Playgrounds
3. Temporal Domain: 15/12/2024 – 14/5/2025

Research Methodology and Field Procedures:

Research Methodology:

The researcher used **the experimental method** with a **pre-dimensional measurement design for one group** where the pre-measurement of the sample members is measured in moderate thermal conditions , and then the same dimensional group is measured in hot and dry conditions (in summer).

B. Research Sample and Sample:

The research population consists of students of the fourth stage of Al-Mustansiriya University, while the research sample consisted of students of the fourth stage of the B division , and the number of them reached 30 students.

Sample homogeneity:

It was confirmed that the sample members were homogeneous in the basic variables that may affect the results, as shown in

Table (1)

Homogeneity	Torsion coefficient	Standard deviation	Broker	Arithmetic mean	Variable
homogeneous	-0.44	0.71	22	21.35	**Age (year)**
homogeneous	-0.34	4.17	178	176.13	**Length (cm)**
homogeneous	0.63	3.72	75	77.4	**Mass (kg)**
Torsion coefficient within the range (-1 to +1)					

Based on the analysis of Pearson's torsion coefficient, all three variables (age, height, mass) are homogeneous, as their torsion coefficient values fall within the acceptable range (-1 to +1). This means that the distributions of these variables are fairly symmetrical and do not suffer from sharp deviation.

2-3 – Devices used and means of data collection:

2.3.1 Means of Information Collection:

Accurate data collection in experimental research is important and essential to ensure the validity of the results and there are several ways to collect data from them

- Website
- Note
- Questionnaires
- References and Scientific Sources
- Books and scientific articles published in peer-reviewed journals.
- Personal interviews with experts andspecialists.
- Lab Results Forms

- **Devices and Tools Used:**
    1. Digital Medical Scale for Weighing .
    2. Basic medical supplies (medical cotton and high quality sterilizers).
    3. Assorted Basket Balls
    4. Signs

Determine the tests and metrics used:

- Biochemical Tests:

Measuring the blood pH level: Using a portable blood gas analyzer. (Blood Arterial Gas Test)

- Measuring the level of lactic acid in the blood:

- Objective of the test: Measure the concentration of lactic acid in the blood before and after exertion.

- Devices and Tools: Portable Lactic Asad (Electronic) Measuring Device .

- Methanol sterilizer solution .

- Medical cotton.

- Registration forms

- Procedures and Conditions :

The device is whistled with its inserted tape, the test (thumb finger) is tested with the device's needle, and a blood sample is taken with the (cut) placed in the device to get the reading,

- Each laboratory (kit) has its own kit and is used only once .

- Registration: The readings are taken directly from the device, and recorded in the special form for each player.

- Offensive skills tests:[1]

Lay-up Shot Test

Objective of the test: To assess the level of peaceful aim .

Performance Method:

1. The player performs the ball from the middle of the basketball court towards the goal of the basket.
2. The player finishes the bat, performs the legal steps (triple) and then executes the peaceful shot.
3. The player is given **10 attempts**,

[1] - Mustafa Zeidan: Basketball: Basketball Training Encyclopedia , 1st Edition, Dar Al-Fikr Al-Arabi, Cairo, 1997, p. 30,

4. **Test conditions: The** training and legal steps for shooting must be done correctly and properly (avoiding a ball walking violation).
5. **Scoring: The** number of successful balls that enter the basket out of 10 attempts.

High Compactness Test: [2]

Test Name : High Tennis Basketball.
Test Purpose : Measure the high tapping speed of 20 m for the dominant arm.
Tools used: Basketball court, electronic stopwatch, 2 legal basketballs, tape Measurement, chalk, whistle.
Procedures: Draw two parallel lines with a distance of 20 m, which represent the beginning and end mark, and be (a)
b)
Performance Description : The laboratory takes the high start standby position behind the starting line (A) drawn on the ground
And give the start signal to the laboratory by running with the high thumping of the dominant arm as fast as possible to reach
To the finish line (B).

- **Test Instructions:**
  - The tester takes the correct position (standby mode).
  - The test ends when you cross the finish line (B) as fast as possible.
  - Each lab has only one attempt.
- Test Circuit:
  - A registrar calls the names, gives the signal to start or not, and records the results second.
  - A timer that tims as well as stands at the finish line (B).
- **Registration:** The laboratory time is recorded in the fold that he traveled from point A to point (B) and when a violation is committed

Legal doesn't count as trying.

-Rapid Pass (Handling) Test:

Purpose of the test : Measure scrolling speed
Necessary tools :
- Legal basketball
- Smooth wall perpendicular to the floor
- Stopwatch

Procedures:
- Smooth wall perpendicular to the floor
- Draw a line parallel to the wall and 5 feet away from it on the floor
- The player stands with the ball behind the starting line, then passes the ball towards the wall with a chest pass 15 times.
- Time is calculated from the moment it gives the start signal until the fifteenth ball touches the wall.

Calculating Grades:
- Score: The number of seconds it takes a player to perform 15 passes.
- The player is not allowed to move more than one step in any direction, and if the player moves more than one step, the test will be retested.

[2] - Mustafa Mohamed Zeidan : Basketball for the Coach and Teacher, Cairo, Dar Al-Fikr Al-Arabi, 1999, p. 72.

Conducting the Exploratory Experiment:

A survey experiment was conducted on a survey sample outside the main research sample consisting of (4 students) to ascertain that:

- Ensure that the sample members understand the tests used
- Verify the devices used for skills
- Ensuring the safety of the medical devices used
- Ensure that the support team understands
- Obtain preliminary data on the time and difficulties that may arise at the main experiment

Scientific Foundations of Tests:

1- **Honesty coefficient:** In order to obtain the honesty coefficient for the tests used, the honesty of the content was used, as "the opinions of experts and specialists, which is often done by logical judgment of the existence or existence of the attribute, attribute or ability in question to verify whether the proposed measurement method actually measures it or not".[3]

2- Stability coefficient: Consistency is defined as "that test that gives the same results or approach when it is reapplied to the same sample and under the same conditions".[4] In this method, the measurement is applied to the same group members (the research sample) and under the same conditions after 7 days , where the simple correlation coefficient between the first application and the second application expresses the degree of stability of the measurement[5]. Table (2) shows the results of the tests.

3- Objectivity coefficient: For the purpose of extracting the objectivity coefficient of the tests, the researcher used the simple correlation coefficient between (referees' scores) as shown in Table (2).

Table (2) shows the stability and objectivity coefficients of the studied variables

Objectivity	T.R.	Stability	Variables	W
0.91	4.72	0.87	Peaceful Targeting	**3**
0.89	4.57	0.91	High Flattening Test	**4**
0.91	5.18	0.88	Thoracic Pass (Handling) Test	**5**

Pre-Tests:

[3] Mohamed Hassan Allawi, Mohamed Nasr El-Din Radwan, Analogy in Physical Education and Sport Psychology , Cairo, Dar Al-Fikr Al-Arabi, 2000, p. 258.

[4] Marwan Abdel Majeed Ibrahim , Scientific Foundations and Statistical Method of Tests and Measurement in Physical Education, 1st Edition , Jordan, Dar Al-Fikr for Printing, Publishing and Distribution, Jordan, 1999, p. 67.

[5] Muhammad Hassan Allawi, Muhammad Nasr Al-Din Radwan, Analogy in Physical Education and Sport Psychology, 2nd Edition , Cairo, Dar Al-Fikr Al-Arabi, 1988, p. 361.

The pre-tests were conducted after the end of the application of the practical lesson of the basketball subject after the end of the first semester of the academic year 2024-2025, on Tuesday, 14/1/2025, where the tests were conducted in moderate to cold weather (the temperature is 19 degrees Celsius at ten o'clock in the morning), and a sample of venous blood was drawn for the members of the research sample, after the end of the practical training of the basketball subject, and more than one device was used to draw blood by the specialized assistant medical team. Blood samples are kept in refrigerated containers and the names of the research sample members are marked on the blood samples.

After that, lactic acid was measured after 5 days after the end of the application of the scientific lessons for the basketball subject by an electronic lactic acid measurement device (POCT) – and once the blood draw and lactic acid measurement is finished – the sample members proceed to perform skill tests (tapping, peaceful aiming, high lactic test , and finally the chest handling passing test).

- Main Experience:

In order to achieve the objectives of the research, which is to identify the variables that may occur to the sample members when applying the practical lessons of basketball in cold and temperate climates from the 11th month to the end of the first semester on 15/1 (January), and to identify the effect of hot and dry weather on the biochemical variables and the performance of some offensive skills in basketball when applying the practical lessons in the middle of the 3rd month (March) to the end of the second semester on 15/5 (May), tests were conducted in those months to identify the The extent of the impact of training or applying practical lessons on the students of the Faculty of Physical Education and Sport Sciences, Al-Mustansiriya University in this atmosphere, and it was done under the supervision of the researcher as he is a professor of basketball in the same college.

- Post-tests:

The tests and post-measurements of the research sample members were conducted on Wednesday, 14/5/2025 at ten o'clock in the morning, on the outdoor playgrounds of Al-Mustansiriya University, and the same conditions were taken into account as the procedures applied in the pre-tests.

Statistical Methods Used:

The statistical package (SPSS) was used to extract the statistical operations of the results of the tribal and post-tests and the statistical methods used were: mean - standard deviation - torsion coefficient - T test

3. Presentation, analysis and discussion of the results:

1-3 Presentation and analysis of the results of pre- and post-biochemical tests and measurements of the research sample members

Table (3)

Results of pre- and post-tests of research sample members for biochemical and skill variables

Significance	Tabular T	T calculated	on	Going to	Collection	Unit of Measurement	Variable
							Variables (Biochemical)
Moral	2.045	-8.91	0.03	7.35	Qibla (Temperate Weather)	**(pH)**	**Blood pH**
			0.04	7.27	After Me (Hot Weather)		
Moral	2.045	9.05	1.3	4.2	Qibla (Temperate Weather)	**mm/L**	**Lactic acid**
			1.2	8.5	After Me (Hot Weather)		
							Skill variables (offensive)
Moral	2.045	-6.41	1.3	7.4	Qibla (Temperate Weather)	**Degree**	**Peaceful Targeting**
			1.8	4.8	After Me (Hot Weather)		
Moral	2.045	5.31	0.35	5.02	Qibla (Temperate Weather)	**Second**	High Flattening Test
			0.42	5.48	After Me (Hot Weather)		
Moral	2.045	4.2	1.6	18.3	Qibla (Temperate Weather)	**Second**	Thoracic Handling Test
			2.02	21.1	After Me (Hot Weather)		

Under the significance level of N-1 and the freedom level of 0.05

Presentation and analysis of the results:

Through Table (3), the (T) test (before/after) was used to compare the averages of performance before and after exposure to different conditions , where the pre-test represents the moderate atmosphere and the post-test represents the hot atmosphere based on the nature of the variables and the results. All the results indicate statistically significant differences**, as the calculated** T value for each variable is greater than **the tabular** T value of 2.045.

Regarding the measurement of (pH)Blood for the measurementQibla (Temperate Weather) The arithmetic mean has reached 7.35 And with a standard deviation 0.03 As for the value T The Calculated Amount has reached -8.91.

As for the dimensional measurement, it reached the arithmetic mean and standard deviation (7.27 - 0.04)

The calculated T-value was 1,8.9, tabular 2.045, and the significance of the differences was significant.

As for the results of the lactic acid measurement, the arithmetic mean and standard deviation of the pre-measurement reached) 4.2 - 1.3 (While the arithmetic mean and standard deviation of the dimensional measurement (8.5 – 1.2)

The calculated T-value was 9.05**, the tabular** was 2.045, and the significance of the differences was significant.

As for the results of the skill tests, the results indicated that there are statistically significant differences between the pre-tests and the post-tests.

Regarding the results of the test of the stamping and peaceful aiming, the mean of the arithmetic and the standard deviation of the pre-test reached (7.4 - 1.3) while the arithmetic mean and standard deviation of the post-test reached (4.8- 1.8 (

While the calculated T value was **-6.41**, the tabular was 2.045, and the significance of the differences was significant.

As for the skill test and the high typing test, the arithmetic mean and standard deviation of the pre-test reached (5.02-0.35), while the arithmetic mean and standard deviation of the post-test reached (5.48-0.42).

While the calculated T value was 5.31, the tabular was 2.045, and the significance of the differences was significant.

Regarding the skill test Thoracic handling The mean and standard deviation of the pre-test (18.3 1.6) while the arithmetic mean and standard deviation of the post-test reached (21.1-2.02).

The calculated T value of 4.2 was tabular 2.045 and the significance of the differences was significant.

3.2 Discussion of the Results:

Through Table (3), according to the available results, we can observe that there are statistically significant differences between the pre- and post-tests of the biochemical and skill variables studied**.** Regarding the results of the measurement of the blood pH level. (pH). The pH decreased from 7.35 (moderate) to 7.27 (hot), **indicating** the occurrence of metabolic acid status in hot climates. The combination of high physical exertion and high temperatures accelerates the body's dependence on the anaerobic system for energy production, leading to an increase in the production of hydrogen ions (H+) and the accumulation of lactic acid, which is directly reflected in the decrease in the pH of the blood. This has been confirmed (Périard et al., 2021) that "heat stress increases dependence on anaerobic metabolism during exercise, leading to faster accumulation of [H+] ions and a decrease in blood pH compared to moderate conditions[6].A **study (**Al-Azzam and Al-Kharsha, 2022) entitled "The Effect of Training in Hot Conditions on Some Physiological and Chemical Variables, confirmed that exercise in heat led to a statistically significant decrease in the level of blood pH in football players[7]".

As for the level of lactic acid, the measurement results showed that the concentration of lactic increased from 4.2 mmol/L to 8.5 mmol/L, this result is completely consistent with the decrease in (pH).Heat stress causes cardiovascular stress, as blood flow is diverted to the skin to cool the body, reducing blood flow to working muscles. This lack of oxygen available to the muscle prompts the body to produce more energy via the anaerobic pathway, producing greater amounts of lactic. Gonzalez-Alonso et al. (2008) have noted that "heat stress reduces muscular blood flow and increases the rate of glycogen metabolism, which contributes to a higher rate of lactic accumulation[8]."

A study (Abu Arida and Abu-Sal, 2023) found that "training in a hot environment significantly increases the concentration of lactate in the blood compared to a temperate environment, indicating an increased metabolic and physiological burden on the athlete."[9]

Regarding the skill variables (offensive) in basketball, we observe through the results of the pre- and post-tests a decrease in the performance of offensive skills (tapping and peaceful shooting, high tapping, chest handling) as the accuracy of shooting decreased and the performance time of the tapping and handling skills increased statistically significantly in hot weather.

The researcher attributes this decline to several reasons: the most important of which is that lactic accumulation and a decrease in pH are directly related to an increase in the feeling of stress and impaired muscle function, which explains the apparent decline in the efficiency of motor performance

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[6] -Périard, J. D., Eijsvogels, T. M. H., & Daanen, H. A. M. (2021). Exercise under heat stress: Thermoregulation, hydration, performance implications and mitigation strategies. *Physiological Reviews, 101*(1), 187-248

[7] - Lazzam, K., & Al-Kharsha, M. (2022). The Effect of Training in Hot Conditions on Some Physiological and Chemical Variables. *Journal of Physical Education Sciences*, *15*(2), 123-135

[8] -Gonzalez-Alonso, J., Crandall, C. G., & Johnson, J. M. (2008). The cardiovascular challenge of exercising in the heat. *The Journal of Physiology, 586*(1), 45-53.

[9] - Abou Arida, A., & A. (2023). The Effect of Training in Hot Environments on Lactate Concentration and Some Physiological Indicators in Athletes. *Jordanian Journal of Mathematical Sciences*, *17*(3), 89

As well as the direct effect of physical and thermal stress: Muscular and physiological fatigue leads to impaired neuromuscular coordination, which negatively affects the accuracy of aiming and the speed of the implementation of complex motor skills such as rapid tapping with control.

Heat and physical stress also reduce mental focus, decision-making speed, and visual attention, all of which are critical factors for successfully performing offensive skills in basketball.**Schmit** et al., 2018 found that "exposure to heat stress led to a marked deterioration in basketball shooting accuracy and ball handling skills, and this deterioration was associated with increased heart rate, basal temperature, and self-perception of stress[10]."

A study (Al-Jubouri & Al-Obaidi, 2021) entitled "The Impact of Hot Climate on Some Physical and Skill Abilities of Basketball Players" indicated that there was a statistically significant decrease in the level of performance of basic skills (taping, passing, shooting) when training in hot weather compared to moderate weather, and attributed this to an increase in the "physiological load" [11] and general fatigue.

4. Conclusions and Recommendations:

4.1 Conclusions:

1. Physical activity in hot, dry environments leads to a statistically significant decrease in blood pH, indicating a state of metabolic acidosis compared to mild climates.
2. Applying practical basketball lessons in hot and dry climates leads to heat stress, especially without adequate hydration, and thus a high level of lactic acid.
3. The application of practical lessons in hot weather negatively affects the accuracy and efficiency of the performance of basic offensive skills in basketball (peaceful shooting, high tapping, chest handling), as accuracy decreased and execution time increased statistically significantly.
4. There is a close correlation between the impact of biochemical variables and the performance of basic basketball skills by heat stress.

4-2 Recommendations: Through the results reached, the researcher recommended several recommendations.

1- Work to provide air-conditioned or shaded well-ventilated indoor halls for practical lessons at times of heat peak.

2- Attention to recovery periods and optimal replacement of lost fluids and electrolytes after practical lessons

3- Organizing awareness lectures for the faculty of physical education and sports sciences about the risks and symptoms of heat stress, and the importance of continuous hydration before, during, and after physical activity.

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[10] -Schmit, C., Duffield, R., Hausswirth, C., Brisswalter, J., & Le Meur, Y. (2018). Optimizing heat acclimation for endurance athletes: High- versus low-intensity training. *International Journal of Sports Physiology and Performance, 13*(6), 816-823.

[11] - Al-Jubouri, H., & Al-Obaidi, A. (2021). The Impact of Hot Climate on Some Physical and Skill Abilities of Basketball Players. *Al-Tarawi Journal of Mathematical Sciences*, *8*(1), 56-70.

4- Conducting similar studies on larger samples, or on different age groups and skill levels, including other physiological variables such as core body temperature, heart rate, indicators of dehydration, and psychological variables such as self-perception of stress.
5- Research the effectiveness of different strategies to mitigate the negative effects of heat, such as using certain sports drinks or cooling the body before exercise.

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1- Abou Arida, A., & Abu-Sal, A. (2023). The Effect of Training in a Hot Environment on Lactate Concentration and Some Physiological Indicators in Athletes. *Jordanian Journal of Mathematical Sciences*, *p.* 89.

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