THE RELATIONSHIP OF CERTAIN PHYSIOLOGICAL VARIABLES WITH BIO-KINETIC ABILITY AND PERFORMANCE ENDURANCE AMONG YOUTH HANDBALL PLAYERS AGED 16-18 YEARS

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ABSTRACT

This study aims to investigate specific physiological variables, Bio-Kinetic capacities, and performance endurance among youth handball players, aged (16-18), affiliated with Al-Diwaniya Sports Club. Additionally, it seeks to explore the interrelationships between the studied variables and performance endurance. The research adopts a descriptive methodology employing a correlational approach. The research cohort comprises fourteen youth handball players within the specified age range, representing the entire population at 100%. The findings underscore the imperative for constructing a rigorously designed test to assess handball performance endurance. Moreover, the physiological analysis of diverse variables associated with performance and the physiological strain endured by players reveals intricate interconnections and influences. These relationships are manifested through chemical interactions, along with the consequential impact of physical exertion:

Keywords: certain physiological variables - Bio-Kinetic ability - performance endurance.

INTRODUCTION AND SIGNIFICANCE

1.1 Research Background and Objectives:

The comprehension of the dynamic responses and adaptations occurring during sporting activities is pivotal for unlocking and optimizing the specificities inherent in training methodologies tailored to the nature of the game. This pursuit is aimed at directly influencing the elevation of functional, physical, skill-related, and tactical proficiencies.

The players' progression is heavily contingent upon the caliber of their physiological capacities and the nuanced evolution of these physiological and biochemical attributes. This evolution, orchestrating the adaptation of diverse bodily systems, empowers players to deliver heightened performances during competitive matches. The exigencies of handball performance mandate a consistent and elevated fusion of physical and skill-related prowess. It is therefore imperative that physiological variables, Bio-Kinetic capacities, and performance endurance synergistically serve each other to attain the envisioned objectives. The assessment of player aptitude through these parameters becomes a crucial undertaking.

The significance of this research lies in unraveling the intricate interplay between select physiological variables, Bio-Kinetic capabilities, and performance endurance in youth handball players. This discernment not only contributes to a profound understanding of player development intricacies but also serves as a foundational basis for delineating targeted training interventions. These interventions, in turn, aim to refine and augment functional, physical, and skill-related facets, thereby culminating in an elevated standard of performance.

1-2 Research Problem:

The nature of handball as a sport necessitates speed, continuous performance, and functional adaptability, which, in turn, contributes to adaptive responses. Given that performance endurance is a critical and influential factor in functional adaptation, as is the Bio-Kinetic ability, which plays a role in determining match outcomes. Observations during handball matches reveal a noticeable decline in player performance, with early signs of fatigue. Consequently, this research was initiated to answer the following question:

To what extent are certain physiological variables related to Bio-Kinetic abilities and performance endurance in youth handball players?

1-3 Research Objectives:

1. To identify certain physiological variables among youth handball players at Al-Diwaniya Club, aged (16-18) years.
2. To assess Bio-Kinetic abilities and performance endurance among youth handball players at Al-"Diwaniya Club", aged (16-18) years.
3. To examine the relationship between physiological variables and Bio-Kinetic abilities among youth handball players at "Al-Diwaniya Club", aged (16-18) years.
4. To investigate the relationship between physiological variables and performance endurance in youth handball players at "Al-Diwaniya Club", aged (16-18) years.

1-4 Research Hypotheses:

1. There is a statistically significant relationship between physiological variables and Bio-Kinetic abilities in youth handball players at "Al-Diwaniya Club", aged (16-18) years.
2. There is a statistically significant relationship between physiological variables and performance endurance in youth handball players at "Al-Diwaniya Club", aged (16-18) years.

1-5 Research Scope:

1-5-1 Human Scope: Youth handball players at "Al-Diwaniya Club", aged (16-18) years.

1-5-2 Temporal Scope: December 1, 2023, to January 20, 2024.

1-5-3 Spatial Scope:" Al-Bilad Medical Laboratory for Pathological Analysis", "Al-Diwaniya Sports Club field"

3-RESEARCH METHODOLOGY AND FIELD PROCEDURES:

3-1 Research Method:

The methodology represents a crucial and fundamental aspect in the execution of scientific research. Therefore, the researcher opted for the descriptive approach (correlational relationships) to align with the nature of the study.

3-2 Research Population and Sample:

The research population was identified as youth handball players aged (16-18), consisting of fourteen players, representing 100% of the original population.

3-3 Research Tools and Equipment:

1. Monark Swedish-made cycle ergometer (Monark/Model 894).
2. K5 apparatus for measuring cardiorespiratory variables.
3. American-made treadmill.
4. Markers.
5. Electronic stopwatch.
6. Measuring tape.
7. Regulation handball field.
8. Five whistles.
9. Adhesive tape.

3-4 Field Research Procedures:

3-4-1 Testing Specific Physiological Variables: 3-4-1-1 Wingate Test[1]: This test was conducted to measure oxygen consumption through the following steps:

- Determine the required resistance using Table (1) based on body weight. [2]

[1] https://en.wikipedia.org/wiki/Wingate_test.
[2] Al-Hazaa, Mohammed: "Physiology of Physical Exertion, Theoretical Foundations and Laboratory Procedures for Physiological Measurements," Vol. 1, Riyadh, Scientific Publishing and Printing, 2008, p. 49.

Table (1) Illustrates the Oxygen Consumption Levels during Physical Exertion Using the Ergometer at Various Capacities

Oxygen Consumption (L/min)	power		Bike Resistance (kg)
	lux	kg ·m/min	
0.6	25	150	0.5
0.9	50	300	1
1.2	75	450	1.5
1.5	100	600	2
1.8	125	750	2.5
2.1	150	900	3
2.4	175	1050	3.5
2.8	200	1200	4
3.1	225	1350	4.5
3.5	250	1500	5
3.8	257	1650	5.5
4.2	300	1800	6
4.6	325	1950	6.5
5	350	2100	7

We determine the required resistance using the following equation:

Player's Required Resistance= $\frac{(7.5\times Player's\ Mass}{100}$

After obtaining the required resistance, we calculate the absolute oxygen consumption by converting the relative oxygen consumption (ml/kg/min) to (L/min) using the following equation: Absolute Oxygen Consumption= $\frac{(Player's\ Mass\times Relative\ Oxygen\ Consumption)}{1000}$

Secondly, measuring the lactate concentration in the blood and heart rate post-exertion: Immediately after exertion, following (5) seconds of performing the "performance endurance" test, during which the participant sits on a chair with their arm attached to a compression band (tourniquet) to facilitate blood withdrawal (2 cc of venous blood) by a specialized chemist. The blood is then placed in medical tubes (tubes) and directly transferred to the specialized laboratory. Each tube is numbered, with each player assigned a specific number for accurate data tracking. After that, the lactate concentration in the blood is measured after (5) minutes of test execution, which is the optimal period for the transition and accumulation of lactate from muscles to blood (1). The measurement strip is placed in the designated location on the device, and after placing the strip, the code number appears. A blood sample is then taken from the laboratory using a lancet, which is used to puncture the fingertip, and then pressed to extract a blood drop. The device screen displays the lactate concentration in the blood based on the specified percentage. Simultaneously, the pulse is measured after the same exertion using the Onrhythm 500 Bluetooth Watch, where a heart rate monitor (Bluetooth) is attached to the chest of the participant to receive signals from the heart and send them via Bluetooth to the wristwatch.

3-4-2 Specific Bio-Kinetic Abilities Test:

First: Explosive Power Test for Lower Limbs (Three-Step Vertical Jump Test) (1)

- **Objective**: Measure the explosive power of the lower limbs.

Second: Circles Compatibility Test:

- **Objective**: Measure the coordination between the eyes and the lower limbs.

Third: 30-Meter Sprint Test from a Standing Start(1):

- **Objective**: Measure transitional speed.

3-4-3 Handball Performance Endurance Test (2):

- **Objective**: Measure the player's ability to endure performance

(1) Muhammad Ali Al-Qatt: Functions of Organs and Training, Cairo, Dar Al-Fikr Al-Arabi, 1999, p. 27.
(1) Hussein Mardan (and others): Babell Test for Measuring Non-Aerobic Muscular Ability of Leg Muscles, Al-Qadisiyah Journal of Sports Education Sciences, Vol. 1, No. 3, 2001, pp. 107-116.
(1) Majid Khodayekhosh Asad: Construction of Physical and Skill Tests in Futsal, 1st edition, Dar Ghaidaa for Publishing and Distribution, Amman, 2011, p. 137.
(2) Salam Hassan Abdullah: The Impact of Sequential Performance Endurance on Some Functional Variables Related to O2 and CO2 for Young Handball Players, Master's Thesis, College of Physical Education and Sports Sciences, Al-Qadisiyah University, 2022, p. 42.

3-5 Exploratory Experiment:

The researcher conducted the exploratory experiment on Sunday, October 11, 2023, with (5) players from the research sample. The objectives of the experiment were to:

1. Assess the feasibility of implementing the study.
2. Identify the challenges that the researcher and assistants may face during the execution of measurements and tests.
3. Confirm the validity of the tools and devices used in the research.
4. Determine the appropriateness of the test with the capabilities of the research sample.

3-6 Scientific Foundations of the Test:

3-6-1 Validity: The researcher sought the opinions of experts and specialists to confirm that the test is suitable for the phenomenon it was designed to measure, with a percentage of (100%) for the tests used in the research. Face validity was employed.

3-6-2 Reliability: The researcher adopted the test-retest method for the used tests by applying them to the exploratory sample. The data were statistically processed using the Pearson correlation coefficient between the two tests, as illustrated in Table (2).

3-6-3 Objectivity: After presenting them to two evaluators, the results of the calculated correlation coefficients indicated a high correlation in the tests.

Table (2) illustrates the reliability and objectivity coefficients.

The Tests	Reliability	Objectivity
Explosive Strength	0.88	0.89
Transitional Speed	0.80	0.89
Coordination	0.97	0.98
Performance Endurance	0.92	0.94

3-7 Main Experiment:

Following the completion of the exploratory experiment and the final preparation of the experiment's requirements, the researcher conducted the main experiment over a period of (3) days, from November 15, 2023, to November 18, 2023, on the research sample. On the first day, physiological tests were conducted, followed by biomechanical tests on the next day, and performance endurance tests on the subsequent day.

3-7 Statistical Methods:

1. Mean (Arithmetic Mean)
2. Standard Deviation
3. Standard Error

Variables		Number	Mean	Standard Deviation	Standard Error	Measurement Unit	Minimum	Maximum
Variables	HR	14	165.7	29.344	7.84	beats/min	64.00	176.40

4- Correlation Coefficient
5- Percentage

4- Presentation, Analysis, and Discussion of Results:

4-1 Presentation of the Central Tendency Characteristics of the Studied Variables.

Table (3) Illustrates the central tendency characteristics of the studied variables.

Physiological Variables	HR	14	165.7	29.344	7.84	Minute/ N	64.00	176.40
	Oxygen Debt	14	29.042	2.362	0.6313	Liters/minute	25.34	34.48
	Lactic Acid	14	5.8129	1.2431	0.3322	ml. mol	1.79	6.77
Bio-kinetics	Explosive Power	14	1384.0	11.901	3.1808	Watts	1359.61	1399.61
	Transitional Speed	14	4.1371	0.0201	0.0053	s	4.11	4.18
	Compatibility	14	8.6731	0.6333	0.1692	s	7.32	9.32
Performance Endurance		14	2.1396	0.0124	0.0033	s	2.12	2.17

4-2 Presentation of the Results of the Relationship Between Physiological Variables and Biokinetic Capacities:

Table (4) Shows the relationship between physiological variables and bio kinetic capacities

Physiological Variables		**Bio-kinetic Capacities**					
		Explosive Power	**Significance**	**Transitional Speed**	**Significance**	**Compatibility**	**Significance**
HR	**Correlation Coefficient**	0.638*	**Significant**	0.578*	**Significant**	0.613*	**Significant**
	Significance Level	0.014		0.030		0.020	
Oxygen Debt	Correlation Coefficient	0.660*	**Significant**	0.271	**Not Significant**	0.564*	**Significant**
	Significance Level	0.010		0.348		0.036	
Lactic Acid	Correlation Coefficient	0.541*	**Significant**	0.578*	**Significant**	0.447	**Not Significant**
	Significance Level	0.046		0.030		0.109	

Below the significance level (0.05).

Table (4) indicates a positive correlation between physiological variables and some biokinetic capacities. Regarding the heart rate variable, there was a significant correlation with explosive power, transitional speed, and compatibility. The researcher attributes this to the increase in biokinetic capacities, which is accompanied by an increase in heart rate due to exertion. Jabaar Rahima noted, "During physical exertion, there is an increase in heart rate due to increased demand for oxygen and energy sources. The heart rate during aerobic physical exertion is less than 170 beats per minute, while during anaerobic physical exertion, it exceeds 180 beats per minute."[2]

Therefore, an increase in heart rate per minute is associated with the heart's function and the stress imposed on it due to exertion (aerobic and anaerobic). "Heart rate usually reflects the heart's effort to meet the body's requirements."[1]

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Oxygen debt is the amount the respiratory system can provide and can be calculated after physical exertion by determining the threshold between the oxygen consumed after exertion and reaching the normal consumption during rest.[2]

Therefore, an increase in the oxygen debt ratio indicates the extent of the physical exertion performed. It shows that muscles involved in the performance have exerted greater muscular effort. This is why players need larger amounts of oxygen during the recovery period to compensate for the oxygen consumed in high-intensity physical exertion. Oxygen debt increases with increasing physical exertion, indicating an increase in biokinetic capacities. The excess oxygen consumption during the recovery period is not solely for compensating for the energy deficit but also for restoring the physiological balance of the body after intense physical exertion. Thus, it increases with the intensity of the physical exertion applied

(2) Jabar Rahima Al-Kaabi: "Physiological and Chemical Foundations of Sports Training," Doha, 2007, p. 57.
(3) Bahaaddin Ibrahim Salama, 1999: "Biological Representation of Energy in the Sports Field," Arab Thought House, Cairo, 1999, p. 52.
(4) Amar Jasim, Aqeel Muslim: "Physiological Foundations of the Respiratory System," Al-Nakhil Printing, 2nd edition, Basra, 2010, p. 78.

As for lactic acid, the production processes of lactic acid are accompanied by disposal processes, leading to a noticeable increase in the concentration of lactic acid in the working muscles. Therefore, it can be indicated that athletes with high aerobic capacities may delay reaching the lactate threshold since their maximal aerobic capacity can handle the production processes of lactic acid by efficiently disposing of it. For this reason, lactate threshold detection is often performed using various measurements, with the most accurate and common method being monitoring the concentration of lactic acid in the blood through protocols designed for this purpose. These protocols involve multiple stages, with lactic acid concentration measured at the end of each stage using various techniques and devices. A concentration of 4 mmol/liter is an indicator of reaching the lactate threshold, where a breakpoint occurs in production processes that surpass disposal, leading to a significant increase in lactic acid and accompanying physiological changes in the working muscles.

Based on the mentioned information, it can be stated that delaying the arrival at the lactate threshold is an indicator of improvement in biochemical activities for all muscles, and it may delay fatigue resulting from lactic acid accumulation.[1]

[1]Amar Jasim, Aqeel Muslim: Same source as mentioned earlier, 2010, p. 78.

4-3 Presentation of the Results of the Relationship Between Physiological Variables and Performance Endurance:

Table (5) illustrates the relationship between physiological variables and performance endurance.

Physiological Variables		Performance Endurance	Significance
HR	Correlation Coefficient	0.874**	Significant
	Significance Level	0.000	
Oxygen Debt	Correlation Coefficient	0.539*	Significant
	Significance Level	0.047	
Lactic Acid	Correlation Coefficient	0.556*	Significant
	Significance Level	0.039	

The table (5) indicates a correlation between the studied physiological variables and performance endurance. As the rates of physiological variables increase, performance endurance also increases. This can be attributed to the fact that functional body variables are linked to the body's need for oxygen, which is essential for the speed and type of physical activity intended to be applied. Therefore, respiratory system variables are affected by changes in blood acidity levels and the amount of consumed O2. The respiratory ventilation response often aligns with the speed of energy production.

Moreover, the pulse serves as an indicator of the speed of physical activity performed. Changes in heart rate occur when high-performance speed is reached and under the oxygen threshold, leading to an increase in catecholamine hormones. Consequently, the heart rate increases to deliver a larger amount of oxygen-loaded blood to the working muscles. Additionally, a significant amount of CO2 is expelled to the lungs to eliminate the CO2 produced during oxidation-reduction processes in energy production(1).

Lactic acid accumulates in the muscles due to high-intensity effort in activities with a lactic acid system. The insufficient supply of O2, which is not enough to meet the demand of this effort, leads to an increased heart rate to push oxygen-loaded blood to the working muscles to meet their oxygen and blood needs. There is a correlation between pulse and lactic acid accumulation. Both increase proportionally with the intensity of the effort and decrease as the intensity of the effort decreases, resulting in a lower heart rate(2).

(1) Hashem Adnan Al-Kilani: "Physiological Foundations of Sports Training," 1st edition, Falah Publishing Office, 2001, p. 322.
(2) Haitham Abdul Rahman Al-Rawi: "Evaluation of Training Programs Based on Some Chemical and Physiological Influences in Volleyball Players in Iraq," Doctoral Thesis, College of Physical Education, Al-Qadisiya University, 1996, p. 17.

5-1 Conclusions:

1. It is essential to develop a standardized test for measuring handball performance endurance.
2. Physiological analysis of various variables related to performance and the physical exertion on the player's body is crucial.

3. The interdependence and impact of physiological and biokinetic variables are evident through chemical interactions and the influence of physical exertion.
4. All physiological variables or biokinetic capacities are influenced by external effort and increase with increased physical exertion.
5. Physiological variables and biokinetic capacities are closely linked to performance endurance, showing adaptation during performance endurance.

5-2 Recommendations:

1. Evaluate training sessions based on physiological and biokinetic variables as important indicators for assessing the training status of players.
2. Conduct exercises that contribute to the development of handball performance endurance and other related sports.
3. Conduct similar studies on handball and other individual and team sports, considering different age groups.

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