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Building a model for measuring the level of physical and skill performance of volleyball players according to the variance level of the MCT1 gene and basic biochemical indicators

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ABSTRACT

The use of modern technology for scientific studies in a variety of sectors, including sports, has led to significant advancements and tremendous progress in this field. This has resulted in the best performance in various competitions and sports, and one of the modern technologies is the field of genetics technology. The aim of this study was to build a model for measuring the level of physical and skill performance of volleyball players according to the variance level of the MCT1 gene and basic biochemical indicators. The researchers used the descriptive approach. The sample of the study consisted of 21 advanced volleyball players from the Middle Euphrates region participating in the Men's Premier League for the 2020-2021 sports season. To solve the research problem, we used the following variables: the MCT1 gene, chemical indicators of blood (LDH enzyme, the concentration of lactic acid in the blood, PH of blood), and the level of physical and skill performance in volleyball. The researchers used the Statistical Package for the Social Sciences (SPSS) for data analysis. In terms of the variance level of the MCT1 gene and various blood chemical indicators for the degree of performance of the skillful physical effort in volleyball, three prediction rates (models) were obtained. The amounts of variability of the MCT1 gene in the research sample varied between high and low levels. The researchers suggest using the model for prediction rates to determine the performance level of volleyball players and stressing genetic study of the MCT1 gene in volleyball players to facilitate the selection of players, particularly juniors.

KEYWORDS

Model; Physical and Skill Performance; MCT1 Gene; Biochemical Indicators; Volleyball

1. INTRODUCTION

Using modern technology for scientific studies in a variety of sectors, including sports, has resulted in significant advancements and tremendous progress in this field. As a result, it led in the best performance in various competitions and sports, and one of the modern technologies is the field of genetics technology, which has a modern focus on utilizing this technology in the sports field, with a trend toward the possibility of using genetics technology to change and improve sports performance. Via genes, the type of sport that suits the individual is determined, a genetic factor specific to fitness and physical performance is improved, and the optimum benefit from training is known (Jastrzębska et al, 2022; Smith et al, 2017).

Due to the amazing progress of genetic engineering sciences, some genes responsible for the change in the level of physical performance of athletes have been revealed, including the gene related to anaerobic effort, fatigue and lactate, which is the MCT1 gene. This type of gene explains the difference in athletic performance between athletes. In the past decade, the family of monocarboxylates (MCTs) has been discovered and 14 genes were identified from this family, including the MTC1 gene, which appears highly in many different tissues. The MCT3 gene is located in the primary membrane of retinal epithelial tissue, while the MCT4 gene is located in skeletal muscle parallel to the Mct1 gene. Together, these two genes are responsible for the rapid absorption of lactate in the blood and muscles, and the oxidation of lactic acid to use it as fuel for energy.

Of the foregoing, we can deduce that genes play a vital role, particularly the MCT1 gene, which is responsible for the quick movement of lactate in the blood and muscles, as well as the process of lactic oxidation, which allows us to use it as a source of energy. This improves performance in a variety of sports, including volleyball, which is one of the group games that require individuals to possess specific attributes that qualify them to play the game type according to the genetic categorization (Marín et al, 2010). Through these genetics, players can be selected according to the type of game that is related to their physical effort and physical ability.

Volleyball requires a high ability to withstand the increase in the concentration of lactic acid as a result of the anaerobic physical exertion in it. This effort is associated with many chemical indicators that give an indication of how efficient the volleyball player is during competition and races. The aim of this study is to build a model for measuring the level of physical and skill performance of volleyball players according to the variance level of the MCT1 gene and basic biochemical indicators.

2. METHODS

2.1. Study Design and Participants

The problem, its nature, and the research objectives are what determine the type of approach used. The researchers used the descriptive approach because it is the appropriate approach to solve the research problem and achieve its objectives.

The researchers identified the research community represented by advanced volleyball players in the Middle Euphrates region participating in the Men's Premier League for the 2020-2021 sports season. They were 25 players. After the homogenization procedure, four players were excluded for not being homogeneous with the community members. Thus, the number of the research sample became 21 players. They represent 84% of the research community.

2.2. Research Variables

To solve the research problem, the variables suitable for the study and the related field treatments were identified and investigated as follows. 1) MCT1 gene. 2) Chemical indicators of blood, including: LDH enzyme; concentration of lactic acid in the blood; PH of blood. 3) The level of physical and skill performance in volleyball.

2.3. Tests and Measurements

2.3.1. MCT1 Gene Measurement

A blood sample was taken from volleyball players (5cc) on Sunday (14/12/2020). Samples are taken from the forearm area of venous blood and placed in special tubes for preserving blood, regularly numbered according to the sequence of the players (from 1-21). The number expresses the player's name and is placed in tubes with the player's number written on it and kept in the cool box to be transferred to the genetic laboratory in the researcher's laboratory for assays in Al-Diwaniyah. After conducting laboratory assays, the detection of MCT1 gene iN its various stages is performed by a specialist in the field of genetic analysis.

2.3.2. Pre-stress assay

The measurements were made before the effort on the research sample on Tuesday (29/12/2021) as follows:

A blood sample of 7.5cc was taken from the players during the rest period in the indoor sports hall in Al-Diwaniyah. Samples are taken from the forearm region of venous blood and the player is in a sitting position. Blood samples are placed in special tubes for preserving normal blood at an

amount of (5cc) to extract values (the concentration of lactic acid and LDH enzyme), while a blood sample is placed in tubes containing a preservative (EDTA) amounting to (2.5cc) to extract values of blood PH numbered according to the players sequence (from 1-21). The number expresses the player's name with the help of a chemical specialist in this field, provided that all temporal and spatial conditions are established to unify them and avoid any error.

2.3.3. The skillful physical performance test

The researchers conducted an anaerobic physical performance test on the study sample at the indoor gymnasium hall in Diwaniyah on Friday (8/1/2021). The test was called "the Zein test" and measures the skillful physical effort. The test is carried out as follows:

- First, the sample perform the warm-up process in a natural and sequential manner for a period of time from (5-10) minutes, because in this way we achieve the physical rehabilitation and prepare all members for the test with a pulse rate of (125-130) beats/minute. This because the test requires preparation and high physical readiness. This is done by identifying the number of heartbeats down to the desired.
- The player A prepares in the back area to perform the skill of serving from the moment the timing begins. The player has the freedom to carry out the serve for station No. (1). After completing the service, the player moves to jump over a barrier with a height of (70) cm. This obstacle is placed near the back line in center No. (6) in station (2), then the player performs a forward roll at station No. (3). The trainer (2) in the area (3) close to the net initiates a crushing batting on the player (A) before he fully stops from the front roll from the center (6), which is marked with (X) in order to focus on the height of the performance level of the skill of the deep defensive exercise against sneaky balls.
- The player A moves with full speed to the center (1) which is specified in the area No. (4) to defend the ball coming from the coach by crushing and then turns to station No. 5 with a quick side movement also to defend the stadium against the crushing balls by the second coach. The coaches must be prepared to do the crushing batting or throw the ball well to ensure the effectiveness of the motor and skill performance and the high level of rapid performance. The player must not stop moving through these stations. This succession in the deep performance of the skill of defending the playing field and defending the serve contributes to increasing skill endurance and making quick decisions in dealing with such situations in play.

- The player moves to station No. (6) to prepare and cover against balls falling from the opposing team or rebounding from the blocking wall. Then he moves at full speed with a sideways movement to the other side of the playing field at station No. (7). Then he moves to station No. (8) to face the crushing batting skill of the coach standing in the frontal area and deliver the ball to the center (3) in the correct manner. This helps the person who prepares the balls in preparing them for his team with the highest degree of accuracy. Player (A) turns to the other side of the field to reach station No. (9) to defend the crushing blows.
- It takes into account the preservation of time and the performance of these stations in the shortest possible time, as well as the location of the balls falling, as exactly happens in the match, as well as focusing on the sequence in the skill and physical performance and how to change and organize the player's defensive and offensive tasks and kinetic behavior.
- The player (A) runs to station No. (10) and gets ready to jump over three hurdles with a height of (70) cm. The distance between each barrier and the other is (100) cm. After descending from the third barrier, prepare to perform the skill of crushing strike from center (4) and direct the ball to center number (5) in the opponent's court. Then the player moves to do a quick attack from position No. (3). After taking a preparatory period and returning close to the front line (offensive) line, he is doing batting skill from center (2) because this position is important for scoring points and directing the ball in center number (5) to increase the level of difficulty for the player.
- The player must take into account directing the ball while performing all kinds of crushing blows (hard - light).
- The player changes the rhythm of a movement from offensive skills to defensive skills, on the opposite side of the field in Center No. (4), where he performs the blocking skill in station No. (4). The trainer performing the shattering skill for the player starts in the center (4), center (3), and center (2). The movement of the player while performing the skill of the blocking wall with respect to the feet shall be intersecting during the performance in order to ensure that the player reaches the ball at the maximum speed, taking into account the fall of the ball while performing the blocking wall towards a confrontation inside the court of the team performing the skill of crushing batting.
- After completing the blocking wall skill, the player moves to the back line to perform the back smash skill after preparing the ball correctly by the coach.

- After player (A) finishes the back smash skill from station No. (17), the stopwatch is stopped to announce the real time for performing the maximum skill physical test, which ranges between (39-45) seconds.

2.3.4. Post-stress assay

The researcher took blood samples after the effort for the anaerobic physical performance in volleyball for the members of the research sample (21 volleyball players). After the test is completed, the players sit on a chair next to the volleyball court, and a blood sample of (5cc) is taken immediately after the skillful physical effort. Samples are taken from the forearm region of venous blood while the athlete is in a sitting position and placed in special tubes for preserving blood, with an amount of (2.5 cc) to extract the values of LDH enzyme. The blood samples are placed in regular blood preservation tubes numbered according to the sequence of the swimmers (from 1-21). The number expresses the player's name by a medical staff specialized in this field. The samples are transported by a refrigeration box to the Al-Bilad Laboratory for pathological analyzes in Al-Diwaniyah.

2.4. Statistical Analysis

The researcher used the Statistical Package for the Social Sciences (SPSS) for data analysis, including the following statistical analysis: descriptive analysis, simple correlation coefficient, multiple correlation coefficient and multiple gradient regression equation.

3. RESULTS

We begin this section by presenting the results of building a model for the level of physical and skill performance according to the variance level of the mct1 gene and the most important biochemical indicators of volleyball players in Iraq.

Table 1 shows the results of the descriptive analysis of the level of heterogeneity of the MCT1 gene, some blood chemical indicators (enzyme LDH, lactic acid and PH blood) and the level of physical performance and skills of volleyball players in Iraq.

Table 1. The level of heterogeneity of the MCT1 gene, blood chemical indicators (enzyme LDH, lactic acid and PH blood) and the level of physical performance and skill

No	Variables		Measuring unit	Arithmetic mean	Standard deviation
1	Level of variance MCT1		Δ	9.718	4.3175
2	Enzyme LDH	Chemical indicators of blood after skillful physical effort in volleyball	IU / L	318.422	41.317
3	Lactic acid		ml.	6.015	1.5028
4	PH Blood		vigor	7.224	0.0651
5	Physical effort skill in volleyball		Sec.	43.295	4.827

Now, we present and explain the results of the contribution ratio and prediction of the level of physical and skill performance in terms of the variance level of the MCT1 gene and some blood chemical indicators after the skillful physical effort in volleyball (Table 2).

Table 2. The percentages of contribution and building a model for the level of physical and skill performance according to the variance level of the MCT1 gene and biochemical indicators.

Method	Variable	Calculated F	Degree of freedom	Correlation Coefficient	*p*	Contribution
Gradient fall	Gene variance level of MCT1	46.748	1-19	0.938	0.000	0.938
	PH blood	22.682	1-18	0.963	0.000	0.084
	Lactic acid	8.882	1-17	0.987	0.000	0.024

The following equations were obtained:

- The level of physical and skill performance in volleyball = 1.043 + (4.312 × MCT1 gene) Model No. (1).
- Example: level of physical and skill performance in volleyball = 1.043 + (4.312 x 9.718) = 42.97617 seconds
- The level of physical and skill performance in volleyball = 6.715 + (2.871 × MCT1 gene (0.186 × blood PH) model No. (2)).
- The level of physical and skill performance in volleyball = 4.972 + (0.869 × MCT1 gene) (0.284 × blood PH) (0.361 × blood lactic acid) model No. (3).

4. DISCUSSION

The MCT1 gene was found in the first sequence following a skillful physical effort in volleyball, whereas blood pH was found in the second sequence and lactic acid was found in the third sequence. This demonstrates that the lower the degree of post-exercise lactic acid concentration, the higher the level of MCT1 gene variability. This is ascribed to the fact that the skilled physical effort required in volleyball is part of the volleyball player's anaerobic labor, which works to create energy in an anaerobic manner.

The increase in the level of lactic acid concentration makes a very high burden on the player, especially when the performance is with maximum effort and more frequently during the testing period. Working at high intensity is able to increase the lactic acid in the blood due to the anaerobic glycolysis process that the body performs to return the ATP complex inside the muscle cell with insufficient oxygen to the working muscles. This leads to the inability of mitochondria to enter the released hydrogen ion into the respiratory chain. Thus, the pyruvic acid combines with the hydrogen ion to form lactic acid. When the glucose molecule is broken down, pyruvic acid is released with a small amount of ATP, then the pyruvic acid reacts with oxygen. When the muscle contracts severely, in this case, the percentage of oxygen in the blood will decrease, causing the pyruvic to combine with the released hydrogen ions to form lactic acid. This increase in concentration when compared with the subjects of the research sample who have a low level of the gene is less as a result of the high level of the MCT1 gene they have. The gene works to get rid of lactate after high anaerobic effort depending on the shuttle transport of lactate and thus becomes more tolerant of muscle fatigue (Heshmat & Abdel, 2010).

The high level of MCT1 gene leads to an increase in the level of PH in the blood, due to the anaerobic effort that the volleyball player performs during the skillful physical test periods, which increases the concentration of lactic acid and thus lowers the level of PH in the blood. This decrease was not at the level affecting the performance of individuals who have a high level compared to individuals who have a low level, because the PH of the blood gives an indication of the amount of regulation that occurs in the body. Any imbalance in blood PH will negatively affect the mechanism of work of all other body systems, including the arrival of nerve signals to the working muscles as well as the effectiveness and activity of enzymes inside the body. The organized solutions work to maintain the PH of the blood within the normal state because the normal person or the athlete can live when the PH of the blood at rest ranges between 6.8 - 7.8. In such methods, it can cause coma and death of the individual. That is, an increase in lactic acid leads to a decrease in blood pH, which

affects the fusion of myosin and actin, and then on the occurrence of muscle contraction, as well as inhibiting the activity of energy-related enzymes as a result of a decrease in blood PH. It also affects the delivery of nerve impulses through the nerve endings (Abdel-Hadi, 2001).

This is characteristic of individuals who have a high level of the MCT1 gene, where the buffer solutions are more effective. Thus, there is ability to bind to the hydrogen ion which removes it from the solution when its concentration in it increases, or provides the solution with a hydrogen ion when it decreases. In this way, biological organizations can maintain the stability of the pH in the body (Abdel-Hadi, 2001).

In sum, we notice a decrease in the time of the skillful physical effort test, where the reason is that an increase in the level of heterogeneity of the MCT1 gene accompanies a decrease in the time of the test. Thus, it leads to achieving the best physical skill level of performance among volleyball players as a result of the high level of the MCT1 gene distinguished individuals in a high capacity of lactic endurance that suits the type of race and the energy system more. When the concentration of lactic acid is high, it gives additional capabilities to the volleyball player that helps him in endurance and increase the disposal of the rise in the concentration of lactic acid. "Every increase in the training in terms of intensity and size is offset by an increase in the functional capacity of the internal organs in a way that ensures growth and develops achievement" (Al-Mandalawi & Al-Shati, 1987).

The individuals with high level of the MCT1 gene have a high level of performance through a reduced performance time compared to individuals with a low level of the gene. The muscles of volleyball players with a high level of the MCT1 gene are characterized by a high percentage of the MCT1 gene. Thus increasing endurance and delaying the onset of fatigue. This in turn works with a low concentration of lactic acid as a result of the elimination processes in the muscles of these individuals. This means that the concentration of the MCT1 gene is proportional to the concentration of lactic acid, which is formed as a result of physiological processes in the body (Heshmat & Abdel, 2010).

The role of genes appears clearly especially the MCT1 gene, the monocarboxylate transporter responsible for the rapid transport of lactate in the blood and muscles and the process of lactic oxidation to benefit from it as a fuel for energy, which leads to an improvement in the level of performance (Aziz, 2018).

5. CONCLUSIONS

In terms of the variance level of the mct1 gene and various blood chemical indicators for the degree of performance of the skillful physical effort in volleyball, three prediction rates (models)

were obtained. The amounts of variability of the MCT1 gene in the research sample varied between high and low levels. The researchers suggest using the model for prediction rates to determine the performance level of volleyball players and stressing genetic study of the MCT1 gene in volleyball players to facilitate the selection of players, particularly juniors.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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