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Comparison of some mechanical variables for first and second place with Olympic level and world champions in the high jump at the 2021 Arab Championships

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Abstract

This research aimed to determine the role of some mechanical variables for the first and second place at the Olympic level and world champions, it can be said that there is a preference for some mechanical variables for the achievement of the high jump, and the research sample was the Arab champions in the advanced category of high jump in the Arab championship on 6/22/2021-16 in Tunisia (Rades Stadium). I used the descriptive method because it suits the nature of the research issue. He used five cameras in different directions and analyzed the attempt (2.16) meters for each vaulter and compared the best vaulters (Hussein Falah and Hamdi Ali) in the mechanical variables of the activity of the three free limbs and compared the reason for the success of the jump, he used five cameras installed on a tripod surrounding the player from all directions and all cameras are at the speed of (120) images / second to fit it with the speed of performance. He reached conclusions where the player (Hussein Falah) relies more on physical abilities than technique, if the technique had been corrected, he would have been able to take advantage of the lost height above the crossbar and break the Iraqi record. The player (Hamdi Ali) relies on technique and physical measurements that give an advantage to the player Hamdi in crossing the bar on the first attempt. We can recommend developing the technique to a height higher than 2.19, which

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was successfully jumped by Hussein Falah to identify and improve weaknesses, whether physical or skill, and conduct tests at intervals and provide effective specialized coaches who are professionals in the high jump .

Keywords: Comparison, Mechanical variables, Kinematic variables, World champions, High jump

Introduction

The science of biomechanics has contributed to the scientific advancement of human movement performance in general and athletes in particular because its main content in the field of physical education is the study of the causes of movement (Ali & Jameel, 2020)., i.e. attention to the internal and external forces causing it and provides the most appropriate solutions by using motor analysis (Abdulhussein et al., 2024) The use of various analytical and scientific programs as well as the use of advanced and modern devices (Hamid, 2016) as well as facilitating the process of detecting the sources of errors in the motor path and adjusting movement paths better according to biomechanical laws, achieve high achievement (Abdul-gani et al., 2024) Use of science whether it is Here we stand that there is a glimmer of hope for progress in this game leads us to wonder whether the world champions have better qualifications than the local champions and whether they adopt the correct methods of training (Aragón & Melissa 1997) (Nag, 2017), so we will conduct a study to find the best mechanical variables in the technical and technical performance of the Arab champions by filming the players participating in the (Arab Championships 2021 for advanced) (Hamed 2001).

The importance of this study is to determine the role of some mechanical variables for the first and second place with the target Olympic level and world champions in the achievement of the high jump event and whether there is a preference for some mechanical variables in the achievement of the 2021 advanced Arab champions for the high jump. Venue of the Arab Championships 2021/6/22-16. It was held in Tunisia (Rades Stadium).

Materials and Methods

The descriptive method was used because it suits the nature of the research issue. The research community was selected by the random method, represented by the Arab champions participating in the high jump event for strength sports (Arab championship in the year 2021), as shown in Table (1) The names of the players participating in the Arab championship high jump event on 2021/6/22-16), who are (100%) of the original community

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and Table (2) where it shows the specifications of each player in the Arab championship of weight, height, highest achievement and training time.

Table (1): Names of players participating in the Arab High Jump Championship on (16-22/6/2021)[3]

No.	Player Name	Height.								
		1.9 m	1.95 m	2.00 m	2.05 m	2.10 m	2.13 m	2.16 m	2.19 m	2.21 m
1	**Hussein Falah Ibrahim (Iraq)**	-	-	-	XO	O	OX	O	OXX	XXX
2	**Hashem Bouhanoun (Algeria)**	-	O	OX	O	XXX				
3	**Khaled Al-Masid (Kuwait)**	O	OX	O	XXX					
4	**Abdul Rahman (Kuwait)**	O	XXX							
5	**Hamdi Ali Bakr (Qatar)**	-	-	-	O	O	O	O	XXX	
6	**Mohamed Talaat Abu Talib (Egypt)**	O	O	O	OXX	XXX				

Table (2): Specifications of each player in the Arab championship(*)

No.	Player Name	Long	Score	Highest Achievement	Age	Training Age

[3] **Personal interview with each player live during the tournament held in Tunisia on Wednesday at 7:00 p.m. on 6/16/2021**

(*) A personal interview with each player during the tournament held in Tunisia on Wednesday at 7:00 pm on 6/21/2021.

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1.	Hussein Falah Ibrahim (Iraq)	190 cm	79 kg	223 cm	25 years	8 years
2.	Hashem Bouhanoun (Algeria)	180cm	73 kg	215 cm	24 years	15 years
3.	Uncle ALMASEED (Kuwait)	182 cm	75 kg	210 cm	26 years	14 years
4.	Abdul Rahman (Kuwait)	181 cm	77 kg	200 cm	25 years	13 years
5.	Hamdi Ali Bakr (Qatar)	192 cm	65 kg	227 cm	24 years	15 years
6.	Mohamed Talaat Abu Talib (Egypt)	198 cm	87 kg	220 cm	31 years	18 years

Various sources were used in collecting information: Arab and foreign sources, observation, analysis, personal interviews(*), the team, the World Wide Web (Internet), software and applications used Devices and tools Miscellaneous cameras (5) (Casio type, Chinese-made) with speeds (from 30 photos/s to 1000 photos/s) (Ibrahim, 2019) with a camera tripod. Documentation camera (2) and tape measure (1).Lenovo laptop (1) and tape measure (2).Drawing scale (1 m) (1).Legal high jump (1).

The researcher consulted many scientific sources and similar previous studies and took the opinions of experts (**) in the field of biomechanics in athletics to determine the most important distances and heights for the stages of the high jump. He conducted photography at the Arab championship held in Tunisia for the high jump event on Wednesday at 4 pm Tunisian time by photographing the Arab champions for the high jump event using five cameras in different directions as shown in the drawing above, analyzing the attempt (2.16) meters for each vaulter, and comparing the best vaulters (Hussein Falah and Hamdi Ali) in the variables of distance and heights of the center of gravity of the body and comparing them with the Ingar. 16 meters for each jumper and comparing the best jumpers (Hussein Falah and Hamdi Ali) in the variables of distance, heights, and center of gravity and comparing them to the explosion.

Mechanical variables of the high jump

(*)A personal interview with each player during the tournament held in Tunisia on Wednesday at 7:00 pm on 6/21/2021.

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Prof. Dr. Ali Shabout Al-Sudani - Biomechanics / Weights - Baghdad University / Faculty of Physical Education and Sports Sciences.

Prof. Dr. Yasser Najah - Biomechanics / Gymnastics - Baghdad University / Faculty of Physical Education and Sports Sciences.

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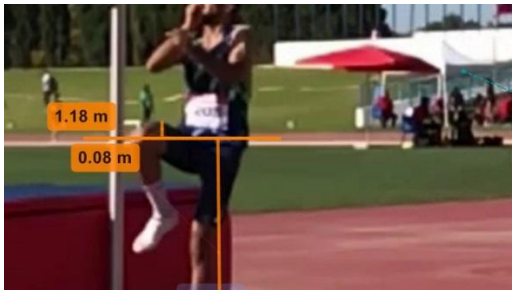
1- **Arm activity closest to the bar (AAN):** Extracts the distance of the highest height reached by the arm in millimeters above the horizontal line of the shoulder divided by the shoulder height in meters (Dhawan & Yasser, 2013).

2- **Arm activity farthest from the bar (AAF):** Extracts the distance of the highest height reached by the arm in millimeters above the horizontal line of the shoulder divided by the shoulder height in meters.

3- **Main leg activity (LLA):** Extracts the distance of the highest height in meters. The leg represented by the start of the knee joint in millimeters above the horizontal line of the hip divided by the hip height in meters.



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4- **Power to the elevation foot (PL):** Extracted according to the force law = (k*x/s)/player's weight.
5- **Pushing force for the elevation foot:** Extracted according to the law, push off force = force * time.
6- **Horizontal force for pushing moment:** After extracting the force, you hit the sine cos of the starting angle.
7- **Vertical force of the moment of impulse:** After the force is extracted, it is multiplied by the sine of the starting angle.

As for the exploratory experiment, the experiment on (Wednesday) at (10:00) am Tunisia time (16/6/2021), the experiment tested the devices used in the research (cameras) on the players (women's heptathlon) in the morning period to know the obstacles that may be faced during the main experiment held in Tunisia to know the tools that need to be provided, the validity of the tools used, the permits that had to be available, the number of members of the assistant team and the mistakes that could have been made, etc. He was able to identify and stabilize the locations of the cameras during this experiment and know the type of camera and the degree of zoom he needs, and then stabilize the method of performance photography by turning on the camera and passing a clip in front of the camera to know the height, the number of the attempt and the player, as well as coordination with the supervisors of the tournament and the judges responsible for judging the event because the main experiment was in the evening period of the tournament for the same day and the time is taken for each attempt or each jump in each height approximately and whether it fits in the storage space of the cameras and charging the batteries. To analyze the video imaging: I used video imaging to determine the biomechanical variables and analyze the movement completely, as it is a way to divide the total sections into parts and study these parts in depth to reveal their subtleties and know the weaknesses and strengths and obtain the biomechanical variables for each stage of the performance, where he used five cameras installed on a tripod that surrounds the player from all directions as shown in Figure (1) and all cameras are at a speed of (120) images/second (Philpott et al., 2021) consistent with that to suit it to the speed of the performance.

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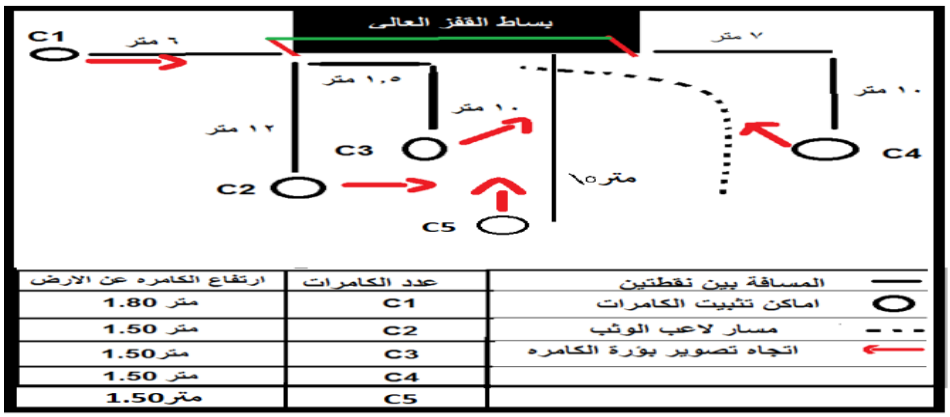

Figure (1): Where the cameras are installed inside the stadium and the direction of each camera

The research test (1) was the achievement test for high jump effectiveness (1) according to rule (185) (Čoh, 2010).

Statistical methods: Appropriate methods were used to determine the differences between the players, i.e. discussing the results directly without statistics and using graphs to illustrate the differences.

Discuss results

1- **Discuss the results of the sum of arm activity on the bar (AAT=AAF+ANN) (Díaz-Jiménez, 1993)**

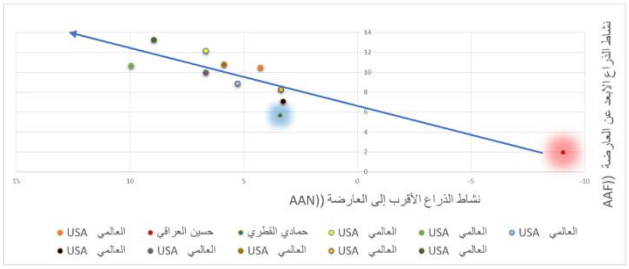

Figure (2): Total arm activity for the bar (AAT=AAF+ANN)

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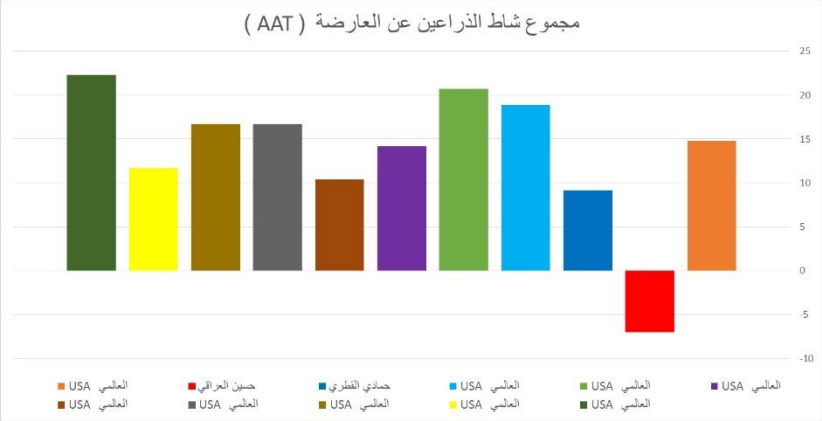

Figure (3): Total arm activity on the bar (AAT)

By viewing Figure (2) and Figure (3), we notice that the level of the world champions (AAN) ranges (3.3-10) mm/m, (AAF) ranges (7.1-13.3) mm/m and (AAT) ranges (10.4-22.3) mm/m. As for the Qatari player, the amount of (AAN), (AAF) and (AAT) were respectively (3.44), (5.7), (9.7) and (14) mm/m, which is a good amount because it is close to the world figure, but not ideal. 14) mm/m, which is a good amount as it is close to the world figure, but not ideal, as for the Iraqi player, the amounts of AAN, AAF, and AAT were respectively (- 9), (2), (7) mm/m and this amount is not good for the stage he reached compared to the amount of world champions, and from the researcher's point of view, if the Iraqi player wants to break the Iraqi record registered in his name, he must work greatly on the speed of arm activity because of its important role in directing the body and the momentum gained from the proximity run towards the top and utilizing the momentum optimally and converting as much of the linear speed into vertical speed and not direct the jumper towards the bar, as confirmed by (Hay, 1993), where we aspire in the near future for the Iraqi athlete to achieve (AAT) (10-15) mm / m.

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2- Discuss the results of the main free leg activity (LLA) and the sum of the three free limb activity (FLA) (Díaz-Jiménez, 1993)

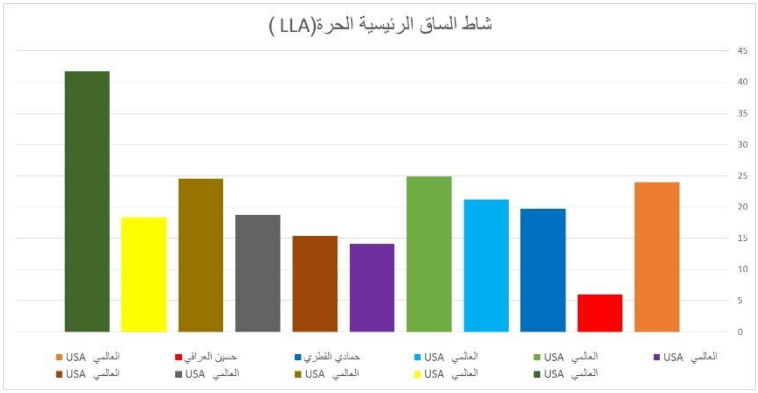

Figure (4): Free main leg activity (LLA)

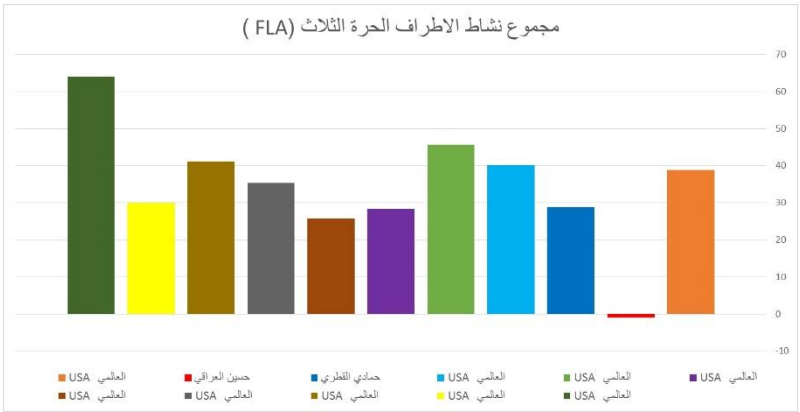

Figure (5): The total activity of the three free-limb activity (FLA)

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By viewing Figure (4) and Figure (5), we notice that the level of the world champions for both (LLA) and (FLA) respectively (14.1-41.7) mm/m, (25.8-64) mm/m, as for the Qatari player, its amount for both (LLA) and (FLA) respectively (19.7), (28.8) mm/m, which is a figure considered good because it is within the range of the world champions for the current level, and this indicates that the player has high flexibility in the hip joint, which plays an important role in the variable (LLA). This number is considered good because it is within the range of the world champions for the current level and this indicates that the player has high flexibility in the hip joint, which plays an important role in the LLA variable, which mainly depends on the ability of the jumper in the extent to which the knee can be raised to the highest point that it can reach during the ascent phase in the last touch, as for the Iraqi-Qatari player, his values for LLA and FLA were respectively (6) and (-1) mm/m, and this indicates that the Iraqi player did not reach the ideal level of performance compared to the world champions, and the difference from him in (LLA) was (8. (1) mm / m. As for (FLA) was (-1) mm / m. This indicates that the total activity of the free limbs is almost non-existent for the Iraqi player, so the player must develop hip joint flexibility (the amount of opening the legs and bringing them as close as possible to 180 degrees from the standing position). In order to be able to perform leg lifts with a greater range during the elevation phase, the researcher advises the Iraqi athlete to focus on the proximal arm because it was negative (below the shoulder line during elevation) and this led to a negative FLA (McErlain, & el.,2014).

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Discussion of the results of kinematic variables of the foot strength during the recovery phase

Table (3): Results of the kinematic variables of the rising foot force during the ascension phase

NO.	Kinetic variables	Olympic Target (Al-Fadhli, Al-Khafaji, and Al-Fadhli, 2023)	World USA (Díaz-Jiménez, 1993)	Hussein al-Iraqi	Hamdi Al-Qatari
.1	Power to the elevation foot(PL) 2x the player's weight	———	5.6	(9.8*79)/2495.9 3.22=	(9.8*65)/1917.5 3.01=
.2	Pushing force of the lifting foot	328.8	———	274.54	191.75
.3	Horizontal force at the moment of propulsion	4420	———	1604.33	1044.34
.4	Vertical force at the moment of propulsion	6625	———	1911.9	1606.15

Through the presentation of table (3), which shows the results of the kinematic variables of the strength of the advancement foot during the promotion phase, we note that the strength of the world champions is equivalent to (5.6) (Čoh, 2010) (King, & el., 2006) of body weight, while for the Iraqi player and the Qatari player respectively (3.22), (3.01) of the player's weight. This indicates the amount of difference in the muscular force exerted on the ground to push the body upwards and according to Newton's third law (every action has an equal and opposite reaction in the direction and on one line of action) the greater the force exerted on the ground the greater the reaction that helps the player to fly at a higher height and overcome gravity by crossing the bar with the help of the repulsive force that he gains from the arc-shaped approach run (*Philpott, & el. 2021)*.

As for the momentum of the elevation foot, we notice from table (3) that the amount of momentum for the target Olympic level (328.8) net.s, while for the Iraqi player the amount of momentum was (274.54) net.s and the momentum of the Qatari player was (191.75) net.s, we notice that the Iraqi player has more momentum than the Qatari player,

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but did not reach the target Olympic level, which is the number that we aspire for the Iraqi player to achieve (Murdan, 2003).

From table (3), we note that the amount of the horizontal component and the vertical component of the force at the moment of impulse for the Olympic level, respectively, was (4420), (6625), and for the Iraqi player, the amount of force was (1604.33), (1911.9) net.s. As for the Qatari player, the amount of force was (1044.34), (1606) net.s, respectively. 15) n.s. We note that the vertical force is greater than the horizontal force, and this indicates that the greater the vertical force, the more the player can overcome the momentum and transfer it from the horizontal vehicle to the vertical vehicle, and we note that the Iraqi player was favored in the vertical force, where the difference between them was approximately (305. 75) nt.s and this is in favor of the Iraqi player which helped him to pass the height (2.19) m, but it is far from the international level where we notice the difference between them is (4.713.1) nt.s and this difference is due to several reasons including excess body weight which causes a great obstacle and also physical strength as we noticed in the Dabney and Klein test and we advise the Iraqi player to develop the physical strength for the long jump and bring it to an amount close to the Olympic level to be able to pass a higher height (Murdan, 2010).

Conclusions

- The player Hussein Falah relies on physical abilities more than the technique, if the technique was corrected, he would have been able to take advantage of the lost height above the bar and break the Iraqi record and emphasized (Al-Karbouli, 2013) the need for some variables that were not available to the player Hussein Falah

- The player Hamdi Ali relies on the technique and physical measurements that give the player Hamdi an advantage in crossing the crossbar on the first attempt.

Recommendations

- Technique should be developed to a higher height than the 2.19 that Hussein Falah failed to do to identify and improve weaknesses, whether physical or skill.

- A complementary study should be done to this study and follow up the player by the specialists in the biomechanics department in the athletics directly and periodic tests and bring specialized trainers for this event and agrees with (Abdullah, 2022).

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