Scholar's Digest- Journal of Multidisciplinary Studies
Volume 3, Issue 10, October - 2024
ISSN (E): 2949-8856
Scholarsdigest.org

THE CONTRIBUTION RATIO OF THE KINEMATIC LAUNCH VECTORS AT THE MOMENT OF PERFORMING THE THROW PHASE AND ITS RELATIONSHIP TO THE ACHIEVEMENT OF HAMMER THROW PLAYERS FOR ADVANCED

1 Dr. Sabah Mahdi Salih
2 Dr. Hasanain Falah Hasan
1,2 Al-Qadisiyah University - College of Physical Education and Sports Sciences -Iraq
sabah.salih@qu.edu.iq 1 , sporteacher15@qu.edu.iq 2

Abstract
The importance of the research came from taking advantage of the values of the results of the kinetic analysis to identify the percentage of contribution of the kinematic launch vectors (launch speed - launch angle - launch point height) to the performance of the throwing stage and its relationship to the achievement of advanced hammer throw players by analyzing these variables and improving them to develop the athletic achievement. The research problem is that the effectiveness of the hammer throw is one of the athletics activities that depends to a large extent on the player's mastery of the stages of technical performance, as the performance includes multiple technical stages that overlap with each other and contain many critical and complex main points, which requires the player to perform them well in order to achieve the digital achievement. As for the research problem, through the researcher's observation of many different sports championships in athletics competitions, he noticed a weakness among players in performing the technical stages (swings, rotations, throwing position) and mastering them, especially the main ones, which is the final throwing stage of the hammer throw, which is a decisive stage to obtain the distance required by the player for the digital achievement, as it depends on the main and important kinematic variables, which are (the speed of the tool's launch, the angle of the tool's launch, the height of the tool's point) in this stage, which the thrower relies on to achieve the goal. Therefore, the researcher decided to study these three kinematic variables mentioned to know their relationship to the achievement and the extent of the percentage of their contribution in this stage through the results of the values of the analysis of the variables for them using kinetic analysis programs that are based on accurate scientific foundations to address the weakness in this stage (throwing the tool) and achieve the main goal of it, which is to achieve the farthest horizontal distance. For the hammer, the aim of the research is to identify the percentage of contribution of the kinematic launch vector variables (launch speed - launch angle - launch point height) at the moment of performing the throw phase and its relationship to the achievement of advanced hammer throw players. As for the research hypothesis, there is a percentage of contribution between the kinematic launch vectors (launch speed - launch angle - launch point height) at the moment of performing the throw phase with the achievement of advanced hammer throw players. The research method The researcher used the descriptive method using the correlation method to suit the nature of the research. The research sample was determined by advanced hammer throw players for the year (2023-2024) and their number is (5) players who compete in the competitions held by the Iraqi Athletics Federation, as they were chosen in the deliberate and

intentional manner. Each player was given a number of attempts amounting to (7) attempts in the achievement test and the most important biomechanical variables affecting it, and thus the number of attempts for all players became (35) attempts or observations. As for the main experiment, the researcher conducted the main experiment on Tuesday, corresponding to 2/30/2024 at the College of Physical Education stadium at Al-Qadisiyah University at exactly eleven o'clock in the morning on the selected sample of national team players who applied for the hammer throw event, where the players warmed up and prepared to conduct the event's test in order to identify the kinematic launch vectors affecting the achievement, a fast camera with a frequency of (300/minute image) was used, placed next to the players at a distance of (7 meters) and vertically at a height of (1.20 meters) to extract the variables at the moment of throwing the hammer, and the following hammer throw test was used:
Test objective: Measure the best horizontal distance covered by the hammer (achievement), Performance description: The testers perform the throw according to the international law of athletics, and the hammer is thrown within the sector designated for throwing, and the tester is given (7) attempts and the total attempts are (35) attempts or observations, then the imaging is transferred to the computer and processed, cut and films are analyzed using the Kinova kinetic analysis program, then the information is collected and stored in the Excel program and then processed statistically using the statistical bag, Conclusions: The results showed significant correlations between the dependent variable (achievement) and the kinematic launch vectors (launch speed, launch angle, launch point height), the researcher recommends the need to pay attention to the biokinematic variables that achieved high contribution rates

Keywords: Kinematic launch vectors, contribution ratio, throwing phase, hammer throw effectiveness.

Introduction

Athletics competitions generally depend on technical performance aspects, although the percentages of reliance vary according to the multiplicity and difficulty of the stages of motor performance of sporting events. We find that achievement in running events may not depend to a large extent on technical performance compared to physical abilities, functional indicators, and body measurements, while we find that field events such as jumping, throwing, and pushing depend to a large extent on the level of technical performance, especially the effectiveness of the hammer throw, because dealing with the tool and preparing speed and strength without violating the law of the event requires a high mastery of the technical aspects required by the thrower during movement within the throwing circle. The issue of identifying and controlling critical points affecting performance requires the use of photography and analysis in order to identify the real problems affecting technical performance and not to be satisfied with relying on abstract observation, because performance within the throwing circle is characterized by speed and overlap between technical stages. ( )

The goal of the kinematic analysis of hammer throw is to detect errors and attempt to correct them by finding auxiliary devices that correct those errors and improve the essential points in performance. In our modern era, kinematic analysis and kinematics have contributed to solving many kinematic problems after studying and analyzing them using devices and techniques to accurately detect the sources of errors in technical performance, no matter how fast it is and how many its stages and variables are, for the purpose of conducting evaluation

and building kinematic models that currently play an influential role in improving the level of training programs, and thus achieving the amount of movement necessary for achievement in track and field. ( ), Many scientists agree that throwing races are very complex events controlled by many indicators. Many coaches in the training process, and most of them, ignore the importance of the biomechanical dimension in improving athletic performance in general and among throwers in particular, due to the lack of experts in this field and the lack of modern technological tools to collect information about movement. Many coaches consider it a difficult science far from application in sports fields. We rarely find a coach or sports club looking for the expertise of a specialist in biomechanical analysis in the sports field, whose duty is to find numerical information about the variables that affect achievement, on which the coach builds his training approach and provides technical and quantitative information about it. Rather, interest in this field has become a difference between athletes despite the convergence of their abilities in other performance determinants. ( ) The importance of the research came from taking advantage of the values of the results of the kinetic analysis to identify the percentage of contribution of the kinematic launch vectors (launch speed - launch angle - launch point height) to the performance of the throw phase and its relationship to the achievement of advanced hammer throw players by analyzing these variables and improving them to develop the technique The mechanics of the player and thus achieve the required athletic achievement.

1-2- Research problem:

The effectiveness of the hammer throw is one of the athletics events that depend to a large extent on the player's mastery of the stages of technical performance, as the performance includes multiple technical stages that are intertwined with each other and contain many critical and complex main points, which requires the player to perform them well in order to achieve the digital achievement. Through the researcher's observation of many different sports championships in athletics competitions, he noticed a weakness among players in performing the stages Technical (swings, rotations, throwing position) and mastering them, especially the main one, which is the final throw stage of the hammer throw, which is a decisive stage to obtain the required distance from the player for the digital achievement, as it depends on the main and important launch vectors, which are (the tool launch speed, the tool launch angle, the tool point height) in this stage, which the thrower relies on to achieve the goal, so the researcher decided to study the three launch vectors mentioned to know their relationship to the achievement and the extent of the percentage of their contribution in this stage through the results of the values of the analysis of the variables for them using the kinetic analysis program (Kinova), which is based on accurate scientific foundations to address the weakness in this stage (throwing the tool) and achieve the main goal of it, which is to achieve the farthest horizontal distance for the hammer.

1-3- Research objectives:

1- Identify the kinematic launch vectors (launch speed - launch angle - launch point height) at the moment of performing the throw stage and their relationship to the achievement of advanced hammer throwers.

2- Identify the relationship between the kinematic launch vectors (launch speed - launch angle - launch point height) at the moment of performing the throw phase and the achievement of advanced hammer throwers.
3- Identify the percentage of contribution of the kinematic launch vectors (launch speed - launch angle - launch point height) at the moment of performing the throw phase to the achievement of advanced hammer throwers.

1-4- Research hypotheses:
1- There is a significant relationship between the kinematic launch vectors (launch speed - launch angle - launch point height) at the moment of performing the throw phase to the achievement of advanced hammer throwers.
2- There is a percentage of contribution between the kinematic launch vectors (launch speed - launch angle - launch point height) at the moment of performing the throw phase to the achievement of advanced hammer throwers.

1-5- Research areas:
1-5-1- Human field: An elite group of throwing competition players for the advanced category in the hammer throw event.
1-5-2- Spatial field: Hammer throw field in the College of Physical Education and Sports Sciences at Al-Qadisiyah University. 1-5-3- Human field: The period from (14\4\2023 to 29\7\2024).

3- Research Methodology and Procedures:
3-1 Research Methodology:
The researcher used the descriptive method using the correlational method to suit the nature of the research problem.

3-2- Research community and sample:
The research sample was determined by advanced hammer throw players for the year (2022-2023), numbering (5) players who compete in the competitions held by the Iraqi Athletics Federation, where they were chosen in the deliberate and intended manner. Each player was given a number of attempts amounting to (7) attempts in the test of the achievement achieved in throwing the hammer and the most important kinematic launch vectors affecting it. Thus, the number of attempts for all players became (35) attempts or observations. The players' physical measurements represented by the players' specifications were taken to ensure their homogeneity. The following table shows this:

Table (2) shows the homogeneity of the research sample in the variables (height, mass, arm length, leg length, chronological age, and training age)

Skew	Median	Standard Deviation	Arithmetic Mean	Unit of Measure	Statistical features / Variables
0.272	177	1.020	177.4	cm	Height
-0.622	94	2.482	93.2	kg	Mass
-0.202	77.5	1.428	77.1	cm	Arm Length
0.584	95	3.200	95.6	year	Leg Length
0.396	26	0.860	26.1	year	Chronological Age
-0.396	11	0.860	10.9	cm	Training Age

The table above shows that the values of the skewness coefficient are between (±1), which indicates the homogeneity of the research sample individuals in these variables, i.e. the normality of their distribution.

3-3- Research tools, methods and devices used:

- Arabic and foreign sources and references.
- Personal interviews with specialists.
- Observation and experimentation.
- Tests and measurements.
- Results transcription form.
- Internet information network.
- Medical scale.
- Dell laptop.
- Measuring tape.
- Adhesive tapes (phosphorous markers).
- Electronic stopwatch.
- (3) legal hammers.
- (1) Japanese-made high-speed camera with a frequency of (300 images/second) with a tripod (1).
- Special program for kinetic analysis (Kenova).
- Compact discs (CD).
- Canon camera for documentation.
- (5) legal hammers.

3-4- Exploratory experiment:

The researcher conducted the exploratory experiment on the sample on Monday (22/2/2024) at the College of Physical Education and Sports Sciences stadium - Al-Qadisiyah University. The aim of the exploratory experiment was:

- To ensure the suitability of the stadium, devices and tools used in the main experiment.

 Obstacles facing the researcher when conducting the test in order to overcome them in the main experiment.
 The amount of time players take to perform the hammer throw test.
 The cameras that will be filmed with and the appropriate places and determining their final location in the main experiment.
 Members of the auxiliary work team in the main experiment.
 Viewing the throwing field.

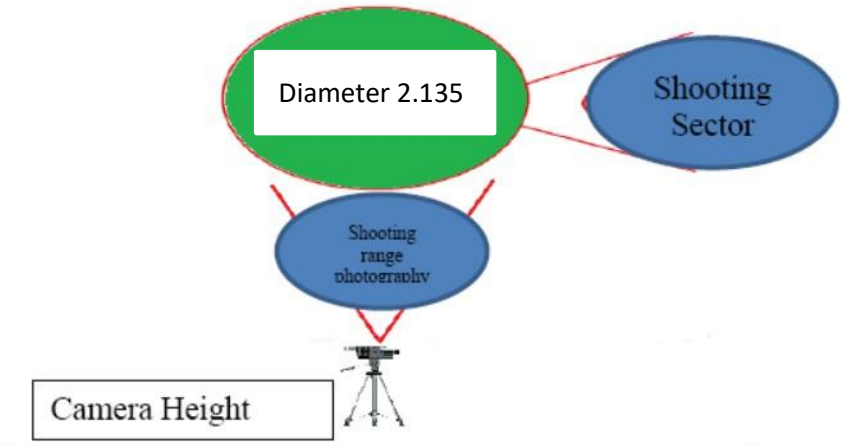

Diagram showing the hammer throw range and camera

3-4- Measuring the kinematic launch vectors at the moment of performing the throwing phase:
• Hammer launch speed: It represents the distance traveled by the center of gravity of the hammer head mass from the moment of launch in the first image to a sequence of images (2-3) divided by the tool distance time, as in the figure

Launching speed at the moment of throwing

• Launch angle: It is the angle enclosed by the path of the hammer's weight at the moment of its launch for a number of images with the path from the center of gravity of the hammer horizontally and parallel to the ground at the moment of throwing. The following figure illustrates this:

• Height of the starting point: It is the vertical distance between the center of gravity of the hammerhead at the moment of launch and the horizontal level of the ground surface measured in meters. (It is one of the very important determinants of launch, as the height of the tool at the moment of throwing plays an important and influential role on the distance achieved, as the player's height is an important anthropometric element for throwing competitors, and the extension of the body at the moment of throwing effectively affects the height of the tool's starting point, which means an increase in the distance achieved, as it has been proven that there is a positive relationship between increasing the speed of launch and the extension of the body, which requires synchronization in performance between all body movements at the moment of throwing, and this only comes about by the player's understanding of the motor perception of this situation on the one hand and his ability to extend the joints and muscles for that on the other hand, and the height of the starting point, ( ) The following figure illustrates this

Figure (3) shows the height of the starting point

3-5- The main experiment:

The researcher conducted the main experiment on Tuesday, February 30, 2024, at the College of Physical Education stadium at Al-Qadisiyah University at exactly eleven o'clock in the morning on the selected sample of national team players who applied for the hammer throw event. The players warmed up and prepared to conduct the event's test in order to identify the kinematic variables affecting the achievement. A fast camera with a frequency of (300 images / minute) was used, placed next to the players at a distance of (7 meters) and vertically at a

height of (1.20 meters) to extract the variables at the moment of throwing the hammer. The following hammer throw test was used:

- Test objective: measuring the best horizontal distance traveled by the hammer (achievement).
- Performance Description: The examiners perform the throw according to the International Athletics Law, and the hammer is thrown within the sector designated for throwing, and the player is given (7) attempts for the examiner and the total attempts are (35) attempts or observations, then the computer imaging is transferred and processed, cut and analyzed using the Kinova kinetic analysis program, and the information is collected and stored in the Excel program and then processed statistically using the statistical bag.

3-6- Statistical methods:

The statistical bag (spss) was used.

- Arithmetic mean.
- Standard deviation.
- Skewness.
- Simple correlation coefficient, Pearson.
- Kurtosis.
- Lowest value.
- Highest value.
- Standard error.
- Contribution ratio.

Chapter Four

4- Presentation and analysis of results:

4-1- Description of the kinematic launch vectors (launch speed - launch angle - launch point height) in the performance of the throwing phase and its relationship to the achievement of advanced hammer throwers and its analysis and discussion:

Table (2)

shows the values of the description of the kinematic launch vectors at the moment of performing the throwing phase for advanced hammer throwers

Skew	Kurtosis	Standard Error	Standard Deviation	Mean	Highest Value	Lowest Value	Statistical features / Kinematic launch variables	
1.159	0.506	2.013	1.190	22.405	25.45	21	Launch speed at the moment of throwing	(hammer throw moment stage)
0.442	-1.138	3.109	1.625	34.545	37.68	32.58	Launching angle at the moment of throwing	
-0.402	-1.176	15.693	3.553	170.814	175.41	164.14	Launching point height at the moment of throwing	
-0.496	-1.674	13.742	2.257	147.519	150.12	144	Achievement	

The table above shows the values of the description of the kinematic launch vectors (launch speed - launch angle - launch point height) with the performance of the throwing stage and its relationship to the achievement of advanced hammer throwers, for the variable (launch speed

at the moment of throwing) the arithmetic mean value is (25.45) and standard deviation (1.190) and the lowest value is (21) and the highest value is (25.45) and the standard error is (2.013) and kurtosis (0.506) and the skewness coefficient is (1.159), the variable (launch angle at the moment of throwing) the arithmetic mean value is (34.545) with a standard deviation (1.625) and the highest value is (37.68) and the lowest value is (32.58) and the skewness coefficient is (0.442) and kurtosis (-1.138) and the standard error is (3.109), the variable (launch point height at the moment of throwing) where the arithmetic mean value is (170.814) and standard deviation (3.553) and standard error (15.693) and the lowest value (164.14) and the highest value (175.41) and kurtosis (-1.176) and finally the skewness coefficient (-0.402), and the last variable (achievement) reached the arithmetic mean value (147.519) and standard deviation (2.257) and the lowest value (144) and the highest value (150.12) and skewness coefficient (-0.496) and kurtosis (-1.674) and the standard error value (13.742). This is a descriptive presentation of the values of the biokinematic variables

4-2- Displaying, analyzing and discussing the results of the correlations of the matrix: Table (3) shows the correlation matrix between the variables and the dependent variable.

Achievement	**Launch point height at the moment of throwing**	**Launch angle at the moment of throwing**	**Launch speed at the moment of throwing**	Kinematic launch variables
.682**	.817**	.947**	1	Launch velocity at the moment of the throw phase
.843**	.936**	1	.947**	Launch angle at the moment of the throw phase
.954**	1	.936**	.817**	Launch point height at the moment of the throw phase
1	.954**	.843**	.682**	Achievement
The tabular value at 33 degrees of freedom and 0.05 significance level is 0.32.				

*0.05 (The value is significant at the significance level)
**0.01 (The value is significant at the significance level)

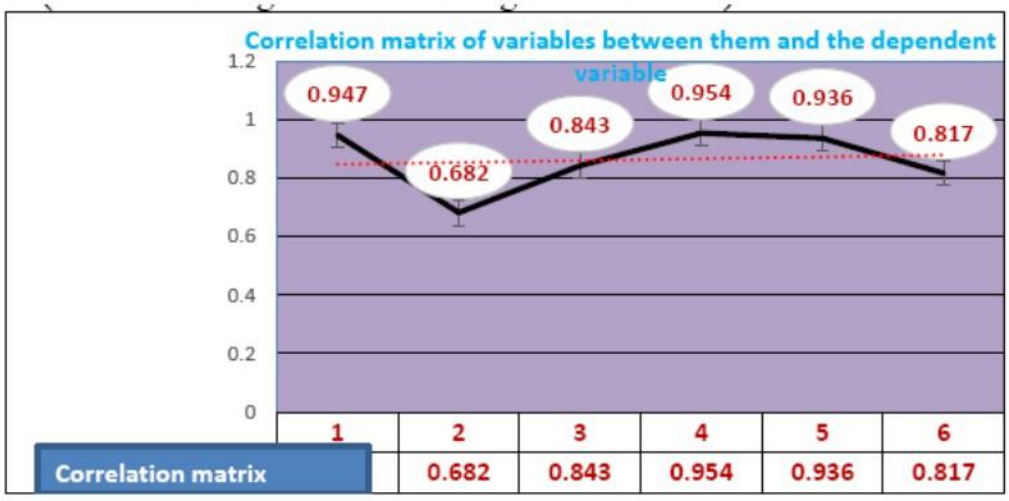

Figure (2)

Illustrating the correlation matrix between the kinematic launch vectors and the dependent variable at the moment of performing the throwing phase

Table (3) and Figure (2) above show the existence of a significant correlation between them and the variables among themselves on the one hand and between them and the dependent variable on the other hand (achievement), at a significance level of (0.01) and a degree of freedom of (33) and a tabular value of (0.32), and shows us the simple correlation matrix in which the calculated correlation values vary if the total sum of the values reaches (4) and all of them appeared significant as the tabular value at a degree of freedom of (35 - 2 = 33) and a significance level of (5%) is (0.32) so the increase of any of the calculated values of the correlation over the tabular value indicates the existence of a significant correlation relationship and the direction is determined whether it is negative or positive according to the existing indication, where it is noted that all the biokinematic variables in the table appeared with a significant correlation value between them and achievement. For the values that showed a significant correlation with the dependent variable, this can be explained as follows: For the variable of launch speed at the moment of throwing, a significant correlation with the dependent variable was observed, and its value reached (0.682) at a significance level of (0.01), as launch speed is considered one of the most important indicators of the moment of the hammer throw phase, and this is what Qasim Hassan Hussein confirmed (the launch speed is at the forefront of the important biokinematic factors indicating the horizontal distance of objects thrown at an angle to the horizontal line, whether the projectiles are at a different or similar level. The greater the difference between the launch and landing levels, the greater the flight time of the tool, thus increasing its chance of horizontal movement of speed, so the additional horizontal distance it achieves increases. In the event that both the launch height and the launch angle are equal, the faster tool will cover a greater horizontal distance, and accordingly the thrower must throw the tool at the greatest possible speed in order to achieve a greater horizontal distance. Many sources have agreed that increasing the launch speed means increasing the total distance (4.59) m ( ). Hochmuth proved that there is a direct relationship between the increase in the speed of launch and the extension of the body, which requires synchronization in performance and kinetic coordination between the body parts and the push at the same time. ( )

As for the variable of the launch angle at the moment of throwing, there is also a significant correlation between it and the achievement, with a value of (0.843) and it can be interpreted that the improvement was great in the launch angle, which is good because it is close to the level of the angles of the good digital level in the numbers and the best, and that the launch angle is one of the important points in the range of the projectile, and that the development that occurred in the launch angle indicated the effect of the training applied by the sample members, as they used several types of force using all possible means, the sole goal of which was to develop the mechanical conditions of performance, especially the launch angle, which inevitably affects the achievement of the good digital level ( ). This was confirmed by Talha Hossam (that the greater the difference between the launch and landing levels, the more this led to a change in the amount of the typical angle that achieves a greater horizontal distance). ( )

The other variable is the height of the starting point at the moment of throwing. There is a significant correlation between it and the achievement if it reaches (0.954). The reason for the significant correlation is the player's focus on it during the movement performance because it is an important factor in influencing the achievement. It also enables the players to achieve sufficient extension of the body's joints at the moment of the throwing phase.

In addition to the above, the ideal technique for performance in hammer throwing requires correct movement coordination between the different parts of the body. In addition to the muscular synergy of the muscle groups participating in the motor performance, it has contributed significantly to investing strength and speed and linking them within a harmonious motor framework and achieving the principle of rapid application of the vector force based on the law of propulsion in order to improve the dynamic time distribution and achieve a high amount of motion for the thrown tool at the moment it leaves the thrower's hand, as the law of propulsion states that the propulsion of any force to a body during a period of time is equal to the resulting change in the amount of motion of that body during that period of time, which leads to achieving the farthest possible horizontal distance for the thrown tool. ( )

As for the variables that showed a significant correlation between them, namely the launch speed variable at the moment of throwing with each of the launch angle variable, its correlation reached (0.947) and the launch point height variable (0.817) at the moment of throwing, as well as the launch angle variable with each of the launch speed variable and the launch point height variable at the moment of throwing, and the launch point height variable with each of the launch speed variable and the launch angle variable at the moment of throwing, from the researcher's point of view, the above variables are related to each other in the technical performance during the hammer throw stage, i.e. an interconnected chain that affects each other due to the players' technique and their adoption of different movement positions during the throw, which leads to a difference in horizontal distances in terms of their increase or decrease, which is related to all biokinematic variables such as achieving a high launch angle and launch speed for the arms and correct rotation of the trunk, which leads to obtaining a high digital achievement.

4-4- Presenting the results of the contribution ratio of the kinematic launch vectors (launch speed - launch angle - launch point height) to the performance of the throwing phase and its relationship to the achievement of advanced hammer throwers, analyzing and discussing them: 4-4-1 Clarifies the most important kinematic launch vectors in the performance of the throwing phase and their relationship to the achievement of advanced hammer throwers

Significance	Level of Significance	Degree of Freedom	Degree of Freedom	Value (F)	Revised Contribution Ratio Contribution Ratio	Contribution Ratio	Correlation Coefficient	Model
spiritual	0.000	33	1	337.536	0.908	0.911	.954	Launching speed at the moment of throwing
spiritual	0.000	32	1	15.125	0.936	0.940	.969	Launching angle at the moment of throwing

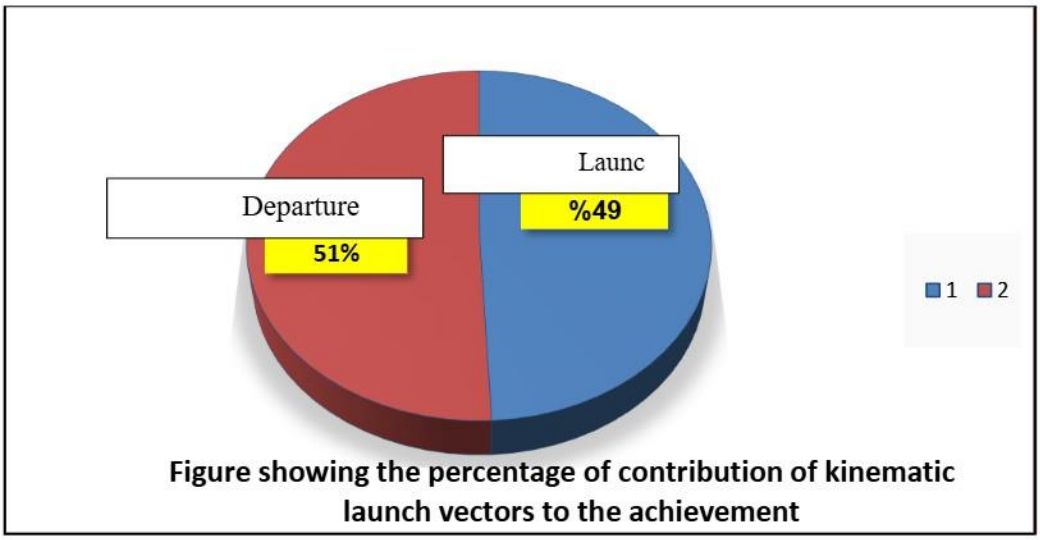

Figure showing the percentage of contribution of kinematic launch vectors to the achievement

Figure (3) shows the percentages of contribution to the achievement

It is clear from the table and figure (2) above that the highest percentage of contributors among the studied variables that contributed to the achievement was in favor of the launch speed variable, which contributed by (91%), while the second and last variable is the launch angle at the moment of the throwing phase, which contributed by (93%) at degrees of freedom (33) and (34) and the calculated (F) value and significance level (0.05).

The researcher explains that the players' emphasis on adopting the correct technique for the technical performance of the correct movement positions of the arms and legs and the working angles during the performance during the moment of the throwing phase, with the players changing the movement of the arms in the correct mechanical way by controlling the increase in the working joints, gave the players the ability to achieve good speed and launch angle in addition to the association of the launch speed with what happens, an increase or decrease in the launch angle variables, as it contributed significantly to correcting the appropriate

positions of the body parts, which led to the development of the appropriate mechanical conditions for the performance.

The use of different motion analysis techniques in analyzing players' movements led to a clear vision for players of the need to feel the strength required for performance according to a correct scientific motion path and the method through which to achieve a launch speed for the arms, torso and legs according to the required launch angle, which leads to increasing their speed, which serves players in achieving the digital level.

Chapter Five

5- Conclusions and Recommendations:

5-1- Conclusions:

1- Relying on the results of the kinetic analysis programs contributed significantly to diagnosing the kinetic errors of the players, which included the kinematic launch vectors.

2- The speed of the hammer launch during the throw depends to a large extent on the level of the players' performance in terms of their level of physical fitness.

3- The optimal use of the mechanical concept is a basic factor in interpreting the kinetic sequence of technical performance.

4- The results showed the existence of significant correlations between the dependent variable (achievement) and the kinematic launch vectors, which are (launch speed, launch angle, and launch point height).

5- The results showed the existence of a correlation between the kinematic variables.

6- The level of technical performance in the hammer throw event greatly affects the digital horizontal distance according to the variables of launch speed, launch angle, and launch point height at the moment of the throwing stage.

7- There are different contribution ratios for the kinematic launch vectors (launch speed, launch angle, launch point height) in the performance of the moment of the hammer throw phase.

9- The highest contribution ratio among the kinematic launch vectors during the performance was for the launch speed variable at the moment of the hammer throw phase.

10- There is a positive effect of the kinematic launch vectors at the moment of the hammer throw phase.

5-2- Recommendations:

1- The necessity of paying attention to the kinematic launch vectors (launch speed, launch angle, launch point height) in the performance of the moment of the throw phase, which achieved high contribution ratios.

2- The necessity of paying attention to the variables with significant correlations with the achievement on the one hand and between them on the other hand.

3- The necessity of emphasizing the conduct of the kinetic analysis to identify the areas of deficiency and weakness in the technical performance in the throwing phase in order to prepare the necessary training.

4- The necessity of emphasizing the use of modern kinetic analysis techniques that would address the real indicators of the variables of speed, angles and heights of the tool during the moment of the throwing phase.

5- The necessity of relying on mechanical laws, kinetic analysis and video imaging to measure the amounts of kinematic launch vectors.

6- The necessity of emphasizing to trainers that education and development of the technical aspects of kinetic performance be based on the basic mechanical requirements and the use of tools and devices that achieve this with the least effort on the athlete.

7- The necessity of providing kinetic analysis tools, devices and programs that work to improve the throwing phase and distance in the effectiveness of hammer throwing.

References

1. Qasim Hassan Hussein; Encyclopedia of Field and Track: (Amman, Dar Al Fikr for Printing, 1998.
2. Qasim Hassan Hussein and Iman Shaker: Principles of Mechanical Foundations of Sports Movements, Amman, Dar Al Fikr for Publishing, 1998.
3. Omar Hamed Khamis: The effect of training using the multi-resistance device in developing some physical and biomechanical abilities and the digital level of hammer throw for youth, unpublished thesis, 2015.
4. Omar Hamed Khamis: The effect of training using the multi-resistance device in developing some physical and biomechanical abilities and the digital level of hammer throw for youth, unpublished thesis, 2015.
5. 5- Omar Hamed Khamis: The effect of training using the multi-resistance device in developing some physical and biomechanical abilities and the digital level of hammer throw for youth, unpublished thesis, 2015. (Vertimax)
6. - Maher Jaafar Amin: The effect of special strength exercises according to the principle of moments on balance Kinetics and some biomechanical variables and achievement of hammer throw effectiveness for advanced students, unpublished master's thesis, 2019.
7. Talha Hossam El-Din and others: Applied Kinesiology, Part 1, 1st ed., 1998.
8. Sawsan Abdel Moneim and others: Biomechanics in the Sports Field, Part 1, Cairo, Dar Al-Maaref, 1977.