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RESEARCH ARTICLE

An Analytical Study of the Change in Some Biomechanical Indicators of Steeplechase (1-2-7-8) in the 400m Steeplechase for Elite Runners Under 20 Years Old

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Abstract
The aim of this study is to analyze the changes in the values of some biomechanical indicators (1- 2- 7-8) of steeplechase in the 400m steeplechase for elite runners under the age of 20. In this study, 8 athletes (age: 19.2 ± 0.98; height: 1.87 ± 0.05) were analyzed in the men's 400 m steeplechase. Analysis of variance test was used to compare differences between male athletes in terms of independent variables; significance was set at $p < 0.05$. As Result; the distance before the hurdle that, there is a non-significant value between the first hurdle and the second hurdle ($p>0.701$). As for the distance variable after the barrier, it turns out that there are significant differences in the first And the seventh, eighth (sig to Hurdle 1, $p<0.013$; $p<0.003$). As for the variable of the height of the body's center of gravity, the differences were not significant between the first and second and in the seventh And the eighth hurdles ($p>0.141$; $p>0.256$). But, We identified significant differences between other hurdles groups. As for the angle tangent variable, the results appeared significant for all the differences between the hurdles except for the difference between the seventh and the eighth barrier. In Conclusion, it is recommended to focus on training physical abilities according to performance and within bends, to train to maintain running rhythm, and to focus on speed and endurance exercises.

Keywords
Biomechanical Indicators, Hurdle Step, 400m Hurdles Race

INTRODUCTION

The 400 m hurdles (400 m-H) competition involves running over 10 obstacles set up at 35 m intervals. Compared to the 110 m hurdle race, overcoming obstacles on a curved track requires different techniques, such as regulation of stride length, tempo and stride patterns. Undoubtedly, performance in the 400 m is related to running ability in the 400 m race. However, Iskra and Pietrzak (2016) stated that even world-class 400 m-H athletes do not have the best personal records in 400 m-H runs. For this reason, 400 m-specific techniques such as stride adjustment and obstacle crossing in bends are thought to be important. During the race, maximum speed occurs between the first and third hurdles and then gradually decreases (**Ditroilo, 2001; Yasui et al., 2008**). Therefore, it can be concluded that the approach section, which is the acceleration phase from the start to the first obstacle, is an important stage for increasing the maximum speed. In fact, there is a strong correlation between maximum speed, approach speed and performance at 400 m (**Yasui et al., 2008**). Additionally, **Karube et al**. (**2003**) stated that athletes emphasize the first obstacle regardless of their performance level and gender, and that the athlete's emotion also shows the importance of th approach. In this approach section, athletes accelerate and adjust their steps. Move to the ideal takeoff position to clear the first obstacle around the bend. Then athletes need to

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maintain their speed to achieve high performance throughout the race (**Ozaki et al., 2019**).

High hurdle racing is one of the most technically demanding athletic events, and biomechanically hurdle racing is a combination of a cyclic sprint and a non-cyclic span of ten hurdles with a height of 1,067 m. Hurdle racing can be divided into the following stages: running to approach the first obstacle, overcoming obstacles and rhythm between obstacles, and running away from the last obstacle towards the finish line. Therefore, a proper steeplechase technique is a complex combination of various running and jumping kinematics. In addition, the hurdler must demonstrate a high level of sprinting skill, excellent flexibility in the hip joint, coordination, balance, dynamic perception, elastic strength and a high level of technical knowledge (**Salo, 2006**). Therefore, athletes, coaches and professionals are constantly looking for opportunities to improve high hurdle performance by focusing on show jumping technique with particular emphasis on kinematic and kinetic analysis (**Coh et al., 2020**).

Most coaches can resort to modern methods of assessing a runner's level in training units to find gaps where the runner's kinetic technique is improved. These methods include the use of force and speed sensors throughout the race distance, as well as imaging with special fast cameras with kinetic analysis programs that output biomechanical indicators that give a digital and graphical concept of the athlete's level. It improves the runner's physical abilities that do not fall to the competitive performance level, making the training process systematic and rational without losing sports training time (**Amara et al., 2019**). Steeplechase is a complex technical event that requires a high level of physical conditioning. In fact, sprint speed, intersegmental coordination, reactive power and excellent technical skills are the most important physical fitness elements that must be regularly developed and routinely implemented in training programs to be successful in the race (**Coh and Zvan, 2018**). In particular, the technique of overcoming the obstacle represents one of the most decisive factors that determine the outcome of the competition (**Sidhu and Singh, 2015**).

The science of biomechanics is one of the sciences that adds the character of standardized biomechanical indicators of the hurdles step (1- 2- 7- 8).

training for researchers and coaches, as well as accurately selecting weak points for runners, and this is what is adopted in higher level training. Considering that running strides depend entirely on how to reach the obstacles at the same speed and with a good hurdle stride without reducing the speed level, the 400 m-H running competition is considered one of speed, endurance races and precise kinetic performance (**Ozaki et al., 2019; Iskra, and Pietrzak , 2016**). This is done only through training to overcome the initial obstacles with as much of the same kinetic performance as possible of the final obstacles. It requires examining the biomechanical indicators of the hurdle steps in which the hurdler can maintain his kinetic performance level. Therefore, the importance of research in finding these indicators to know the level of success of runners and any rises and falls in them. Indicators during performance phases give the coach a graphical indication of both the training and the level of success (**Otsuka and Isaka, 2019**).

Considering that ten obstacles are present in the 400m-H race, the obstacles are distributed over the race distance and each obstacle constitutes a step within the performance distance, and the kinetic performance in the obstacle step is mastered throughout the passing speed and ensures the protection of the obstacle, a championship in the 400 m hurdles race at the Iraqi Athletics Championships The levels of runners varying between one and the other, the fact that passing in the least amount of time, therefore shortening the total race time, and the fact that the two researchers are experts on running races were noticed here. To investigate this problem in depth for the same athletes and to investigate the effect of the hurdle step on the kinetic performance level at certain distances in order to reach the cause of the rise and fall in the kinetic level of the hurdle step and therefore its effect on the hurdle step.

Purpose

The aim of this study is to analyze the changes in the values of some biomechanical indicators (1- 2- 7-8) of steeplechase in the 400m steeplechase for elite runners under the age of 20.

Research hypotheses

There are no statistically significant differences between the values of some

MATERIALS AND METHODS

The researchers used the descriptive approach in the style of correlational relations due to its suitability to the objectives of the research and the closest to solving the research problem.

Research Approval

Data were collected as part of the at the Ministry of Youth and Sports Athletics Stadium in Baghdad. This case study followed ethical standards and received approval from with reference number [No.10/144 and date 2/08/2023]. Participant provided informed consent, with the volunteer form covering research details, risks, benefits, confidentiality, and participant rights. The research strictly adhered to the ethical principles of the Declaration of Helsinki, prioritizing participant's rights and well-being in design, procedures, and confidentiality measures.

Participants

The research population consisted of 400 m hurdlers under 20 years of age, elite participants of the Iraq Championships, the second stage of which will be held in 2022. In this study, eight athletes (age: 19.2 ± 0.98; height: 1.77 ± 0.05) were analyzed in the men's 400 m steeplechase (Table 1). The research sample of the participants was chosen consciously, and the degrees they achieved (first, second and third) are given in detail in Figure 1.

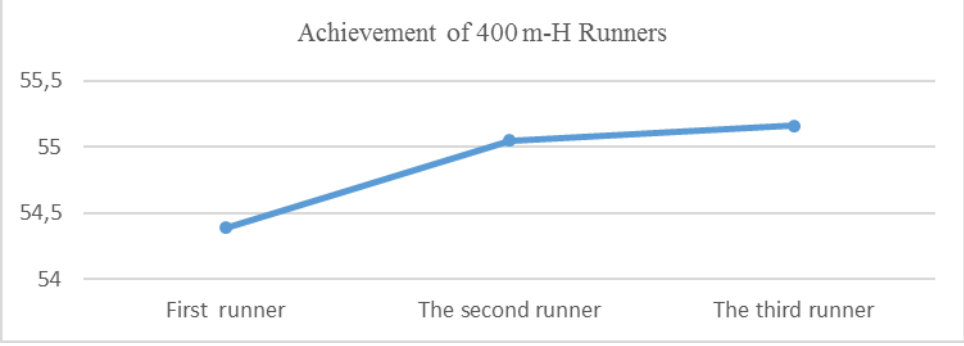

Figure 1. The best time achieved by the participants in the 400m steeplechase

Table 1. Anthropometric characteristics of participants

Variables	Descriptive Statistics		
	Means	Standard deviation	Skewness
Age (year)	19.22	0.986	-0.06
Height (cm)	1.77 ±0.05 m	0.587	0.10
Body mass (kg)	65.00 ±0.05 kg	0.894	0.58
Gender	Male (n=8)		

Data Collection

All data; It was collected using the International Information Network (Internet), Personal interviews, Tests and measurements, Registration form and information dump, Biomechanical laws and equations and Kinetic analysis program (kinovea).

Procedure of Measurements

Three-dimensional (3D) kinematic analyses of the hurdling sequences were performed over the entire 400-m distance (i.e., 4 hurdles) with ten mutually synchronized digital cameras [Shutter speed 1/240th of a second and sample rate 60 Hz] with wide conversion lens [× 0.6; 45.5 × 29 mm]. Cameras were placed in pairs 8,5-m away and 1.10-m above the floor with an angle of 60° and 120° for the first and the second camera, respectively. Each pair of cameras permitted the analysis of 1-2-7-8 hurdles (figure 1).

The first camera (1 hurdles): photographing the first checkpoint

The second camera (2 hurdles): filming the second checkpoint.

The third camera (7 hurdles): photographing the seventh checkpoint.

The fourth camera (8hurdles): photographing the eighth checkpoint

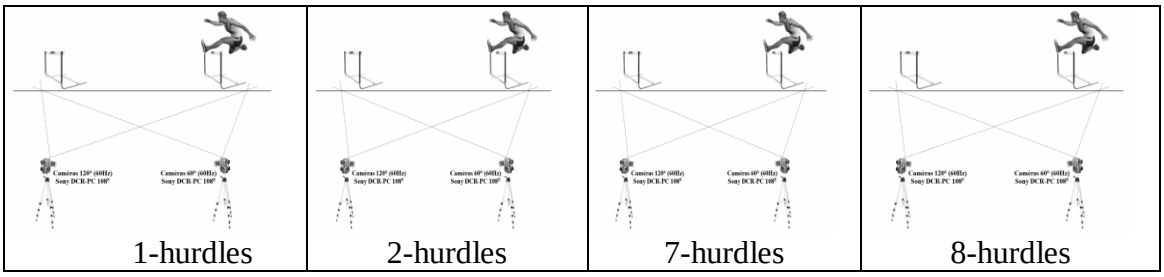

Figure 2. Procedure of Measurements

Procedures

400m hurdles achievement test (**Muhammad Abadi Abdul-Khafaji, 2003**): Its aim: to measure the total time, as well as all biomechanical indicators related to the research. Conducting a 400-meter hurdles run test in accordance with international law, with video filming procedures as follows: The fast video cameras for the analysis of the mechanical indicators of the hurdles step were placed on the hurdless within the two curves perpendicular to each hurdles. The distance before the hurdle (the ascent distance) for the four hurdles under discussion: it is measured directly through the process of kinetic analysis, which is determined by measuring the distance between the places of the runner's foot's back support to the vertical projection of the hurdle crossbar. The distance after the hurdles (landing distance) for four hurdless under discussion: It is measured directly through the kinetic analysis process, which is determined by measuring the distance between the vertical projection of the hurdle beam and the front support of the runner's foot.

The height of the body's center of gravity above the hurdles for the four hurdless under study: It is measured directly through the process of kinematic analysis by determining the highest height of the center of gravity of the runner's body vertically from above the hurdles to the ground at its highest height above the hurdles to the vertical projection of the hurdles beam. Tangent of the angle of inclination of the runner's apex of the curve: (**Sareeh Abdul Karim, 2009**). The mean of the tangent angle of inclination was extracted after identifying the runner's speed for the total step of the hurdles and dividing it by the ground acceleration and the radius according to the following equation:

$$\text{Tangent angle of inclination} = \frac{\text{speed}(2)}{\text{Ground acceleration x radius}}$$

Experimental Design

The two researchers conducted the test on 15/11/2022 at (4) in the afternoon with the help of the assistant work team, as the research test included a test of running a distance of 400 m / hurdles on the athletics track - Ministry of Youth and Sports - Baghdad and conducting video imaging to measure biomechanical indicators For each hurdles in question, After that, the imaging was taken for processing by the kinetic analysis program, which the researchers agreed to use among other analysis programs (kinovea) for its ease of use and the most agreed upon by the kinetic analysis specialists, and then extracting data on Excel to treat it statistically, and then prove the hypotheses and achieve the research goals.

Statistical analysis

All statistical analyses were carried out using SPSS Statistics 26 (IBM SPSS, Inc., Chicago, IL). Data were reported as mean ± standard deviation (SD) and confidence intervals at 95% level (95% CI).

Effect size (d) was calculated using GPOWER software. Data were tested for normal distribution using Shapiro-Wilk's test. Analysis of variance test was used to compare differences between male athletes in terms of independent variables; significance was set at $p < 0.05$.

The researchers used Excel program to extract the following mathematical operation (**Al-Bayati and Sareeh Abdul-Karim Al-Fadhli. 2012**).

Difference ratio, convergence ratio (percentage) (first value - second value / first value X100), where the first value represents the value of the first curve and the second value represents the value of the second curve.

RESULTS

Table 2. The statistical description of the values of some biomechanical indicators of the research sample

Variables	Hurdles	X	SD
Distance Before the Hurdles	Hurdle1	1.9133	.06429
	Hurdle2	1.8967	.02082
	Hurdle7	1.8400	.07550
	Hurdle8	1.7467	.01528
Distance After the Hurdles	Hurdle1	1.1700	.02646
	Hurdle2	1.1433	.01528
	Hurdle7	1.2200	.01000
	Hurdle8	1.2367	.02082
High Center of Gravity of the Body	Hurdle1	18.6667	.57735
	Hurdle2	20.0000	1.00000
	Hurdle7	21.3333	1.52753
	Hurdle8	22.3333	.57735
Tangent of the Angle	Hurdle1	8.6667	.57735
	Hurdle2	9.6667	.57735
	Hurdle7	10.6667	.57735
	Hurdle8	11.0000	0.00000

Through the table (3) above, which shows the contrast between the four hurdles, which showed the presence of significant differences between them in the variables of the study, and to show the preference of the values of biomechanical indicators, a statistical method must be used to find them, so the researchers resorted to using (L.S.D) the least significant difference to indicate the preference of the differences between them.

Table 3. Shows the analysis of variance for some biomechanical indicators of hurdles (1, 2, 7, 8) in the study sample.

Tests	Source of Contrast	Sum of Squares	Degrees of Freedom	Mean of Squares	F Value Calculated	P Value	Type Sig
Distance Before the Hurdles	Between	0.051	3	0.017	6.462	0.016	Sig
	Inside	0.021	8	0.003			
Distance After the Hurdles	Between	0.017	3	0.006	15.356	0.001	Sig
	Inside	0.003	8	0			
High Center of Gravity of the Body	Between	22.917	3	7.639	7.639	0.010	Sig
	Inside	8	8	1			
Tangent of the Angle	Between	10	3	3.333	13.333	0.002	Sig
	Inside	2	8	0.250			

Through table (4) above, which shows the differences between the arithmetic mean of the three runners and the value (L.S.D) of some biomechanical indicators of the four hurdles, as it is evident through the first indicator (the distance before the hurdle) that there is a non-significant value between the first hurdle and the second hurdle because the values are in the distance before the hurdle ($p>0.701$). For the same variable, the differences between the first obstacle and the eighth obstacle were found to be significant (sig to Hurdle 1, $p<0.004$), Similarly, the second obstacle

and the eighth obstacle were found to be significant (sig to Hurdle 2, p<0.007).

As for the distance variable after the barrier, the differences were non-significant between the first and the second barrier (p>0.126) but it turns out that there are significant differences in the first And the seventh, eighth (sig to Hurdle 1, p<0.013; p<0.003). At the same time, there are significant differences in the second And the seventh, eighth (sig to Hurdle 1, p<0.001; p<0.000).

As for the variable of the height of the body's center of gravity, the differences were not significant between the first and second and in the seventh And the eighth hurdles (p>0.141; p>0.256). But,We identified significant differences between other hurdles groups.

As for the angle tangent variable, the results appeared significant for all the differences between the hurdles except for the difference between the seventh and the eighth barrier (Table 4).

Table 4. Shows the difference between the means and the value of (L.S.D) for some biomechanical indicators of the four hurdles

Tests	Groups	Difference Between The Means X	P Value	Type sig
Distance Before the Hurdles	Hurdle 1-2	0.016	0.701	Non sig
	Hurdle 1-7	0.073	0.118	Non sig
	Hurdle 1-8	0.166	0.004	**sig to Hurdle**1
	Hurdle 2-7	0.056	0.213	Non sig
	Hurdle 2-8	0.150	0.007	**Sig to Hurdle**2
	Hurdle 7-8	0.093	0.056	Non sig
Distance After the Hurdles	Hurdle 1-2	0.266	0.126	Non sig
	Hurdle 1-7	-0.050	0.013	**Sig to Hurdle**1
	Hurdle 1-8	0.066-	0.003	**sig to Hurdle**1
	Hurdle 2-7	0.076-	0.001	**sig to Hurdle**2
	Hurdle 2-8	0.093-	0.000	**sig to Hurdle**2
	Hurdle 7-8	0.016	0.318	Non sig
High Center of Gravity of the Body	Hurdle 1-2	1.333-	0.141	Non sig
	Hurdle 1-7	2.666-	0.011	**sig to Hurdle**1
	Hurdle 1-8	3.666-	0.002	**sig to Hurdle**1
	Hurdle 2-7	1.333-	0.141	Non sig
	Hurdle 2-8	2.333-	0.021	**sig to Hurdle**2
	Hurdle 7-8	1-	0.256	Non sig
Tangent of the Angle	Hurdle 1-2	1-	0.040	**sig to Hurdle**1
	Hurdle 1-7	2-	0.001	**sig to Hurdle**1
	Hurdle 1-8	2.333-	0.000	**sig to Hurdle**1
	Hurdle 2-7	1-	0.040	**sig to Hurdle**2
	Hurdle 2-8	1.333-	0.011	**sig to Hurdle**2
	Hurdle 7-8	0.333-	0.438	Non sig

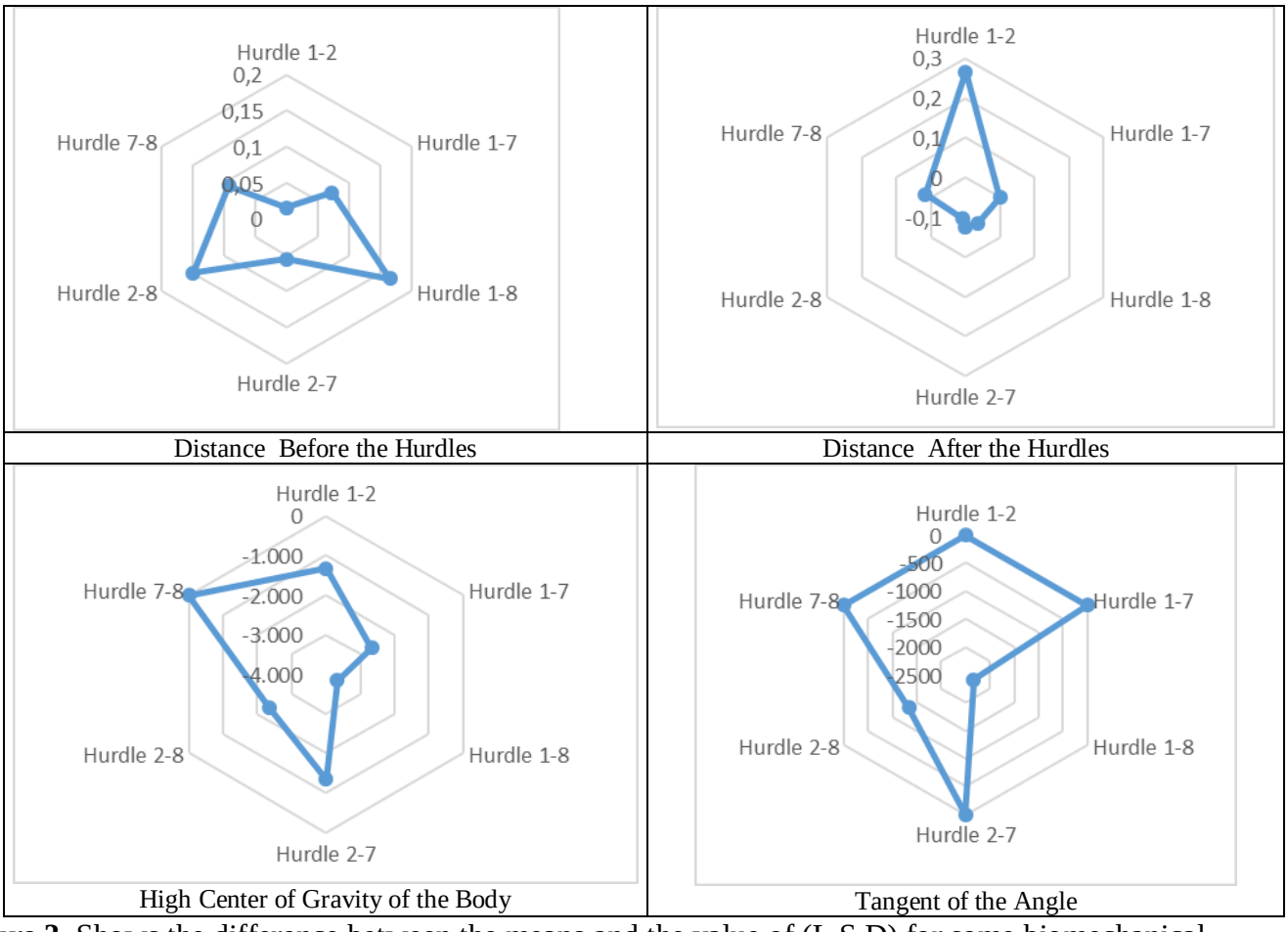

Figure 3. Shows the difference between the means and the value of (L.S.D) for some biomechanical indicators of the four hurdles

DISCUSSION

Hurdle events are part of the athletics program at the Olympic Games and all other outdoor major championships. Athletes must overcome ten obstacles over designated distances, making the event extremely technical as hurdlers attempt to minimize contact with each barrier while maintaining forward speed. Previous studies have focused on one and/or a maximum of three obstacles with kinetic or kinematic analysis (**Bezodis et al, 2019**). Therefore, the current study can be considered unique in that it examines both biomechanical and kinematic variables of the change in 400 m steeplechase performance (1-2-7-8 hurdles).

Results indicated that; through table (4) above, which shows the differences between the arithmetic mean of the three runners and the value (L.S.D) of some biomechanical indicators of the four hurdles, as it is evident through the first indicator (the distance before the hurdle) that there is a non-significant value between the first hurdle and the second hurdle because the values are in the distance before the hurdle The same barrier in the two hurdles with a small difference that was not sensed by the statistical method, and this indicates that the crossing of the first barrier was at the same speed as the crossing at the second barrier, because the variable speed is directly effected with the distance indicator according to the speed law, and here the steps are fixed and with a constant contact time and flight time in all steps up to the barrier The second, and this is what the researchers agree on with what was stated by "It is noted that there is a change in speed caused by the contact of the foot with the surface of the ground, and this contact, if it is for a long time, causes an unwanted momentary stop, and this stop causes a change or decrease in speed, i.e. the appearance of differences in speed"(**Al-Fadhli. 2009**).

This is evidence that the elite runners are distinguished by maintaining speed rates in the first curve. As for the same variable, the differences between the first hurdle and the eighth

hurdle were significant, and this indicates that the distance before the hurdle for the first hurdle was greater than the distance for the eighth hurdle, and this indicates a decrease in the average speed. However, slightly, causing the runner to reduce the distance of the ascent before the barrier to control the effective technique over the barrier without an increase in the crossing time. One study, in an analysis of hurdle runners using three-dimensional (3D) videography (50 Hz), found that absolute descent and recovery stride lengths at the national standard (0.03 and 0) differed little between men and women. Additionally, a 3D study using a higher sampling rate would allow greater precision in identifying specific events such as takeoff and touchdown, which could provide a more accurate assessment of kinematic and spatiotemporal aspects of steeplechase performance such as stride lengths and transition time (**Hanley et al., 2021**).

As for the distance variable after the barrier, the differences were non-significant between the first and the second barrier, and this indicates that the runner has the same compatibility for this distance, and this indicates the preservation of the endurance of the muscle strength responsible for pulling the leading leg beyond the barrier, but it turns out that there are significant differences in the seventh barrier And the eighth, and this indicates that the runners do not have the endurance of strength for these distances, and this is what works to reduce the effectiveness of the muscles to work with strength and speed to pull the leading foot directly after the barrier, and here the coaches must take into account the strength endurance training for this distance in order to work to reduce the passing time and thus Reducing completion time. The basic training task for the athlete includes the ability to maintain an adequate step pattern, that is, the number of steps that ensure a minimum loss of speed when subsequent segments are passed between obstacles (**Iskra ve Coh, 2011**). During hurdle racing, split times are measured as touchdown split times, separated by the moment the front foot touches down. Intergroup comparisons in 400 m hurdles races have reported that the faster hurdlers' finish times, the faster their touch down times in the second half of the race (**Breizer and Korchemny, 1990; Otsuka and Isaka, 2019**).

As for the variable of the height of the body's center of gravity, the differences were not significant between the first and second hurdles, because the runner is characterized by high passing speed, high compatibility, and good competitive capacity, which causes the same height values between the two hurdles. This also indicates that their coaches focus in their training on the distance of the first arc, and this is what We find it from close results in all biomechanical indicators, as well as non-significant differences between the differences for the seventh and eighth hurdles, and this indicates a decrease in the average speed for a distance before the eighth hurdle until the distance after the eighth hurdle. In other words, the speed plateau, and here the runner tries to maintain the speed without increasing it as a result of the close physical capabilities between the elite runners At the local level, after the distance of the eighth hurdle, it begins to gradually decrease until the finish line, and from here the coaches must focus on this distance in their training and the presence of hurdles to take advantage of the special physical capabilities with the rhythm of the hurdles and to stay away from free exercises without hurdles, as mentioned ": The hurdles runners should not spend a lot of time on sprint training without hurdles, because the hurdles running rhythm (movement weight) is not similar to the sprinting rhythm in short distances" (**Ibrahim. 1992**).

Claiming that horizontal speed is one of the most important factors, based on obstacle clearance analysis, and therefore loss should be minimized; otherwise the working time will be reduced. In addition, the athlete's take-off distance and landing distance are also important in order to overcome the obstacle as quickly and biomechanically effective as possible (**Salo, and Grimshaw,1997**). As for the variable the height of the body's center of gravity, the correct positioning of these two points determines the optimal flight trajectory, which is reflected in the flight time, in which the body's center of gravity should be as short as possible. According to **Coh and Zvan** (**2018**) and **Bubaj et al.** (**2008**) These two conditions are a prerequisite for the optimal flight path of the Body's center of gravity.

This optimal path results in shorter flight time. In addition to the correct position, the kinematic-dynamic structure of take-off and landing is also important as it directly affects the speed of obstacle clearance (**Chin-Shan et al., 2020; Amara et al., 2017**). To summarize the above considerations, following the main criteria for an optimal obstacle clearance technique

include horizontal speed, height of the Body's center of gravity during takeoff, rear foot speed, flight time, height of the Body's center of gravity during landing, and contact time (**Park et al., 2011**).

As for the angle tangent variable, the results appeared significant for all the differences between the hurdles except for the difference between the seventh and the eighth barrier. The researchers attribute this significance to the presence of the first barrier at the top of the curve and passing it at a high speed, and we know that the high speed in the curve requires a greater inclination to the interior as a result of the effect of the centrifugal force towards Thus, the runner's inclination towards the inside increases when passing the first barrier, and the presence of the eighth barrier at the end of the curve in the area of contact with the rectum, and here the concentrated repulsion action on the runner decreases, and thus the inclination decreases, and this shows the significant differences between the two hurdles, while we find in the seventh and eighth hurdles there are non-significant differences And for the same reason in the previous variable, as a result of the runners' attempt to maintain the ideal maximum speed in the performance endurance zone, although the results were not of high values, but they are close, and from here the coaches must emphasize running at a steady rhythm and at a high speed, and emphasize on passing one leg after controlling the rhythm of the distances in order to It shows us similar biomechanical indicators, regardless of the physical abilities that must be based on the training curriculum from the point of view of the researchers on biomechanical indicators. It is difficult to analyze 400 m hurdles kinematics in terms of movement structure. Running straight sections and turns, changing the forefoot, and unpredictable changes in the way of negotiating obstacles due to increased fatigue demand are particular indirect (non-competitive) tools for movement analysis. Researchers have mostly focused on changes in the center of gravity during obstacles (**Przednowek et al., 2016**). Additionally, kinetic and kinematic results are widely used to help improve the training and performance of athletes.

And this is indicated by "The method of running differs in the curve from that in the straight, so all parts of the body must take the appropriate mechanical positions, which differ from those that it takes in the case of running in the straight, and it aims primarily to resist the centrifugal force, so it The more the player tries to increase his speed in the curve, the more resistance he exerts against the centrifugal force, and to overcome this force, the body in the case of running in the curve must take a position that is completely different from that in the straight line, if both the instep of the left and right feet turn inwards (towards the edge interior of the curve field) to assist with steering during running,As for the body, it also inclines towards the inside (left side) in order to relatively reduce the radius of the sphere in order to increase the diagonal acceleration (towards the center) in order to maintain the tension force towards the inside, just as the right shoulder rises above the left shoulder, and the head also tilts slightly inward. Extending the movement of the right arm while the range of movement of the left arm close to the inner edge of the curve field decreases " (**Khawla Ibrahim, AK. 2012**).

Conclusiıons

Through the results of the differences, it became clear that there is a decrease in the values of the biomechanical indicators in the seventh and eighth barrier, indicating a decrease in the rate of speed. Through the results between the differences between the circles of the biomechanical indicators, it is inferred that the rate of speed training for the runners in the presence of hurdles is low compared to the percentage of endurance speed in the absence of hurdles. Through the results between the mean differences of the biomechanical indicators of the distance variable before and after the barrier, there is a weakness in the force tolerance of the muscles responsible for pulling the leading leg.

Recommendations

Emphasis on training physical abilities according to performance and within curves. Emphasis on training within the rhythm of the same man passing to maintain the running rhythm. Emphasis on performing speed endurance exercises with hurdles.

Conflict of interest

No conflict of interest is declared by the authors. In addition, no financial support was received.

Ethics Committee

Data were collected as part of the at the Ministry of Youth and Sports Athletics Stadium in Baghdad. This case study followed ethical standards and received approval from with reference number [No.10/144 and date 2/08/2023].

Author Contributions

Study Design, ME, AN; Data Collection, ME, AN; Statistical Analysis, ME; Data Interpretation, ME, AN; Manuscript Preparation, ME, AN; Literature Search, AN; All authors have read and agreed to the published version of the manuscript.

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