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The contribution percentage of the first (20) meters and the last (20) meters in the performance of elite sprinters in the (100, 200, 400) meter races

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Abstract

The sprint events (100, 200, 400) meters for men are considered among the most distinguished events in athletics. They require high levels of physical abilities and specialized motor skills, and certain bodily specifications. Similar to other sprinting events, performance in these events relies on a comprehensive application of technical aspects, and they significantly and effectively depend on the intermediate distances within them. The significance of the research stands out through continuous attention to athletic achievements and the ongoing process of their development. Additionally, it underscores the importance of kinetic analysis in identifying crucial weaknesses among sprinters. Furthermore, achieving optimal performance in the initial and final (20) meters is of utmost importance, as it can make a significant difference in the fastest races of track and field events. The cognitive problem of the study revolves around the question of the possibility of identifying the contribution percentage of the initial (20) meters and the final (20) meters to the final performance in the (100, 200, 400) meters. It focuses on the weak points sprinters encounter in achieving their optimal times for the required distances. The study aims to analyze these aspects and implement their applications to enhance athletic performance. Moreover, the study underscored the neglect of employing motion analysis to precisely identify weaknesses, as well as the lack of attention from coaches towards these value characteristics, so they can program their training routines to achieve their goals as quickly as possible with the least effort. The research aims to identify the numerical values of the time taken to cover the first (20) meters and the last (20) meters and the contribution percentage of these distances to the final performance. The researchers employed the descriptive method with a correlation relations approach and the contribution percentages due to its suitability to the nature of the study problem. The research population was selected from elite sprinters participating in the (400, 200, 100) meters. The total number of participants was (24) athletes who represented their respective clubs in the third round of the 2022 Club Championships. The research sample consisted of (12) athletes, with an average of (4) runners for each event selected randomly. The tests were conducted at the Al-Najaf International Stadium. The researchers used two (CASIO FH13.5) analysis cameras with a speed of 120 shots per second, and the analysis was done using the Kenova software. After analyzing and discussing the results, the researchers found a significant correlation between the time taken to cover the first and last (20) meters with the completion of (100) meters. There was also a correlation between the duration to traverse the first (20) meters with the completion of (200 and 400) meters. However, there was no correlation between the time taken to cover the last (20) meters with the completion of (200 and 400) meters. and this achieves one of the sustainable development goals of the United Nations in Iraq which is (Good Health). In light of this, the researchers recommend conducting extensive studies on these activities to identify the most critical weaknesses.

Keywords	**Time contribution percentage, sprinters' achievement in the (400, 200, 100) meters events.**

Introduction

The sports field is one of the significant domains in the lives of nations. Consequently, there has always been continuous attention to sports activities to achieve the highest levels of success. It can be either by using theoretical and applied sports sciences or modern scientific methods and

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techniques. One of the most distinguishing features of our current era is the significant scientific and technological advancements that have taken place in all areas of life, leading to the emergence of modern scientific outputs that have brought about immense changes. This development has opened new horizons for research and progress in the sports field. The level of sports achievement in recent years in sports in general, and in athletics in particular, has seen significant advancements. The differences in achievements have become very narrow. It can be attributed to the integration of various other scientific disciplines in the service of sports training, including biomechanics, motion analysis, physiology, and anatomy, all of which have a significant impact on athletic performance.

Athletics includes a range of beautiful events. The sprinting events (100, 200, 400) meters are thrilling for spectators and athletes. These events offer a blend of competition and dynamic performance, creating a source of enjoyment and anticipation for all involved.

The cognitive problem of the study revolves around the question of the possibility of identifying the contribution percentages of the first (20) meters and the last (20) meters to the final performance in the (100, 200, 400) meters. It also focuses on the weak points sprinters encounter in achieving their optimal times for the required distances and working on analyzing these aspects and applying them to improve performance. Moreover, the study underscored the neglect of employing motion analysis to precisely identify weaknesses, as well as the lack of attention from coaches towards these value characteristics, so they can program their training routines to achieve their goals as quickly as possible with the least effort.

The ongoing process of developing athletic achievements highlights the importance of research. The significance of kinematic analysis in identifying the main weaknesses of runners is also emphasized. Furthermore, it underscores the importance of achieving optimal times for partial distances, in particular the first and last 20 meters, which make the difference in the fastest race for track and field events and invests in the science of kinematic analysis in revealing the numerical values of these distances and their contribution percentage to the final achievement in each event.

The research aims to identify the numerical values of the time taken for the first and last partial distances of 20 meters each in the final achievement of sprinting the events of the (100, 200, 400) meters sprints for advanced athletes. Additionally, the study aims to identify the contribution percentage of the times for the first and last 20-meter partial distances in the final achievement attained for the (100, 200, 400) meters races for elite sprinters.

The researchers hypothesized that there is a statistically significant correlation between the first and last 20-meter partial distances in the final achievement of sprinting the events of the (100, 200, 400) meters races for advanced athletes. Furthermore, there are varying contribution percentages for the first and last 20-meter partial distances in the final achievement attained for the (100, 200, 400) meters races for elite sprinters. As for the research field, the human domain consisted of advanced athletes participating in the (100, 200, 400) meters races, with a total of 12 sprinters for the season 2022-2023. The temporal scope extended from 10/1/ 2023, to 10/3/ 2022. The spatial domain encompassed the Al-Najaf International Athletics Stadium.

Method and Procedures:

The researchers employed a descriptive approach with the correlational relationships and contribution ratios method, which is defined as "one of the forms of organized scientific analysis and interpretation to describe a phenomenon or problem, classify it, analyze it, and subject it to study and analysis" (8). The study population included advanced athletes participating in the

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Modern Sport
Vol.22 No.3 ,2023
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(400, 200, 100) meters sprints, totaling 24 athletes who represented their respective clubs in the third round of the Club Championship in 2022. The research sample consisted of 12 athletes, with an average of 4 athletes for each event, selected using a random sampling method. These athletes represented the elite sprinters of the (2022-2023) season from Al-Jaysh, Al-Shurṭa, Al-Ḥashed, Al-Za'faraniyah, Al-Najaf, and Al-Minaa.

Data Collection Methods and Used Devices and Tools:

Data Collection Methods:

Arabic and foreign scientific references and sources. The World Wide Web (Internet). Observation. Testing and measurement.

Used tools:

Running field at Najaf International Stadium for Athletics. The starting block for sprinting is a Swedish Nordic block. The race starting pistol is a Chinese clack-sound pistol. Timing clocks, a total of (3).

Korean-made analysis camera, type (CASIO Exilic EX-FH12.5), with a speed of 120 shots per second, along with two tripod stands. Kinetic analysis software (Kenova). Computer of type (DELL). Cones for marking the first 20-meter and last 20-meter distances.

Field Research Procedures:

Sprinting Performance Tests (100, 200, 400) meters races (6):

Purpose of the test: Identify the performance of each athlete within the specified race.

Used Tools: A standard sprinting track, in addition to using two cameras placed at the first 20 meters and last 20 meters of the specified race.

Performance Method/ The sprinters start in a low position on alternating starting blocks, as shown in Figures (1, 2, 3).

Measurement Method/ The achievement time is measured using three timing clocks, and the arithmetic mean is calculated.

Exploratory experiment/ The exploratory was conducted on a sample of three individuals who were not part of the main study's sample group. On Tuesday, 21/2/2023, one person was selected for each activity at the Al-Najaf Al-Ashraf International Stadium.

Main Experiment:

The main experiment was conducted on Thursday, Friday, and Saturday, 2-3-4/3/2023, at the Najaf Al-Ashraf International Stadium. The research sample was assessed through individual performance tests for the runners. This approach was adopted to enable the kinematic analysis cameras to precisely determine the partial distances times for the first and last 20 meters of each (100, 200, and 400) meter race. Two CASIO FH13.5 cameras were used, operating at a speed of 120 shots per second and positioned at a height of (1.2) meters. They were placed perpendicular to the race track at a distance of every 20 meters from the start and end of the race and 12 meters away from the middle of the defined running zone. This zone was marked as the third zone, as illustrated in the figures: (1) for the 100-meter test, (2) for the 200-meter test, and (3) for the 400-meter test.

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Figure (1)
It illustrates the placement of cameras for the 100-meter sprint

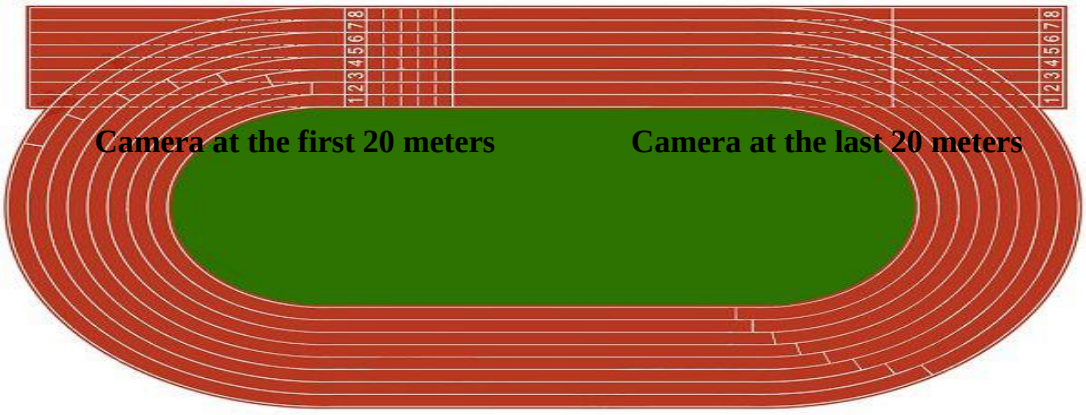


Figure (2)
It illustrates the placement of cameras for the 200-meter sprint

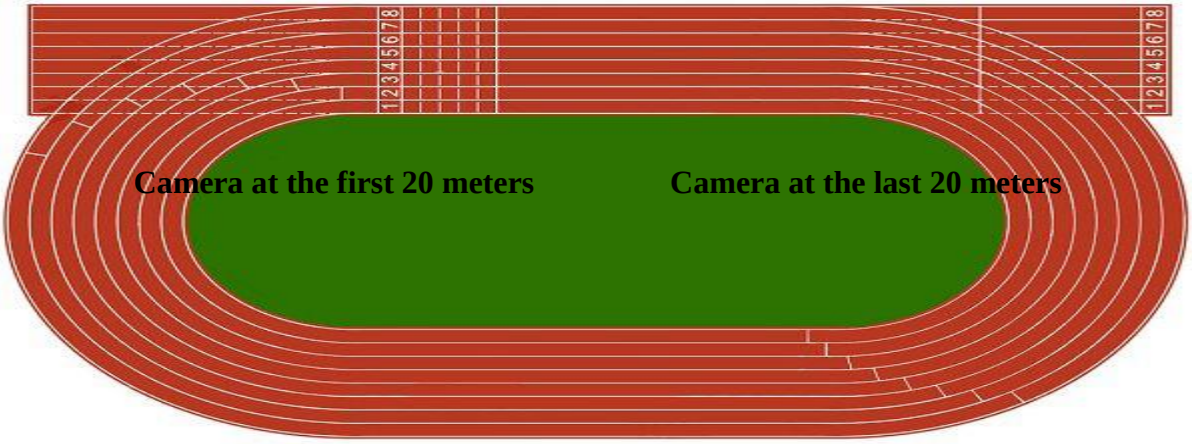
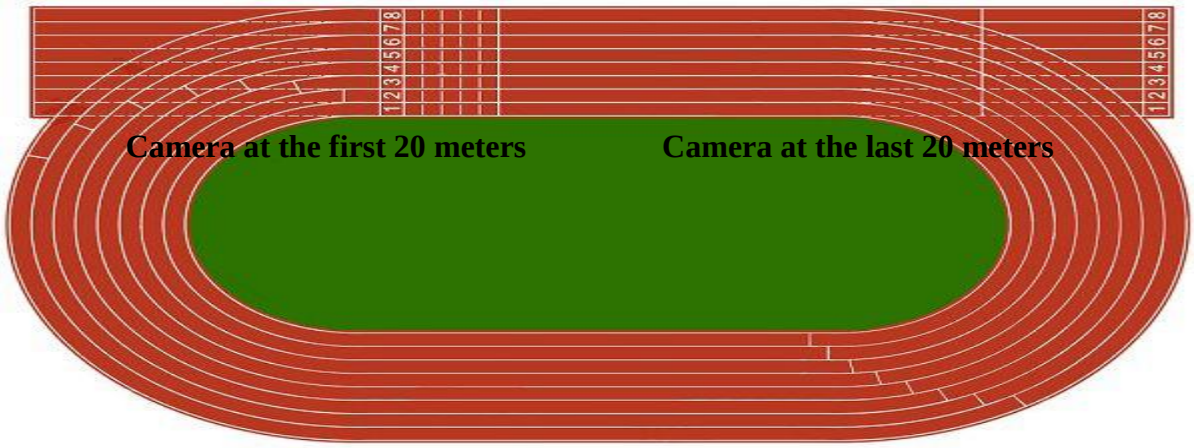


Figure (3)
It illustrates the placement of cameras for the 400-meter sprint



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Modern Sport
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Published 30/09/2023 Open Access

Table(1)
It illustrates the arithmetic mean, standard deviation, and skewness coefficient values for the research sample.

Event	Variables	Arithmetic Mean	Standard Deviation	Standard Error	Skewness coefficients	Kurtosis
100-Meter Sprint	First 20-meter distance	2.686	0.1161	0.07601	0.914	0.411
	Last 20-meter distance	2.703	0.1033	0.06247	0.363	-0.998
200-Meter Sprint	First 20-meter distance	2.693	0.0756	0.05674	0.477	-0.452
	Last 20-meter distance	2.680	0.0612	0.05366	0.227	-0.351
400-Meter Sprint	First 20-meter distance	2.690	0.0652	0.05234	0.643	0.558
	Last 20-meter distance	2.777	0.0544	0.04683	0.456	-0.678

Table (1) illustrates the values of the arithmetic mean, standard deviation, and skewness coefficients for the research variables. The arithmetic mean values are greater than the standard deviations, indicating a lack of dispersion among the research sample individuals. The values of the skewness coefficients ranged between (0.227 and 0.914), which means they are within the range of (±1), indicating that they fall within the range of neutrality.

Results:

Table (2)
It illustrates the correlation coefficients between the 100-meter sprint performance and the time taken for the first and last 20 meters of the race.

Seq.	Variables	100-meter sprint	Sig value	Statistical significance
1	Time of the first 20 meters distance	0.802	0.002	Significant
2	Time of the last 20 meters distance	0.834	0.001	Significant

Table (3)
It illustrates the correlation coefficients between the 200-meter sprint performance and the time taken for the first and last 20 meters of the race.

Seq.	Variables	200-meter sprint	Sig value	Statistical significance
1	Time of the first 20 meters distance	0.729	0.007	Significant
2	Time of the last 20 meters distance	0.600	0.039	Significant

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Vol.22 No.3 ,2023

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Table (4)
It illustrates the correlation coefficients between the 400-meter sprint performance and the time taken for the first and last 20 meters of the race.

Seq.	Variables	400-meter sprint	Sig value	Statistical significance
1	Time of the first 20 meters distance	0.680	0.015	Significant
2	Time of the last 20 meters distance	0.618	0.032	Significant

Note: Degrees of freedom = 10, meaning when n-2, and the value of R is 0.57, which is statistically significant at a value of (Sig) < (0.050).

Table (5)
It illustrates the results of studying the contribution percentages of the first and last 20-meter times to the total time taken to complete a 100-meter sprint.

Seq.	Variables	Correlation coefficient	T value	F value	Contribution percentage
1	Time of the first 20 meters distance	0.802	4.241	17.948	0.643
2	Time of the last 20 meters distance	0.834	4.776	22.808	0.695

Table (6)
It illustrates the results of studying the contribution percentages of the first and last 20-meter times to the total time taken to complete a 200-meter sprint.

Seq.	Variables	Correlation coefficient	T value	F value	Contribution percentage
1	Time of the first 20 meters distance	0.729	3.364	11.319	0.531
2	Time of the last 20 meters distance	0.600	2.373	5.63	0.360

Table (7)
It illustrates the results of studying the contribution percentages of the first and last 20-meter times to the total time taken to complete a 400-meter sprint.

Seq.	Variables	Correlation coefficient	T value	F value	Contribution percentage
1	Time of the first 20 meters distance	0.680	2.935	8.616	0.463
2	Time of the last 20 meters distance	0.618	2.485	6.175	0.382

Discussion:

Tables (5,6,7) illustrate that the times associated with covering the first and last 20 meters significantly contribute to the 100-meter sprint, with percentages of contribution reaching (64% and 69%) respectively. It indicates a high contribution of these time measurements to the 100-meter sprint. It is further emphasized by the correlation coefficients between these measurements and the sprint. Additionally, the time taken to cover the first (20) meters moderately contributes to the 200-meter sprint, with a contribution percentage of (53%), while traversing the last (20) meters, the 200-meter sprint's contribution is weak, only (36%). The times taken to cover the first and last (20) meters

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weakly contribute to the 400-meter sprint. The contribution percentages of these measurements were (46% and 38%) respectively. It indicates that the contribution percentages of these times are low in the 400-meter sprint. The correlation coefficients between these measurements and achievement support this assertion. The researchers reviewed past research and studies to enhance comprehension of these occurrences' particularities. The opinions were unanimous that each event has its characteristics and requirements. As Nawar Maddada mentioned, "Sprint events share four fundamental stages: starting, acceleration, maximum speed, and maintaining maximum speed. However, the distances of each race differ from one to another as in the (100, 200, 400) meters" (17). People often observe that sprinters typically specialize in two events, either the 100m and 200m or the 200m and 400m. Some studies attribute this phenomenon to the athletes' inclination towards specific speed qualities or their ability to endure them, in addition to some athletes possessing the characteristics necessary for excelling in a suitable event.

The researchers attribute these results to coaches' emphasis on start-up exercises and acceleration in the race. It is because they represent more than (70%) of the race distance, as mentioned in most studies. Significant contributions to achievements across all sprint races (100m, 200m, and 400m) have been made. The researchers agree with the views of (Ruaa and Bushra) (on the necessity for coaches to divide the race distances and provide balanced training) (10). The researchers share the viewpoint of (Hassan Nouri et al.) (who emphasize the importance of identifying the partial distances in the 100-meter race, which could contribute to the achieved final achievement) (7). When examining the training programs of most athletes, it is evident that the percentage of speed and acceleration training surpasses the volume of speed endurance training. It seems to be one of the reasons the times of these distances, especially the first (20) meters of each race, have contributed to the final achievement. The researchers also agree with Adil Al-Dulaimi (on the importance of explosive strength training in achieving appropriate times for intermediate distances in sprint races) (12). The researchers emphasize what Ahlam Shughati confirms (the significance of anaerobic training in improving performance for 200-meter runners and other fast sprints) (2).

While the (times for the last 20 meters) did not contribute significantly to achieving influential contributions in the 200- and 400-meters races. The researchers justify this from two perspectives: firstly, the limited inclusion of endurance training in coaching methodologies, and secondly, the time taken to cover the last 20 meters is almost equal to the total time taken to achieve the goal. As a result, the relationship and its resulting contribution percentage are not impactful. However, this does not imply that this time does not affect the overall time. If we consider that achieving a time reduction of around (0.1 seconds) can lead to a new achievement. In addition, results can be explained from a physiological and mechanical perspective. The most critical physical abilities associated with the 100m race are the capacity for rapid force endurance, which some researchers perceive as "the ability to maintain a high level of strength with quick contractions over a relatively long period against high external resistance" (18).

Atheer Sabri and Aqeel Al-Katib also mention that "the momentary force exerted in each step, which represents the muscles' ability to overcome external forces in the shortest possible time during each contact with the ground (with each step)" (1) should be handled precisely and professionally. The researchers note that most sprinters work towards a noticeable increase in stride length during this distance to maintain their average speed. At the same time, the stride frequency naturally decreases during the speed endurance phase, which results in an extended

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Vol.22 No.3 ,2023
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time taken to cover the specific distance of the last 20 meters. Thus, it is assumed that emphasis should be placed on the sprinter maintaining a consistent stride frequency as much as possible while relatively increasing stride length. It may explain why a sprinter who excels in shorter distances with high speed could also perform well in longer distances with a slightly lower speed. As highlighted by Kaye Thorne and David McCarley, "This could be a result of training programs developed by coaches, which should focus on enhancing speed endurance.

This aspect becomes one of the evaluation criteria for the training level" (14). As for the time taken to cover the first 20 meters, which showed a high contribution percentage to all events, the researchers attribute this to the fact that this phase is an effective stage often included in the training. The low starting intensity for distances of 20 to 30 meters is a type of training that athletes usually perform three to four times a week, as observed by (Widad et al.) These training sessions, as indicated by Widad and colleagues, contribute to "developing effective acceleration, leading to a reduction in the time taken to cover the distance due to continuous repetitions at high-intensity speeds. It enhances the efficiency of the active muscles and thus improves their performance" (19). The researchers also agree with Intisar Rashid Hamid that increasing tilt of the torso and rapid arm movement will lead to an increase in the body's forward momentum, which results in a boost during take-off (4).

This suggests that maintaining forward lean in this phase is significant for promoting speed increment (3). Jamila and Ali Shaboot also mention that "sprinting involves rapid arm motion, followed by the trunk, hip, and the push of the back leg, which is stronger than the front leg that initiates the movement, and the start is executed at top speed" (5). Additionally, the researchers see that "the success of sprinting relies on both the length and frequency of steps, as speed is a product of step frequency and length" (16). Moreover, athletes utilize a specific and fundamental range for step length.

The researchers also agree with Ali Naeem and Sareeh Al-Fadhli that "achieving excellence and reaching a high level in athletics activities is not solely achieved through utilizing the best scientific methods in sports training. It is also a result of proper utilization of modern measurements and tests, along with scientific planning accompanied by the relevant test results that adhere to the laws of motion and their practical application in training" (13). Many scientific studies have also proven the importance of developing and improving muscular and explosive strength. It is significant to focus on developing targeted muscle strength for quick movements. Therefore, it has become clear that the muscular strength engaged in sprinting significantly determines athletes' maximum speed. It relies on various types of jumping exercises, which constitute fundamental training units within the curriculum of sprinters in general. As those involved in athletic training agree, the physical and physiological adaptations achieved are the result of the athlete undergoing regular and standardized exercises that are scientifically structured. These exercises are scientifically designed to elevate the athlete's training level and assist them in achieving good performance (15). As for the varying ratios of distances covered at different times, this is natural depending on the capabilities of the runners and how they prepare for the race.

The researchers agree with what (Sareeh Abdul Kareem) affirms, that "the essential element in speed events is the necessity of persisting in technical training and improving it while acquiring strength. It combines power and speed in technical movement, enhancing neural pathway efficiency and improving exercise angle, speed, and range" (11).

Finally, the two researchers agree with Risan, "achieving technical stages requires muscles with high force output to be completed efficiently and quickly. This output can be

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obtained from trained and balanced muscles in terms of muscular strength on the movement joints" (9).

Conclusions:

1. The time taken to cover the first 20 meters in the 100- and 200-meter sprints have a significant and influential contribution to the final achievement. It is due to the training programming of starts, reactions, and accelerations within the athletes' daily training regimen up to 60 meters.
2. The time taken to cover the last 20 meters in the 100 meters' sprint also has a high and significant contribution to the final achievement. It is attributed to the limited overall time and its proportion to the time of the first 20 meters.
3. There is a weak contribution percentage in the time taken to cover the first and last 20 meters in the 400 meters' event, in addition to the last (20) meters in the 200 meters' event. The reason for this weakness is the lack of specific endurance for speed among the sampled individuals.

The researchers recommend the following:

1. Emphasizing to coaches and athletes the utilization of the current study's results in training and capitalizing on them for all sports activities that directly rely on sprinting.
2. Utilizing kinematic analysis, weaknesses and strengths can be accurately identified using a scientific approach.
3. Conducting a similar study on other events, most notably hurdles and relay events.

Author's declaration:

Conflicts of interest: None

We confirm that all tables and figures in this article are ours and written by the researchers themselves.

Ethical-Clearance: this manuscript approved by local ethical committee of physical education and sport sciences college for women on (April /2023)

Author's contributions:

All contributions of this study were done by the researchers (F.I. and I.S.) who get the main idea and work on writing and concluding also with number of experts, Mahir Jaafer in Statistics, Oliver Stoll in revision, Inaam Ghalib in translating, Maurizio Bertollo in proofreading

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نسبة مساهمة زمن ال (20) متر الاولى وال (20) متر الاخيرة في إنجاز عدائي فعاليات (400,200,100) متر المتقدمين النخبة

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2&1 جامعة بغداد/ كلية التربية البدنية و علوم الرياضة للبنات

مستخلص البحث

تَعدّ فعاليات العدو السريع (400,200,100) متر للرجال من أهم الفعاليات المميزة بألعاب القوى، وهي تتطلب قدرات بدنية عالية وقابليات حركية خاصة بالإضافة إلى بعض المواصفات الجسمية، وكبقية فعاليات الركض السريع الأخرى فان الأداء فيها يعتمد على تطبيق النواحي الفنية بشكل متكامل، والتي تعتمد بشكل فعال ومؤثر على المسافات الجزئية فيها.وتبرز أهمية البحث من خلال الاهتمام المتواصل بالإنجازات الرياضية والاستمرار في عملية تطويرها والى أهمية التحليل الحركي في كشف أهم نقاط الضعف لدى العدائيين، والى أهمية تحقيق المسافات الجزئية ال (20) متر الاولى وال (20) متر الاخيرة بأفضل زمن ممكن والتي تصنع الفارق في أسرع السباق لفعاليات ألعاب القوى. وتمحورت المشكلة المعرفية للدراسة في التساؤل عن امكانية التعرف على نسب المساهمة لمسافة ال (20) متر الاولى وال (20) متر الاخيرة بالإنجاز النهائي لل (400,200,100) متر والتركيز على نقاط الضعف التي يعاني منها العداء في تحقيق الزمن المثالي للمسافة المطلوبة والعمل على تحليل هذه الجزئيات وتطبيقاتها في تطوير الإنجاز.وإلى إهمال استعمال التحليل الحركي والتعرف على نقاط الضعف بدقة عالية، أضافة الى عدم الاهتمام من قبل المدربين بخصائص هذه القيم لكي يبرمجوا برامجهم التدريبية بغية تحقيق أهدافهم بأسرع ما يمكن وبأقل جهد. وهدف البحث إلى التعرف على القيم الرقمية لزمن قطع مسافات ال (20) متر الاولى وال (20) متر الاخيرة وعلى نسبة مساهمة هذه المسافات في الإنجاز النهائي. واستخدمت الباحثتان المنهج الوصفي بأسلوب العلاقات الارتباطية ونسب المساهمة لملاءمته طبيعة مشكلة الدراسة واختارتا مجتمع البحث من عدائي (400,200,100) متر المتقدمين وعددهم (24)عداء مثلوا انديتهم في نهائيات بطولة الاندية الدور الثالث للعام 2022 م, اما عينة البحث فكانوا (12) عداء بمعدل (4) عدائين لكل فعالية أخذوا بالطريقة العشوائية وأجري الاختبار عليهم في ملعب النجف الدولي، وتم استعمال كاميرتي تحليل نوع CASIO FH13.5 بسرعة 120 لقطة بالثانية وتم التحليل ببرنامج (Kenovaوبعد تحليل ومناقشة النتائج توصلت الباحثتان الى وجود نسبة مساهمة كبيرة بين زمن قطع مسافة ال(20) متر الاولى والاخيرة مع إنجاز 100متر، وكذلك وجود نسبة مساهمة بين زمن قطع مسافة ال(20) متر الاولى مع إنجاز 200 و400 متر، وعدم وجود نسبة مساهمة بين زمن قطع مسافة (20) متر الاخيرة مع إنجاز 200 و400. وهذا ما يحقق احد اهداف التنمية المستدامة للامم المتحدة في العراق (الصحة الجيدة). وفي ضوء ذلك توصي الباحثتان بإجراء دراسات موسعه لهذه الفعاليات لتشخيص اهم نقاط الضعف

الكلمات المفتاحية: نسبة مساهمة الازمان ، انجاز عدائي (400,200,100) متر