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The Effect of Specialized Straight-Line Sprint Training on Performance Endurance at Maximum Speed, Stride Length, and Stride Frequency in the 200-Meter Sprint for Athletes Under 20 Years of Age

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RESEARCH ARTICLE

The Effect of Specialized Straight-Line Sprint Training on Performance Endurance at Maximum Speed, Stride Length, and Stride Frequency in the 200-Meter Sprint for Athletes Under 20 Years of Age

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Abstract

The significance of this research lies in the ongoing focus on athletic achievements and the continuous effort to enhance them, as well as in the importance of motion analysis in identifying the main points of weakness among under-20 sprinters in the 200-meter race.

The cognitive problem of the study centers around the question of whether it is possible to identify the key numerical values related to the straight segment of the 200-meter sprint, and whether it is feasible to calculate one physical ability (performance endurance at maximum speed) and another mechanical ability (stride length and stride frequency). It also addresses the lack of application of motion analysis in accurately identifying weaknesses, in addition to the insufficient attention given by coaches to these numerical values when designing their training programs to achieve their goals as quickly and efficiently as possible.

The research aimed to design specific training drills for the straight sprint segment and to examine their effect on performance endurance at maximum speed, stride length, and stride frequency in the 200-meter event for sprinters under the age of 20.

The researchers employed the experimental method with two equivalent groups, as it was suitable for the nature of the study's problem. The research population was selected from 200-meter sprinters under the age of 20, totalling 12 athletes representing their clubs in the finals of the Third Round of the 2024 National Clubs Championship. The performance test was conducted at the Al-Najaf International Athletics Stadium. A total of five motion analysis cameras (CASIO FH13.5), operating at a speed of 120 frames per second, were used, and the data were analyzed using the Kenova software. Following the analysis and discussion of the results, the researchers concluded that there were statistically significant differences between the pre- and post-tests of both groups, as well as statistically significant differences between the post-tests of the two groups, in favour of the experimental group.

In light of these findings, the researchers recommend adopting the proposed straight-line sprint training drills for the 200-meter race and conducting more extensive studies on this athletic event.

Keywords: Straight-line sprinting, Motion analysis, 200-meter event

1. Introduction

The field of sports is considered one of the most significant areas in the life of nations. For this reason, continuous attention has always been given to athletic movement with the aim of achieving the highest levels of performance, whether through theoretical or applied sports sciences.

One of the defining characteristics of our modern era is the remarkable scientific progress witnessed across all fields of life. This advancement has opened

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new horizons for exploration, research, and development within the realm of sports.

In recent years, athletic performance has notably improved across most sporting disciplines, particularly in track and field. The margins between elite athletic achievements have become increasingly narrow, largely due to the integration of various scientific fields into the science of sports training. Among these are biomechanics, motion analysis, physiology, and anatomy—all of which are now combined in service of athletic excellence.

Biomechanics is regarded as one of the most important sciences that provides athletes with the necessary knowledge to apply anatomical principles and mechanical laws to specific movements. One of its key branches is motion analysis, which is based on the measurement of angles, distances, time intervals, and movement trajectories, all aimed at enhancing athletic skills [11, p. 25].

Today, motion analysis is considered an indispensable science in advanced countries across all sports, particularly when performance is measured in fractions of a second—where the coach's expert eye is replaced by the precision of the camera.

In the present study, we focus on one of the most dynamic and captivating events in track and field: the 200-meter sprint—an event in which the athlete must exert maximum effort with technical precision from the moment of the start until crossing the finish line.

This race consists of five essential technical phases: the start, first acceleration, second acceleration, maximum speed, and maximum speed endurance. Together, these phases constitute the overall technical performance of the event. Each phase influences and is influenced by the others to varying degrees, and they are significantly affected by a range of physical and biomechanical variables, particularly those related to how the athlete runs through the curve and straight segments of the race.

The integration of track and field training—particularly the 200-meter sprint—with various scientific disciplines has significantly contributed to enhancing athletes' performance through the development of scientifically grounded training programs. Since athletic achievement relies on several key pillars—including training load programming, the implementation of tests, objective measurements, the selection of appropriate tools and equipment, and the design of suitable exercises based on quantitative and qualitative biomechanical-physical analysis data—the researcher aims to conduct a comprehensive analysis of the race. This involves identifying points of weakness in order to address them, and recognizing strengths to reinforce them, with the hope that this effort will offer practical value to both athletes and coaches.

From this perspective, the importance of the research emerges in its focus on analyzing one of the most critical phases of the race: the straight-line sprinting segment. The study proposes training interventions that aim to raise performance levels in this part of the race, which spans approximately 100 meters. This straight section is essential for compensating for the loss of speed that typically occurs during the first 100 meters of the race run along the curve. The decline in speed on the curve is primarily due to mechanical factors—most notably, the centrifugal force that results from running along a curved path with a certain inclination angle. This requires a biomechanical adjustment of the body's position, which in turn leads to a reduction in speed compared to that achieved during straight-line running.

The aim of this study was to analyze the final 100 meters of the 200-meter race, which represents the straight-line sprinting segment, in order to identify certain mechanical variables, particularly stride length and stride frequency. These values were compared with the ideal stride length and frequency specific to each sprinter, as determined by the James He equation. The research also sought to design specialized training drills for straight-line running that would enhance special speed endurance, stride length, and stride frequency, based on the same equation. Additionally, the study aimed to identify the significance of differences between the preand post-tests, as well as between the post-tests of both groups, in the performance achievement test.

The researchers hypothesized that there would be no statistically significant differences between the pre- and post-tests for both the control and experimental groups, while there would be statistically significant differences in favor of the experimental group in the post-test.

As for the research fields:

- The human field consisted of 200-meter sprinters under the age of 20 who participated in the qualifying rounds of the 200-meter event at the Iraqi Athletics Federation's Third-Round Championship in October 2024.
- The spatial field was the track at Al-Najaf Al-Ashraf Secondary International Athletics Stadium.
- The time field extended from November 1, 2024, to the date of final submission of the research on March 15, 2025.

Table 1. It presents the mean, standard deviation, median, and skewness coefficient for the research sample.

Variables	Unit of Measurement	Mean	Standard Deviation	Median	Skewness Coefficient
Height	cm	1.65	0.117	1.64	−0.448
Body Mass	Kg.	6.336	2.943	66.5	−0.206
Chronological Age	Year	19.16	1.115	19.0	−0.300
Training Age	Year	3.0	1.264	3.25	0.789
Ideal Stride Length	cm	2.09	0.643	2.05	0.658

2. Methodology and procedures

The researchers employed the experimental method with two equivalent groups, which is defined as "the approach that most accurately addresses a wide range of scientific problems in both practical and theoretical contexts" [14, pp. 33].

Furthermore, the researchers aimed to "introduce a characteristic or variable through which the condition of the sample individuals could be altered" [10, p. 10].

The research population and sample were deliberately selected and consisted of 200-meter sprinters under the age of 20, who participated in the qualifying rounds of the 200-meter event at the Iraqi Athletics Federation's Third-Round Championship, 2024. The total number of participants was 12 sprinters, representing the elite athletes from Iraqi clubs in this age category.

3. Data collection methods and tools used

3.1. Data collection methods

The researchers collected information through various sources, including Arabic and foreign scientific references, the World Wide Web (Internet), direct observation, and the use of testing and measurement procedures.

3.2. Instruments and equipment used

The experimental procedures were conducted on the running track at Al-Najaf International Athletics Stadium. The equipment included Swedish-made Nordic starting blocks and a Chinese-manufactured Clack-type sound starting pistol. Timing was recorded using three stopwatches.

For biomechanical analysis, the researchers used five Korean-made CASIO Exilim EX-FH12.5 cameras, each calibrated to record at 120 frames per second and mounted on tripods. The Kenova motion analysis software was employed to calculate distance, time (speed), stride length, and stride frequency. Data processing was performed using a DELL computer, and cones were used to mark training distances.

3.3. Sample homogeneity

Prior to implementing the tests related to the study and initiating the training program prepared by the researchers, steps were taken to control the variables that could affect the accuracy of the research findings. To this end, the researchers verified the homogeneity of the study sample with respect to several anthropometric variables: height, body mass, chronological age, training age, and ideal stride length.

These variables were statistically assessed as presented in Table 1, which includes the mean, standard deviation, median, and skewness coefficient.

Table 1 presents the values of the mean, standard deviation, median, and skewness coefficient for the research variables. The means were higher than the standard deviations, indicating a lack of dispersion among the individuals in the research sample. The skewness coefficients ranged between −0.448 and 0.789, which fall within the acceptable range of ±1, confirming that the data are normally distributed.

3.4. Description of the 200-Meter performance test [6, p. 175]

3.4.1. Test objective

To assess the performance outcome of each sprinter within the specified race.

3.4.2. Equipment used

A standard legal sprinting track, along with five video cameras positioned perpendicularly at every 20-meter segment of the 100-meter straight-line portion of the designated race distance.

3.4.3. Performance procedure

Athletes perform the test using the low start position from starting blocks, alternating turns, as illustrated in Fig. 1.

3.4.4. Measurement method

Performance time is recorded using three stopwatches, and the mean value of the three is used as the official result.

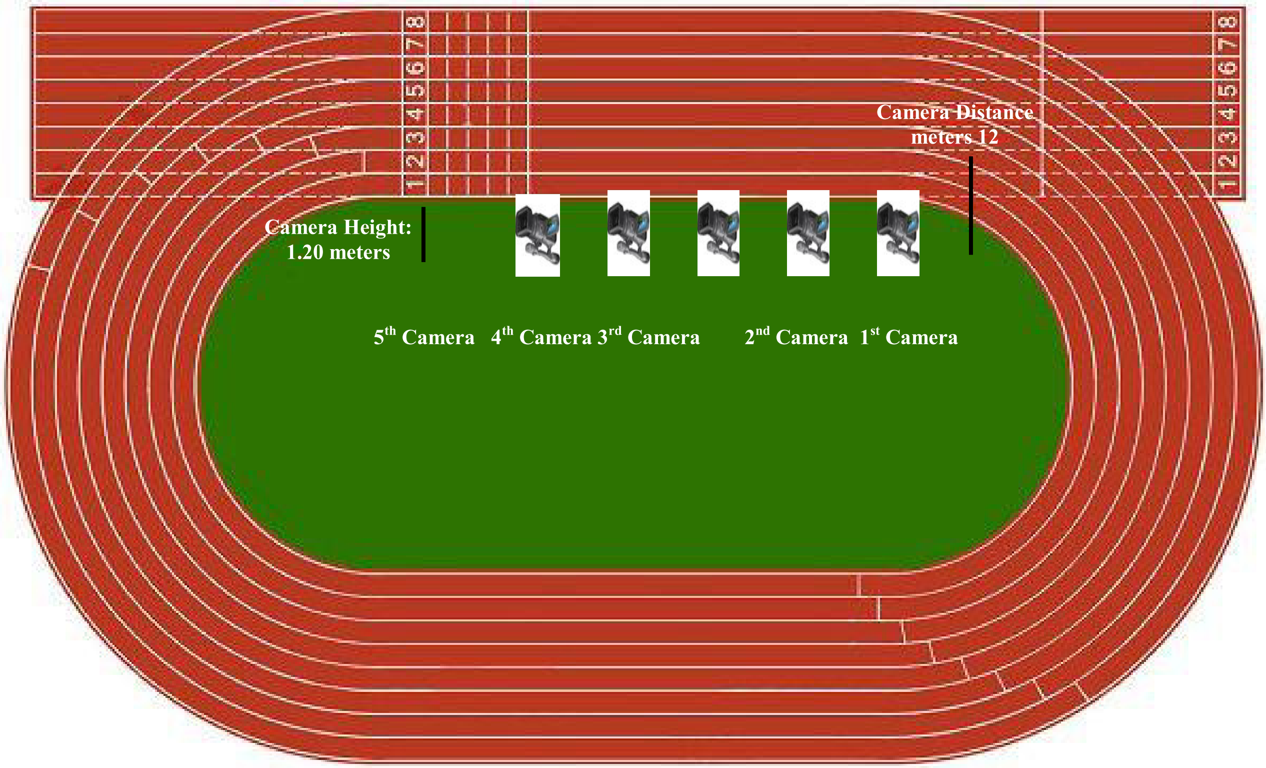

Fig. 1. Illustrates the positioning of the cameras along the straight segment during the 200-meter performance test.

3.5. Pilot study

The pilot study was conducted on Friday, November 1, 2024, at 4:00 p.m. on the track of Al-Najaf Al-Ashraf International Stadium, using two sprinters who were not part of the research sample. The purpose of the pilot was to determine optimal camera placement and to test all straight-line sprint training drills based on ideal stride length and frequency during the special speed endurance phase. The pilot helped identify the appropriate positions for placing the cameras perpendicular to the second sprinting lane, including the distance from the center of the lane and the camera height of 1.20 meters, as well as the distance between the cameras and the third running lane, which was 12 meters. A total of five cameras were used, each positioned perpendicular to a 20-meter interval along the 100-meter straight segment. The pilot also determined the time required to conduct the test, the responsibilities of the supporting team, and included checking each camera's memory cards (RAM) and calibrating the recording speed to 120 frames per second.

3.6. Main experiment – Pre-test

The main experiment was conducted on Saturday, November 2, 2024, at the Al-Najaf Al-Ashraf Secondary International Athletics Stadium, using the research sample. The performance test was administered to the sprinters individually, in accordance with IAAF 2019 standards, to allow the motion analysis cameras to capture the biomechanical variables of the final 100-meter segment of the race—representing the straight-line sprinting phase—with high precision.

A total of five CASIO FH13.5 motion analysis cameras were used, each set at a recording speed of 120 frames per second and positioned at a height of 1.20 meters, perpendicular to every 20 meters from the beginning to the end of the straight segment. The cameras were placed at a distance of 12 meters from the center of the designated sprinting lane, which was specified as the third lane, as illustrated in Fig. 1.

3.6.1. Calculation of variables

The following variables were measured:

1. Performance time for the 200-meter sprint was recorded using stopwatches.
2. Speed on the straight segment was calculated using the motion analysis software Kenova (version 0.9.5).
3. Stride length and stride frequency were also measured using the Kenova motion analysis software.

Fig. 2. Illustrates the method for calculating the average stride length over the final 20 meters of the 200-meter performance test.

Table 2. It presents the equivalence between the experimental and control groups based on the independent samples t-test.

		Experimental Group (n)		Control Group (n)				
No.	Variables	Mean	SD	Mean	SD	t-value	Sig-value	Significance
1	Straight-Line Sprinting Speed	7.42	0.078	7.41	0.065	2.364	0.422	Not significant
2	Stride Length	2.07	0.014	2.05	0.018	2.436	0.231	Not significant
3	Stride Frequency	3.58	0.052	3.62	0.073	2.545	0.309	Not significant
4	200-Meter Performance Time	24.59	0.791	24.48	0.572	2.455	0.559	Not significant

Degrees of Freedom: n 2 = 10 . . . Significant at (Sig) < 0.050.

As for calculating the average stride length over the 100-meter straight segment, it was computed by dividing the distance into five consecutive 20-meter intervals. The stride length was determined for each of the following segments: the first 20 meters, second, third, fourth, and fifth. The arithmetic mean of these five values was then calculated to represent the average stride length for the straight segment of the 200-meter race, as illustrated in Fig. 2.

3.7. Equivalence between the research groups

After completing the logical calculations for all variables related to the study and for all twelve sprinters, it was necessary to establish group equivalence before implementing the proposed training program. The researchers ensured the equivalence of the experimental and control groups, based on the principle that "the researcher must establish groups that are equivalent, at a minimum, with respect to variables relevant to the study" [17, p. 407]. To control for factors that might influence the accuracy of the study's results and to attribute any differences in outcomes solely to the independent variable, the researchers applied the independent samples t-test to the raw scores from the pre-test for all research variables. The results are presented in Table 2.

The results presented in Table 2 indicate that the two groups are equivalent in all variables related to the study, as no statistically significant differences were found between the members of the sample.

3.8. Implementation of the training program prepared by the researchers

The researchers developed a set of training exercises aimed at improving stride length and stride frequency during the special speed endurance phase, based on the optimal stride length equation proposed by James G. Hay, which relates ideal stride parameters to the athlete's body height.

The training program was implemented starting on Saturday, November 9, 2024, and continued for eight weeks during the pre-competition and competition periods, with sessions held three times a week (Saturday, Tuesday, Thursday), concluding on Thursday, January 2, 2025.

Each training session lasted between 90 to 120 minutes, depending on the intended objective. Training was conducted individually for each athlete within

Table 3. It presents the core sprinting exercises (RU) focused on the 100-meter straight segment of the 200-meter race.

Code	Exercise Content	Training Objective	Mechanical Objective
Ru1	Sprinting 80 meters from starting blocks with stride control markers	Developing reaction time, acceleration phase, and specific sprinting speed	Regulating the movement trajectory through performance angles and stride frequency
Ru 2	Sprinting 90 meters from starting blocks with stride control markers	Developing reaction time, acceleration phase, and specific sprinting speed	Regulating the movement trajectory through performance angles and stride frequency
Ru 3	Sprinting 100 meters from starting blocks with stride control markers	Developing reaction time, acceleration phase, and specific sprinting speed	Regulating the movement trajectory through performance angles and stride length
Ru 4	Sprinting 80 meters from a standing start with stride control markers	Enhancing specific sprinting speed and speed endurance	Regulating the movement trajectory through performance angles and stride length
Ru 5	Sprinting 90 meters from a standing start with stride control markers	Enhancing specific sprinting speed and speed endurance	Regulating the movement trajectory through performance angles and stride length
Ru 6	Sprinting 100 meters from a standing start with stride control markers	Enhancing specific sprinting speed and speed endurance	Refining the overall movement pattern, stride length, and stride frequency

Table 4. It presents the core sprinting exercises (RU) designed for the specific distances covering the full 200 meters.

Code	Exercise Content	Training Objective	Mechanical Objective
Ru7	Sprinting 120 meters from starting blocks with stride control markers	Developing reaction time, acceleration duration, and specific sprinting speed	Regulating the movement trajectory through performance angles and stride frequency
Ru 8	Sprinting 150 meters from starting blocks with stride control markers	Developing reaction time, acceleration duration, and specific sprinting speed	Regulating the movement trajectory through performance angles and stride frequency
Ru 9	Sprinting 200 meters from starting blocks with stride control markers	Developing reaction time, acceleration duration, and specific sprinting speed	Regulating the movement trajectory through performance angles and stride length
Ru 10	Sprinting 120 meters from a standing start with stride control markers	Enhancing specific sprinting speed and speed endurance	Regulating the movement trajectory through performance angles and stride length
Ru 11	Sprinting 150 meters from a standing start with stride control markers	Enhancing specific sprinting speed and speed endurance	Regulating the movement trajectory through performance angles and stride length
Ru 12	Sprinting 200 meters from a standing start with stride control markers	Enhancing specific sprinting speed and speed endurance	Refining the overall movement path, stride length, and stride frequency
Ru 13	Sprinting 250 meters from a standing start with stride control markers	Enhancing specific sprinting speed and speed endurance	Refining the overall movement path, stride length, and stride frequency
Ru 14	Sprinting 300 meters from a standing start with stride control markers	Enhancing specific sprinting speed and speed endurance	Refining the overall movement path, stride length, and stride frequency

See Appendix [1], which presents a sample training unit prepared for the research participants.

a general framework, taking into account the specific training needs of each sprinter, and based on the motion analysis of the pre-test results, which identified each athlete's strengths and weaknesses.

Table 3 and Table 4 presents the training exercises developed to enhance special speed endurance over the 100-meter straight segment of the 200-meter sprint.

3.9. Post-tests

Following the completion of the training program developed by the researchers for the study sample, the post-test was conducted on Saturday, January 4, 2025, at 3:00 p.m., on the Al-Najaf Al-Ashraf International Athletics Stadium. All testing conditions were carefully controlled, including the location, time, equipment, and camera placements, ensuring consistency with the pre-test settings.

3.10. Statistical tools

The researchers employed appropriate statistical methods to address the study problem and derive results using the Statistical Package for the Social Sciences (SPSS), version 26. Specifically, they utilized the paired samples t-test and the independent samples t-test where applicable.

4. Results

Table 5. It presents the significance of the differences between the preand post-tests for the control group.

		Control Group – Pre-test		Control Group – Post-test				
No.	Variables	Mean	SD	Mean	SD	T-value	Sig-value	Significance
1	Straight-Line Sprinting Speed	7.41	0.065	8.01	0.075	3.128	0.040	Significant
2	Stride Length	2.05	0.018	2.09	0.080	2.675	0.143	Not significant
3	Stride Frequency	3.62	0.073	3.82	0.111	3.108	0.036	Significant
4	200-Meter Performance Time	24.48	0.572	23.67	0.572	2.910	0.046	Significant

Degrees of freedom: n 1 = 5 . . . Significant at (Sig) < 0.050.

Table 6. It presents the significance of the differences between the preand post-tests for the experimental group.

		Experimental Group – Pre-test		Experimental Group – Post-test				
No.	Variables	Mean	SD	Mean	SD	T-value	Sig-value	Significance
1	Straight-Line Sprinting Speed	7.42	0.078	8.33	0.084	3.209	0.000	Significant
2	Stride Length	2.07	0.014	2.11	0.054	2.980	0.045	Significant
3	Stride Frequency	3.58	0.052	3.95	0.097	3.006	0.032	Significant
4	200-Meter Performance Time	24.59	0.791	23.51	0.564	3.150	0.022	Significant

Degrees of freedom: n 1 = 5 . . . Significant at (Sig) < 0.050.

Table 7. It presents the significance of the differences between the post-tests of the experimental and control research groups.

		Experimental Group – Post-test		Control Group – Post-test				
No.	Variables	Mean	SD	Mean	SD	T-value	Sig-value	Significance
1	Straight-Line Sprinting Speed	8.33	0.084	8.01	0.075	2.620	0.258	Not significant
2	Stride Length	2.11	0.054	2.09	0.080	2.453	0.341	Not significant
3	Stride Frequency	3.95	0.097	3.82	0.111	2.705	0.201	Not significant
4	200-Meter Performance Time	23.51	0.564	23.67	0.572	1.745	0.590	Not significant

Degrees of Freedom: n 2 = 10 . . . Significant at (Sig) < 0.050.

5. Discussion

The results presented in Table 5 for the control group indicated statistically significant differences in three variables: straight-line sprinting speed, stride frequency, and 200-meter performance time. However, no statistically significant difference was observed in stride length, despite a visible improvement in the post-test mean. The researchers attribute this outcome to the participants' adherence to the training programs prescribed by their coaches.

The researchers align with the perspective of Saad Mohsen regarding the variation in training methodologies and their educational foundations. He stated: "Regardless of differences in the scientific and practical foundations of training programs, a well-designed training program will inevitably lead to the desired development—provided it is built on a scientific basis, considers individual differences, applies optimal repetitions and rest intervals, and is implemented under proper conditions in terms of location, timing, and equipment, with supervision from specialists" [8, p. 75].

This interpretation supports the observed improvements in the post-test performance of the control group participants.

As for the results presented in Table 6 concerning the experimental group participants, all outcomes showed statistically significant differences across all variables. The researchers attribute these results to the effectiveness of the specialized training program they designed, which was specifically tailored to enhance performance during the straight-line phase of the 200-meter sprint.

The training was structured to simulate realistic competition conditions experienced by young sprinters, incorporating markers and individualized control indicators for each athlete. These were determined based on each runner's ability level and stride length during the special speed endurance phase.

This aligns with the approach adopted by the researchers, who based the design of their training program on the results of motion analysis in order to construct a scientifically sound methodology tailored to the individual characteristics of each sprinter.

Special attention was given to the integration of key mechanical variables—speed, distance, and time—and the results clearly reflect a strong relationship between these metrics and the athletes' performance outcomes.

The researchers also conducted a thorough review of the most relevant literature and previous studies to gain deeper insight into the specific nature of this event. The consensus among researchers was that each track event has its own biomechanical requirements and technical demands. The 200-meter sprint, in particular, possesses distinct mechanical characteristics, as noted by Sareeh Al-Fadhli et al. [15, p. 77], Wedad et al. [19, p. 11], Esraa et al. [4, p. 14], Zainab [20, p. 4], and Intisar [7, p. 13].

They emphasized that sprinting events share four fundamental phases: start, acceleration, maximum speed, and speed endurance. However, the distance covered in each phase varies depending on the race. The 200-meter sprint remains the most decisive factor across all sprint events, as athletes specializing in this distance often demonstrate qualities that enable them to successfully compete in either the 100-meter or 400-meter races. According to the cited studies, the reason a 200-meter sprinter is likely to specialize in two events—either 100m and 200m, or 200m and 400m—is attributed to the athlete's inclination toward either explosive speed or speed endurance, in addition to possessing the physical characteristics that align with the specific demands of these events.

The researchers concur with Ruaa Amer Ismail and Bushra Kadhum Abdul-Ridha on the necessity for coaches to give greater attention to segmenting race distances and providing balanced training programs [18, p. 6]. They also support the view expressed by Hassan Nouri Taresh et al., who emphasized the importance of identifying partial segments within the 200-meter sprint, as these may significantly contribute to the athlete's overall performance outcome [5, p. 30].

The researchers also agree with Al-Dulaimi, who emphasized the importance of explosive strength training in enhancing sprinting speed and achieving optimal times in critical segments of sprint races [1, p. 11]. Furthermore, they affirm the conclusion drawn by Suhad Ibrahim, who highlighted the role of anaerobic training in improving the performance of 200-meter sprinters as well as athletes in other short-distance events [16, p. 471].

Based on the results, the first hypothesis—which stated that there would be no statistically significant differences between the pre-tests and post-tests for the studied variables in both research groups—was not confirmed. Accordingly, the researchers reject the null hypothesis and accept the alternative hypothesis, which affirms that there are statistically significant differences between the pre-tests and post-tests for the studied variables in both research groups.

As for Table 7, which presents the significance of the differences between the post-tests of the experimental and control groups, the results revealed no statistically significant differences across all variables examined in the current study. However, a noticeable improvement was observed in all mean values, favoring the experimental group.

The researchers attribute these findings to the training program they developed based on precise scientific principles, supported by detailed motion analysis. Furthermore, the results may be interpreted from both physiological and biomechanical perspectives. One of the most critical physical abilities associated with the 200-meter event is special speed endurance, which some scholars define as "the ability to sustain a high level of force through rapid contractions over a relatively extended period of time against a high external resistance" [9, 103]. This quality demands a highly specialized and professional approach to training.

The researchers observed that most sprinters tend to significantly increase their stride length during this portion of the race in an effort to maintain their average speed, while at the same time, stride frequency naturally tends to decrease during the speed endurance phase. Nonetheless, the athletes in this study achieved notable improvements, reducing their times by approximately one second—a development attributed to gains in both stride length and frequency.

The researchers suggest that sprinters should be trained to maintain a consistent stride frequency while simultaneously achieving a relative increase in stride length. This interpretation supports the idea that an athlete capable of covering shorter distances at high speeds can also cover longer distances at slightly lower speeds, depending on their ability to manage both stride length and frequency efficiently.

Regarding the significance of the present study for sprinters under the age of 20, the researchers align with Candra and Rumini in emphasizing the importance of early intervention to correct performance. They note that: "In order to achieve optimal athletic performance, development must begin at an early age, and this applies equally to both junior and youth categories" [3; p. 25].

Furthermore, the researchers maintain that successful sprinting performance depends heavily on stride length and stride frequency, as speed is the result of both. They emphasize that competitive athletes rely on a clearly defined and fundamental stride length range as a basis for optimizing their sprinting performance.

The researchers concur with Naeem and Al-Fadhli, who emphasized that:

"Achieving high performance and excellence in track and field events is not solely the result of applying advanced scientific training methods, but also depends on the correct use of modern measurements and testing, along with scientific planning informed by the outcomes of relevant biomechanical assessments and the practical application of motion laws in training" [2, p. 95].

They further agree with the widely held view among sports training professionals that: "Physical and physiological adaptations are the result of consistent, well-structured, and scientifically designed training programs that can significantly improve an athlete's fitness level and help them reach competitive achievements" [20, p. 5]. As for variations in the time it takes athletes to cover specific distances, this is considered a natural outcome of individual capabilities and the way in which each athlete is prepared for competition.

The researchers also agree with the assertion made by Mohammed et al., who emphasized that: "The fundamental element in sprint events lies in the continuous refinement and enhancement of technique alongside the development of strength, in order to integrate speed-strength into the technical movement. This integration leads to improved efficiency of neural pathways, thereby enhancing the working angle of the movement, its speed, and range" [13, p. 121].

Accordingly, the second research hypothesis was confirmed, which states that there are no statistically significant differences between the post-tests for the studied variables in the two research groups.

6. Conclusions

1. The training program developed by the researchers had a highly significant impact on improving straight-line sprinting speed during the 200-meter race.
2. The training program developed by the researchers had a highly significant impact on enhancing stride length during the 200-meter race.
3. The training program developed by the researchers had a highly significant impact on improving stride frequency during the 200-meter race.
4. The training program developed by the researchers had a highly significant impact on improving overall performance in the 200-meter race.

7. Recommendations

1. The researchers recommend that coaches and athletes utilize the findings of the current study during training and apply them to improve key sprinting parameters, namely stride length and stride frequency.
2. Emphasis should be placed on the use of motion analysis, as it is a scientific tool that accurately identifies strengths and weaknesses, thereby contributing to the development of effective training solutions.
3. It is recommended to conduct similar studies on other track events, particularly the 100 meters, 400 meters, 110-meter hurdles, and the various types of relay races.

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 (November/2024).

Author's contributions

All contributions of this study were done by the researchers (A.A. and E.S) who get the main idea and work on writing and concluding also with number of experts, Maher Jaafar Ameen in Statistics, Khitam Mousa in revision, Batoul Ahmed Salim in proofreading.

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Appendix (1)

Week Six – Training Session Eighteen – Part of the Designed Program

Thursday, 15/2/2023 - Intensity: 90% - Duration: 97 minutes - Objective: Special speed, special speed endurance

Section and Duration	Attributes and Elements	Intensity	Exercise Name	Work Duration	Number of Repetitions	Rest Between Repetitions	Rest Between Exercises	Total Work and Rest Duration	Notes
Preparatory section 35 minutes	Aerobic	-	800 meters + accelerations	270	1	-	-	270 Sec.	General Warm-Up
	Flexibility	-	Dynamic	20 Sec.	3	60 Sec.	90 Sec.	270 Sec.	From jogging
	Skill-based	-	ABC 1	10 Sec.	3	120 Sec.	120 Sec.	390 Sec.	Stride length
	Skill-based	-	ABC 2	10 Sec.	3	120 Sec.	120 Sec.	390 Sec.	Stride frequency
	Skill-based	-	ABC 3	10 Sec.	3	120 Sec.	120 Sec.	390 Sec.	Knee lift
	Skill-based	-	ABC 4	10 Sec.	3	120 Sec.	120 Sec.	390 Sec.	Alternating legs
Main Section 46.5 minutes	Acceleration	85%	Ru1	4 Sec.	2	90 Sec.	120 Sec.	220 Sec.	Unit Volume: 860 meters
	Acceleration	95%	Ru2	4 Sec.	2	120 Sec.	120 Sec.	250 Sec.	
	Stride Length	90%	Ru 5	8 Sec.	2	180 Sec.	300 Sec.	500 Sec.	
	Stride Frequency	85%	Ru 6	9 Sec.	2	180 Sec.	270 Sec.	470 Sec.	
	Speed Endurance	95%	RUS8	10 Sec.	2	180 Sec.	300 Sec.	500 Sec.	
	Speed Endurance	90%	RUS9	10 Sec.	2	180 Sec.	270 Sec.	470 Sec.	
	Educational	-	Explanation of Today's Objective	390 Sec.	-	-	-	390 Sec.	
Concluding Section 15.5 minutes	Flexibility	-	Static	20 Sec.	3	60 Sec.	90 Sec.	270 Sec.	From a lying position
	Aerobic	-	800 meters	270 Sec.	1	-	-	270 Sec.	Jogging only
	Psychological	-	Encouragement and motivation	390 Sec.	-	-	-	390 Sec.	Relaxation exercise

1. Contribution of the first researcher: 70%.
2. Contribution of the second researcher: 30%.
3. Beneficiary institution: The Iraqi Central Federation of Athletics.