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Effects of Speed Training According to Target Running Time on the Development Model of Running Step and Achievement in 100m Race for Young Female Athletes

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ABSTRACT

In this study: To preparation the speed training program in accordance with the target time for young age group of female players in Baghdad Governorate, and usage with them during competition sport events "100m. running" of the effect on developed some variables of it (running step-speed-achievement). The research protocol was carried out with an experimental and a two-equivalent group (control-experimental) pre-test post-test. The sample: The research community included (10) female young athletes in Baghdad governorate, who compete in 100 meters run. Two groups (5 athletes per group) were randomly divided. The pre-tests were conducted by the researchers on the research sample in terms of their 100-meter sprint performance skills. The test was video-recorded using a camera positioned in the center of the field 140 cm above. Subsequently, the following variables were derived: (number of steps, step length, and step frequency). The researchers then delivered 8-week speed training, with three weekly training sessions. High intensity interval training protocol was performed, by a (80- 95%) of intensity; referred to as (2:1) ripple ratio between sessions and intervals through week21112-11. Posttests were given and analyzed upon completion of the training. Data were analyzed by researchers through the statistical software, SPSS. It was found that timed speed resulted in improved performance for the sprint variables (number of steps, step length, step frequency) in the 100m with implications related to achievement gains.

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KEYWORDS
speed training according target time, variables running step, 100-meter sprint achievement

1. Introduction

The world is in the process of facing tremendous and astonishing growth in sports, that sports sciences due to undertaking various new methods of training have risen to great extent. Thereby making a clear progress for various achievements at the international, Olympic or even Arab championships. Countries have now started to look at women's sports; and we see the record breaking levels in every championship. The developed countries have poured resources into enabling this group to feel highly empowered through better science and full use of the techical and physical potential of al atheletes.

Women's athletics is an international sport and has a great and special status among all sports. Unique from any other sport and growing in significance are the frequent breaking of world records, and the variety of events, none like the others – running, taking a jump, making a leap or propelling an object- along with sub activities within each category.

The 100m race is a fascinating test of speed and technique. A combination of strength and cunning is necessary to pull away at such a distance. The athlete must complete a good start, possessing maximum effort during the race2 (Radi et al., 2020). The 100-m sprint is not just a sporting event, but an avenue for demonstrating physical strength, speed and endurance of runners as well as running skills. This is contingent

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on pre-planning the race in structured training. Attention is paid to the target time for each runner, which is confirmed using a recording camera with high accuracy. Progress is tracked throughout the race allowing for a personalized training program that aids runners to increase in their capacity to sustain speed.

This action depends on morphological characteristics and the level of integration between them, that allows the athlete to withstand fatigue caused by loads specific to this activity, therefore maintaining a stable pace and maximun speed. Believe that increases in physical characteristics affect the number of steps and so can keep optimal together the step rate/step length ratio during race. This, obviously is the critical and most important factor in race performance which necessitates that the athlete has a certain level of integration of physical (strength-endurance) and technique in order to keep “ideal” ratios throughout distances. However, these two factors are affected by fatigue as the effort continues throughout the race, especially in the final stages. The importance of this research lies in developing speed training programs with target times using a standardized scientific methodology for developing running step variables. The researchers hope that this will contribute to raising the achievement level of female athletes.

Research problem:

The research problem lies in answering the following questions:

- Does speed training with target times play a role in developing running step variables for young female athletes?
- Does timed speed training play a role in improving the achievement of young female athletes in the 100-meter sprint?
- Is there a difference between the training methods developed by the researchers and traditional training methods in their effect on the research variables?
- If there is a difference between the training methods developed by the researchers and traditional training methods in their effect on the research variables, which method is more effective?

Research Objectives

- To identify the effect of timed speed training on improving the running step variables of young female athletes.
- To identify the effect of timed speed training on improving the achievement of young female athletes in the 100-meter sprint.
- To identify the difference between the training methods developed by the researchers and traditional training methods in their effect on the research variables.
- To identify which method is more effective than the training methods developed by the researchers or traditional training methods in influencing the research variables.

Research hypotheses:

- Speed training with a target time has a positive effect on developing the running step variables of young female athletes.
- Speed training with a target time has a positive effect on improving the achievement of young female athletes in the 100-meter sprint.
- Identifying the difference between the training methods developed by the researchers and traditional training methods in their effect on the research variables.

Research fields:

- Human field: Young female athletes in Baghdad Governorate participating in the 100-meter sprint.
- Time field: (11/11/2025) to (26/1/2026)
- Spatial field: Al-Jadriya Stadium at the University of Baghdad.

Research methodology and field procedures:

Research Methodology:

The researchers employed the experimental method and a two-group equivalent (control and experimental) design with pre- and post-tests.

Community and sample research:

The researchers defined their research community using a comprehensive enumeration method, consisting of (10) young female athletes participating in the 100-meter sprint in Baghdad Governorate. Their ages ranged from (16-17) years, with a training period of (1-2) years. They were randomly assigned (by lottery) to two groups of (5) athletes each.

Data Collection Methods:

The researchers used the 100-meter sprint achievement test as a data collection method. Step variables were extracted from this test and consisted of the following variables: number of steps, step length, and step frequency.

Equipment and Tools Used in the Research:

The researchers used several pieces of equipment and tools, including:

- One video camera.

- A whistle.
- A registration form.

Description of the 100-meter Achievement Test (Wu: 2025)

- Test Objective: To measure achievement in the 100-meter sprint.
- Equipment: 400-meter athletics track, timing clock, registration form, whistle.
- Achievement Description: The test is conducted according to the rules and regulations of the International Association of Athletics Federations (IAAF). The athlete sits in the designated starting position. The referee gives the instruction "Take your place," then "Ready," and then the starting signal is given. The athlete then runs the 100-meter sprint.
- Recording: The timekeeper records the athlete's time in seconds to the nearest tenth of a second.

Exploratory Experiment

Scientific research experts recommend conducting a preliminary trial of the tests used to obtain reliable and necessary results and information for use in the main experiment. Accordingly, the researchers conducted a exploratory study with three female athletes from outside the research sample. This exploratory was conducted at the College of Physical Education, University of Baghdad, on Saturday, November 22, 2025, at 4:30 PM. The athletes were tested on their achievement in the 100-meter sprint. The objectives of the exploratory experiment were:

- To identify the strengths and weaknesses encountered by the researchers in the main tests.
- To assess the adequacy of the support team and their understanding of how to apply the test items and their assigned roles during the tests for the research sample.
- To determine the number of cameras needed to cover the test, their placement, and the appropriate camera distance.
- To assess the suitability of the allotted time for the test for the athletes.

This exploratory experiment successfully achieved its objectives.

Main Experiment:

Pre-Test:

The researchers administered pre-tests to the research sample. The tests were conducted at the College of Physical Education, University of Baghdad, at 4:30 PM on Monday, November 24, 2025. Video recording was made using a video camera. The researchers controlled all relevant variables, such as location and time, to use them in the post-tests.

Equivalence between the Two Research Groups:

To ensure the achievement level of both groups, it was necessary to confirm that the two groups were at a similar level. This is one of the factors that influence the results of the differences between the two groups and is therefore considered a significant factor in the experiment. Accordingly, the researchers conducted an equivalence test between the two groups.

Table (1) shows the homogeneity and equivalence between the two research groups

Variables	Control group		Experimental group		T value	Level Sig	Type Sig
	Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation			
Achievement effectively in 100 meters	14.258	1.016	14.226	1.039	0.853	0.448	equivalence

The table above shows that the significance level for the independent samples t-test is greater than the margin of error of 0.05. This indicates no statistically significant difference between the two groups, suggesting equivalence between the research groups.

Description of Step Variable Extraction:

The researchers placed a video camera in the center of the field, 140 cm above the ground and at approximately equal distances from the running tracks. Markers were placed at the starting and finishing lines. Each athlete was filmed individually from the beginning of the 100-meter sprint. The following variables were extracted:

- Number of steps: The number of steps in the 100-meter race was determined using the Kinovea software.
- Step length: This was calculated using the equation (Step length = Distance traveled / Number of steps).
- Step frequency: This was calculated using the equation (Step frequency = Number of steps / Time) (Hussein

Mardan Omar and Ayad Abdul Rahman. 2011).

Speed Training Implementation Plan According to Target Time

The researchers began implementing speed training according to target time on the experimental group sample from November 30, 2025, to January 22, 2026. The researchers incorporated the following into their training:

- Speed training according to target time was implemented for 8 weeks, with 3 training sessions per week, resulting in a total of (24) training sessions.
- The training sessions were implemented on Sundays, Tuesdays, and Thursdays of each week.
- The researchers used a high-intensity interval training method with an intensity ranging from (80-95%).
- The researchers ensured a 2:1 ratio of training loads between daily and weekly sessions.
- · Target time specific speed training work was performed at the commencement of the main training session (following warm-up) to ensure mental and physical preparedness for training targets was obtained. • The intensity of training was matched according to the principle of repetition.
- · The investigation identified rest periods according to the heart rate, where 120bpm was considered as resting heart rate between repetitions and 90bpm as the heart rate for resting period between series and exercises.
- A target time was proposed for each athlete based on the sub-distances of the exercises, and the distance time was standardized accordingly.
- One second was added for every 5% of the training intensity.

Post-Tests

After completing the exercises prepared by the researchers, post-tests were administered to both research groups. The researchers ensured, as much as possible, that the conditions were identical in terms of time, location, and equipment. The tests were conducted at the College of Physical Education and Sports Sciences, University of Baghdad, at 4:00 PM on Friday, January 23, 2023.

Statistical Methods Used

The researchers used the SPSS statistical software to process the data and present the results. The following statistical methods were employed:

- Arithmetic mean
- Standard deviation
- t-value for paired samples
- t-value for independent samples
- Cohen's effect size
- Eta effect size

Results and discussion:

Presentation, Analysis, and Discussion of Results

Presentation of the results of the control and experimental groups in the pre- and post-tests.

Table (2) Differences between the pre- and post-tests in the research variables for the control and experimental groups

Variables		Measuring unit	Pre-test		Post-test		T value calculated	Level Sig	Sig Type
			Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation			
Control	Number of steps	Number	48.984	1.188	47.552	1.069	3.974	0.002	Sig
	Length step	Meter	2.041	1.362	2.103	1.277	4.153	0.001	Sig
	Frequency step	Number/second	3.435	1.224	3.393	1.258	3.882	0.005	Sig
	Achievement	Second	14.258	1.016	14.012	1.094	4.116	0.000	Sig
Experi	Number of steps	Number	48.575	1.195	46.329	1.004	7.491	0.000	Sig

	Length step	Meter	2.058	1.401	2.158	1.193	6.659	0.000	Sig
	Frequency step	Number/second	3.414	1.198	3.343	1.116	7.015	0.000	Sig
	Achievement	Second	14.226	1.039	13.857	0.992	6.988	0.000	Sig

The table above shows statistically significant differences in all research variables. The significance level for the paired samples t-test was less than the margin of error (0.05), indicating significant differences between the pre-test and post-test results in favor of the post-test results for both the control and experimental groups. To determine the impact of the training on the players, the researchers used Cohen's effect size.

Table (3) Cohen's Effect Size between the Pre-Test and Post-Test Results for Research Variables in the Control and Experimental Groups

Variables		**Measuring unit**	**Tests**		**Differences between the two tests**	**value cohen's**	**Interpretation of value**
			Pre-test	Post-test			
Control	Number of steps	Number	48.984	47.552	1.432	1.777	Strong
	Length step	Meter	2.041	2.103	0.062	1.857	Strong
	Frequency step	Number/second	3.435	3.393	0.042	1.736	Strong
	Achievement	second	14.258	14.012	0.246	1.841	Strong
Experimental	Number of steps	Number	48.575	46.329	2.246	3.350	Very Strong
	Length step	Meter	2.058	2.158	0.1	2.978	Very Strong
	Frequency step	Number/second	3.414	3.343	0.071	3.137	Very Strong
	Achievement	second	14.226	13.857	0.369	3.125	Very Strong

The table above shows that the effect of the trainer's training on the research variables was strong for the control group, with values ranging between 1.2 and 2. According to the interpretation of these values, the trainer's approach had a strong effect.

However, the experimental group, which underwent speed training according to the target time, had a very strong effect on the research variables, as the effect size values were greater than 2. According to the interpretation of these values, the effect of the approach was very strong.

Presentation of the results of the control and experimental groups in the post-tests.

Table (4) Differences between the control and experimental groups in the post-tests.

Variables	**Measuring unit**	**Control group**		**Experimental group**		**T value calculated**	**Level Sig**	**Type Sig**
		Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation			
Number	N	47.5	1.0	46.3	1.0	3.	0.	Sig

of steps	umber	52	69	29	04	896	000	
Length step	Meter	2.103	1.277	2.158	1.193	4.108	0.000	Sig
Frequency step	Number/second	3.393	1.258	3.343	1.116	4.269	0.000	Sig
Achievement	s econd	14.012	1.094	13.857	0.992	3.953	0.000	Sig

The table above shows statistically significant differences in all research variables. The significance level for the independent samples t-test was less than the margin of error (0.05), indicating significant differences between the control and experimental groups in the post-tests, favoring the experimental group.

Table (5) Effect size (Eta) between the results of the control and experimental groups in the post-tests

Variables	**Measuring unit**	**Groups**		**Differences between the two groups**	**value Eta**	**Interpretation of value**
		Control group	Experimental group			
Number of steps	Number	47.552	46.329	1.223	0.603	large
Length step	Meter	2.103	2.158	0.055	0.628	large
Frequency step	Number/second	3.393	3.343	0.05	0.646	large
Achievement	s econd	14.012	13.857	0.155	0.610	large

The table above shows that the effect size difference between the two groups is (large) because the effect size value (Eta) is greater than (0.14). According to the interpretation of these values, the effect size is large between the two groups.

Discussion of Results

The results above show significant differences between the control and experimental groups, favoring the experimental group, in the 100-meter sprint and in the step variables (number of steps, step length, and step frequency). Researchers attribute these differences to speed training tailored to the target time. The implications of this are that the training successfully balances step length and frequency by way of neuromuscular adaptations, resulting in a greater velocity despite the thermodynamically unlikely speed. A support to this interpretation is the hypothesis by (Coates, 2023) that mechanical and physiological factors determining runners' performances in short races are associated with step length. This rise isn't just because you're getting stronger, however: it's also a function of your body using that elastic energy in muscles more efficiently. Such a trade-off between speed per step and no. of steps can improve the overall efficacy of runners during sprint endurace races. Here, Pugh underlines the significance of several mechanical factors in maximal effort running and how training influences step length and frequency. For example, longer steps would require stronger muscles in the legs and hips. This results in greater horizontal propulsion and hence, speed (Asal & Abdul, 2020). 1 participants were encouraged to run with a target time, speed training helped develop the cargo works needs of the athletes or members who participate for each event to adjust values connected strength and speed. That this connection can be discerned from "reaching the highest movement frequency and keeping that frequency for the most time" (Bastawisi Ahmed. (1999: 2025)SadiqDhiab, A., ArkanHameed, Z. & AliSadeq,A.P.

Coaches are mainly working on the development of maximum speed, combination of two essential components: step length and step frequency. It has been reported that speed is related to the optimal match: step length (the amount of distance between two consecutive steps taken during running) and step frequency (number of steps performed in a period time; Kamal Jamil Al-Rabdhi. 2001). That's one finding from the training those athletes followed, which also encompassed distances both shorter and longer than 100 meters. The emphasis was increasingly on achieving speed faster as distance was reduced, using a more effective balance between step frequency and step length as the key element (rather than more modest changes in speed) across any given distance. (Atheer Sabri Al-Jumaili, 1990; Muhammad Abdul Hassan. 1995)

Scientists think that in the 100m, speed is the only aspect that matters. The time goal of the researchers in this investigation was therefore appropriate for the physical capability of athletes, leading to a constructive performance improvement without decrementing performance level. The training was then designed to break the race into stages - starting, accelerating and getting to top speed. This was through analysis which allowed the athletes to know about their timing and then controlled them on their own. This also helped in creating neuromuscular coordination, which led to an increase in the step length and frequency (Tahir & Al-Selmi, 2023).

Conclusions and Recommendations:

Conclusions:

- The speed training based on the objective was helpful to improve step variables(number of steps, step length, step frequency) of young female players in 100m events.
- Speed training for coming-bute time: performance in 100 m.run on female track and field athletes. 3. Increased step variables had a beneficial effect for younger female athletes in the 100 m sprint.
- The fewer steps the post-testes demonstrated that the athletes were more effective with their effort.
- The effect size of the experimental group was much higher than that of the control group.

Recommendations

- Apply target time settings as well as speed training, which also contributes to the improvement of step variables.
- Use effect size statistical techniques, whose interest is vital for the measurement of the impact on our research variables.
- Undertake other analysis applying the protocols use to a different running event (e.g., 200-m sprint).
- Investigate other types of training beyond PE and apply to the 100m sprint.

References:

1- Asal, F. H., & Abdul, S. R. (2020). The effect of different exercises using the play training method to develop some physical and skill abilities of young football players. Dirasat in Humanities & Social Sciences, 3(3)

2- Atheer Sabri Al-Jumaili (et al.). 1990. Track and Field Training. Baghdad: Baghdad University Press.

3- Bastawisi Ahmed. 1999. Foundations and Theories of Sports Training. Dar Al-Fikr Al-Arabi, Cairo.

4- Coates, A. M., et al. (2023). A Perspective on High-Intensity Interval Training for Performance and Health. Sports Medicine, 53(1), 85–96.

5- Hussein Mardan Omar and Ayad Abdul Rahman. 2011. Biomechanics in Sports Movements. 1st ed. Najaf Press.

6- Kamal Jamil Al-Rabdhi. 2001. Sports Training for the 21st Century. Department of Publications and Publishing, Amman.

7- Muhammad Abdul Hassan. 1995. Specific Endurance and its Effect on Some Functional Variables and the Level of 400-Meter Performance. Unpublished PhD Dissertation, College of Physical Education, University of Baghdad.

8- Radi, M. N., Hassan, A. B., & Ali, M. M. (2020). Effect of Specific Tactical Exercises in Some Biochemical Indicators and Psychological Endurance and Achievement of 400 M Hurdles for Young Players. Indian Journal of Forensic Medicine & Toxicology, 14(1).

9- Sadiq Dhiab, A., Arkan Hameed, Z., & Ali Sadeq, A. 2025. Estudio analítico (from the future application and the distance) at the moment of despegue of the vallas and its effect in the consecución of the carrera of the 100 m vallas in the jugadores. Retos, 70, 1412-1421. https://doi.org/10.47197/retos.v70.117253

10- Tahir, S. A., & Al-Selmi, A. D. H. 2023. The Effect of a Training Curriculum According to the Physiological Index and the Transitional Speed of the 100m Hurdles Runner. Revista iberoamericana de psychology and deporte, 18(3), 259-262.

11- Wu, Y. 2025. Integrating strength, speed, and endurance: a comprehensive training model for 100m and 400m sprints. Retos, 67, 1200-1210

Appendix

Unit 1

Exercise	Training Intensity	Number of Repetitions	Number of Sets
Run 30 meters from a flying position	% 80	3	2

Run 50 meters	% 85	2	2
Run 60 meters	% 80	3	1