The Impact of Mechanical Training in Accordance with Regulating the Optimal Stride Length in the First and Second Straight Phases on the Achievement of 400 Meter Events for Men

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DOI: https://doi.org/10.37359/JOPE.V36(1)2024.2032
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Article history: Received 2/march/2024 Accepted 21/march/2024 Available online 28/march/2024.

Abstract
The significance of this research is primarily anchored in the sustained interest in athletic achievements and the ongoing process of their development through the application of biomechanics and its integration into the science of sports training. The study aims to focus on the regulation of the optimal stride length according to the runner's height, necessitating specialized mechanical training tailored to specific distances when sprinting in both the first and second straight sections of the 400-meter event. This is proposed through the suggestion of six interval distances (90, 80, 70, 60, 50, 40 meters).

In light of their research objectives, the authors hypothesized that there would be no significant statistical differences between the pre-test and post-test measurements of male 400-meter sprinters. The researchers employed an experimental method with a single group to suit the nature of the research problem. The sample consisted of six athletes representing (Army, Police, Militia) clubs. The training program included 24 training units over eight weeks, with an average of three training units per week. The researchers concluded several key findings, notably that the designed training had a significant impact on the sample group, as evidenced by the significant differences observed. In light of the results, the researchers recommend the application of these training methods according to the special equation for calculating the optimal stride length in other activities to enhance performance towards better outcomes.

Keywords: Mechanical training, Optimal stride length, 400-meter event.

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Introduction:

The realm of sports constitutes one of the pivotal arenas in the lives of nations, hence the continuous focus on athletic movements to achieve the highest levels of performance. This is achieved through the employment of both theoretical and applied sports sciences. Among the foremost reasons for attaining sports achievement is the fulfillment of all general and specific requirements and means for an athlete’s success. It is recognized that one of the crucial means and requirements is the science of biomechanics and the utilization of mechanical indicators in diagnosis firstly, and treatment secondly, through the application of equations and laws specific to the science of movement, which the researchers consider theoretical sciences that can be applied in practical reality.

The 400 meters event, like other sprinting events in athletics, fundamentally relies on physical elements, particularly stride length and frequency, which are significant factors in achieving success in the race.

Maximum speed is one of the most important of these physical elements, along with other primary elements that must be present in an athlete, where stride length and frequency are crucial variables in achieving victory and performance.

Upon reviewing most of the existing literature and previous research, the researchers found that stride length and frequency are among the most prominent variables that should be focused on. Numerous studies on the 400 meters event have addressed important topics related to mechanical indicators, especially the variables of stride length and frequency, which are among the most important determinants in performance improvement, warranting a brief mention of the most significant among them.

The study by Mohammed and Al-Shamaa (2021) aimed to prepare functional strength training with relative weights to develop special capabilities and performance in the 400 meters sprint for men, and to understand the impact of functional strength training with relative weights on developing these special capabilities and performance in the event. The significance of the research lies in preparing functional strength training with relative weights to body parts of the athlete without adversely affecting motor performance. The research problem involves preparing training with relative weights for each part of the athlete’s body for the muscles working during the 400 meters event to develop the special capabilities for this event. The researchers employed an experimental method with equivalent groups to solve the research problem, making experimental and control groups similar in all variables except the independent variable. The researchers selected their sample intentionally from elite athletes specializing in the 400 meters sprint in Iraq for men (ages above 20 years), then divided them into two equivalent groups, each containing 4 players. The researchers concluded that there was a significant improvement in the level of specific physical capabilities for the 400 meters event as a result of using functional strength training with relative weighting, and there was a clear interaction in the experimental research sample with training by relative weighting compared to other strength training methods. The researchers recommended the use of functional training to develop muscular strength in all sports events in general and the 400 meters event in particular, and to conduct future research using relative weighting and focusing
on using practical weights first, and the possibility of easily changing their weights with the capability of placing most of the heavy weights in particular.

The study by Ajil and Al-Fadhli (2020) aimed to prepare special training according to the centrifugal law on some physical capabilities for the second curve and the performance of running 400 meters, and to understand the impact of special training according to the centrifugal law on these physical capabilities and performance. The researchers relied on the experimental method with a single group pre-test and post-test design, and the research sample was intentionally selected for the availability of conditions and ease of implementing field procedures, consisting of 6 runners for the 400 meters hurdles within the Sports Talent Center in Baghdad. The researchers measured the performance of running 400 meters and the speed rate for the second curve during the first and second tests and a 300 meters run from a high start. The researchers concluded that training according to the centrifugal law had a significant effect on improving the performance of running 400 meters.

The study by Ali Lefta (2010) aimed to prepare exercises using distances shorter than the race distance to develop special speed endurance and performance in running 400 meters for youth athletes. The research also sought to understand the impact of these exercises on developing special speed endurance and performance in the 400 meters event for youth. The researcher used the experimental method suitable for the nature of the research, and the sample consisted of 12 runners training on the Rusafa side in the centers of Al-Shaab Stadium, Hay Ur Center, and Al-Kashafa Stadium, fitting the research conditions in terms of age, regularity, and training continuity, with their ages ranging between 14–16 years. The researcher chose a 300 meters run speed endurance test to measure the special speed endurance capability for the 400 meters event and a 400 meters performance test. The researcher concluded that using exercises shorter than the race distance helps to develop special speed endurance for running 400 meters as well as its performance. The specificity of training quality from testing an appropriate training load and specific distances similar to the actual performance of the race itself and physical capabilities associated with running 400 meters have a positive effect on developing the performance level of the players. The researcher recommended using exercises with distances shorter than the race distance to develop special speed endurance and performance in running 400 meters, focusing on shorter distances, conducting similar research on middle distances (800 and 1500 meters) and 400 meters hurdles, and using appropriate time duration and high intensity in developing special speed endurance. Emphasizing that as the race approaches, it is preferable to use distances shorter than the race distance for the specificity of the 400 meters event.

Following this review of the most significant previous studies related to the research topic, it is essential to present the logical reasons for benefiting from these studies. In the first study, it was indicated that preparing functional strength training with relative weights aims to develop special capabilities and performance in the 400 meters sprint for men. The second study highlighted the preparation of special training according to the centrifugal law for some physical capabilities for the second curve and the achievement in running 400 meters. The third study focused on preparing exercises using distances shorter than the race distance to develop special speed endurance and performance in running 400 meters for youth. The researchers leveraged previous studies in determining the sample and conducting tests, exploring what is new and unstudied in previous studies, specifically the optimal stride length in the first and
second straight sections, one of the reasons for undertaking the current study is the possibility of identifying the optimal stride length for each runner relative to their height through James Hay’s equation, and the researchers' belief that stride length and frequency are decisive in achieving victory in the race, necessitating the employment of all feasible methods for this purpose, including ABC training and inclines with a gradient of (5-20) degrees for ascending and descending to develop muscular strength (the mechanical action of the working muscles).

**Procedures:**

The researchers employed an experimental design with a single group (Al-Kazemi, 2012), and the research population was selected intentionally, consisting of 400-meter runners totaling 12 individuals. The research sample represented 50% of the research population, amounting to 6 athletes who participated in the Central Iraqi Union Championships for the year 2023.

A preliminary experiment was conducted on the research sample on Friday, August 25, 2023, at the Najaf Al-Ashraf International Stadium for Athletics, involving two runners outside the sample group. The purpose of conducting the preliminary experiment by the researchers was to ascertain the following:

- The suitability of the location for the main experiment.
- The appropriateness of the devices and tools used in the tests.
- Determining the responsibilities of the support team.
- Establishing the placement, height, and distance from the running field for the cameras, specifically in the second straight section.
- Identifying potential difficulties that the researchers might face during the main experiment.

Observations from this preliminary test were noted for the purpose of addressing them during the main experiment.

Subsequently, the main experiment was conducted on Friday and Saturday, September 1 and 2, 2023, at the Najaf Al-Ashraf International Stadium for Athletics on the research sample by conducting three tests: a 50-meter flying start test, a 300-meter seated start test, and an individual performance test for runners (IAAF2019), to allow motion analysis cameras to accurately measure stride length. Two (CASIO FH13.5) motion analysis cameras were set at a speed of 120 frames per second and a height of 1.3 meters, orthogonal to the last 40 meters of both the first and second straights, and placed 13 meters away from the second running field. Every 20 meters was filmed by a camera to analyze the stride length in the last 40 meters of each straight, and then a suitable training program was developed for each runner based on the motion analysis data for stride length and compared with James Hay’s equation. On the first
day, a 50-meter flying start test and a 300-meter seated start test were conducted, whereas on the second day, a 400-meter seated start test was carried out as follows:

First Test/ 50 Meter Flying Start Test: (Al-Hakeem, 2004, p. 113)

- **Purpose of the test**: To measure maximum speed and analyze the stride length for the last forty meters.

- **Equipment used**: A straight running track measuring 65 meters in compliance with regulatory requirements, three stopwatches (for timekeepers), and a clearly visible pink marker indicating the end of 15 meters and the beginning of 50 meters.

- **Performance method**: The test starts from a standing ready position, and upon the start signal, the participant accelerates towards the start line, ending at (15) meters, where the first assistant signals with a quick gesture from the wrist and an extended hand holding a red flag. At this point, the timekeepers start the stopwatches, and when the participant crosses the finish line of the (50) meters, the stopwatch is stopped.

- **Measurement method**: The time is recorded to the nearest 0.01 second using three stopwatches, with the median timing taken.

Figure (1) illustrates the procedure for initiating the 50-meter test from a flying start position on the straight track.

Second Test/ 300 Meter Run from a Seated Start: (Ajil & Al-Fadhli, 2020)

- **Purpose of the test**: To measure the performance of running (300) meters, starting from the 1500 meters race start line, for the purpose of analyzing stride length on the first and second straights.
**Equipment used:** A running track measuring 300m in compliance with regulatory requirements, and three stopwatches (for timekeepers).

**Performance method:** The test begins immediately after the warm-up process, with the participant positioned at the start line in a seated start position. The starter then gives the signal to commence, at which moment the timekeepers activate the stopwatches. When the participant crosses the finish line, the stopwatches are stopped.

**Measurement method:** Time is recorded to the nearest 0.01 second using three stopwatches, with the median time being taken.

Figure (2) demonstrates the method for conducting the 300-meter test from a seated position at the 1500-meter start mark.

Third Test/ 400 Meter Run from a Seated Start: (International Association of Athletics Federations IAAF, 2019)

- **Purpose of the test:** To measure the performance of running (400) meters and analyze the stride length on the first and second straights for the last forty meters of each.

- **Equipment used:** A running track measuring 400m in accordance with regulatory requirements, and three stopwatches (for timekeepers).

- **Performance method:** The test begins immediately after completing the warm-up process, with the participant being signaled at the start line. The participant then assumes a seated start position. Following this, the starter gives the signal to begin, and at this moment, the timekeepers activate the stopwatches. When the participant reaches the finish line, the stopwatches are stopped.
• **Measurement method:** Time is recorded to the nearest 0.01 second using three stopwatches, with the median time being taken. Additionally, Figure (3) illustrates how to commence the race, and Figure (4) shows the placement of cameras on the first and second straights.

Figure (3) illustrates the procedure for initiating the 400-meter test from a seated start position.
Figure (4) demonstrates the placement of cameras for all three tests.

Regarding the method for measuring stride length, measurement is conducted using the Kenova motion analysis software, as illustrated in Figures (5), (6), and (7).

The figure (5) illustrates the method of measuring step length in a 50-meter sprint test.
Figure (6) illustrates the method of measuring step length in a 300-meter seated test.

Figure (7) illustrates the method for measuring stride length in the second straight section of the 400-meter test.

Upon completing the designated training from September 3, 2023, to October 26, 2023, post-test assessments were conducted on Saturday and Sunday, October 28 and 29, 2023, following the same procedures and conditions as the pre-test. Subsequently, the results were analyzed using the Statistical Package for the Social Sciences (SPSS) Version 24 for statistical processing, including mean, standard deviation, skewness coefficient, and the T-test value for paired samples, along with the significance value (sig).

Results:
Table (1)

Displays the mean, standard deviation, and skewness coefficient for the research sample in the studied variables.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Unit of Measurement</th>
<th>Mean</th>
<th>Median</th>
<th>Standard Deviation</th>
<th>Skewness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height</td>
<td>cm</td>
<td>1.756</td>
<td>1.755</td>
<td>0.0175</td>
<td>-0.248</td>
</tr>
<tr>
<td>Mass</td>
<td>kg</td>
<td>76.33</td>
<td>76</td>
<td>2.9439</td>
<td>-0.206</td>
</tr>
<tr>
<td>Chronological Age</td>
<td>years</td>
<td>27.16</td>
<td>27.5</td>
<td>2.3166</td>
<td>-0.300</td>
</tr>
<tr>
<td>Training Age</td>
<td>years</td>
<td>7</td>
<td>6.5</td>
<td>1.2649</td>
<td>0.889</td>
</tr>
</tbody>
</table>

This table encapsulates the statistical analysis of four different variables: Height, Mass, Chronological Age, and Training Age. Each variable is quantitatively described by its mean, median, standard deviation, and skewness metrics, with units of measurement appropriately assigned.

Table number (1) presents the mean values, standard deviations, and skewness coefficients for the research variables. The mean values are greater than the standard deviations, indicating a lack of dispersion among the sample members. The skewness values ranged between (0.889 and -0.300), which are confined within (± 1), suggesting that they fall within the normal distribution range.

Table (2) Displays the differences between the pre-test and post-test for variables related to stride length and performance in (400, 300, 50) meters.

<table>
<thead>
<tr>
<th>Test</th>
<th>Unit</th>
<th>Pre-Test Mean</th>
<th>Pre-Test SD</th>
<th>Post-Test Mean</th>
<th>Post-Test SD</th>
<th>t-Value</th>
<th>Sig. Value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 Meter Test</td>
<td>seconds</td>
<td>5.47</td>
<td>0.287</td>
<td>5.35</td>
<td>0.281</td>
<td>13.37</td>
<td>0.000</td>
<td>Significant</td>
</tr>
<tr>
<td>Stride Length</td>
<td>meters</td>
<td>2.18</td>
<td>0.015</td>
<td>2.21</td>
<td>0.020</td>
<td>-3.13</td>
<td>0.026</td>
<td>Significant</td>
</tr>
<tr>
<td>300 Meter Test</td>
<td>seconds</td>
<td>38.27</td>
<td>0.747</td>
<td>37.46</td>
<td>0.315</td>
<td>3.199</td>
<td>0.024</td>
<td>Significant</td>
</tr>
<tr>
<td>Stride Length in the First Straight</td>
<td>meters</td>
<td>2.17</td>
<td>0.012</td>
<td>2.18</td>
<td>0.013</td>
<td>-2.236</td>
<td>0.076</td>
<td>Not Significant</td>
</tr>
<tr>
<td>Stride Length in the Second Straight</td>
<td>meters</td>
<td>2.21</td>
<td>0.013</td>
<td>2.24</td>
<td>0.014</td>
<td>-4.341</td>
<td>0.007</td>
<td>Significant</td>
</tr>
<tr>
<td>400 Meter Test</td>
<td>seconds</td>
<td>49.55</td>
<td>0.791</td>
<td>48.45</td>
<td>0.583</td>
<td>3.122</td>
<td>0.026</td>
<td>Significant</td>
</tr>
<tr>
<td>Stride Length in</td>
<td>meters</td>
<td>2.08</td>
<td>0.013</td>
<td>2.11</td>
<td>0.017</td>
<td>-6.708</td>
<td>0.001</td>
<td>Significant</td>
</tr>
</tbody>
</table>
the First Straight |      |      |      |      |      |      
Stride Length in the Second Straight | meters | 2.13 | 0.016 | 2.15 | 0.011 | -3.114 | 0.027 | Significant 

Degrees of Freedom (df) = n-1 = 5... Significant at (Sig) < 0.050.

**Discussion of Results:**

The results presented in Table (2) show significant statistical differences in all the studied variables except for one, which is the stride length in the first straight of the 300-meter performance test. The researchers attribute this to the specifically designed training based on mechanical principles through ABC exercises aimed at developing the regulation of stride length, as well as slope and interval distance exercises through step regulation exercises suitable for each runner's height according to James Hay's equation during maximum speed phase or maintaining maximum speed when running in the straight section.

From both practical experience and theoretical background in biomechanics and sports training (movement sciences), the researchers realize that one of the most challenging aspects of speed training in general is controlling stride parameters (stride length and frequency) and the dialectical inverse relationship between these two variables.

An important issue to address is when to increase stride length and when to increase its frequency. The available answer to this two-part question involves analyzing the entire race distance, identifying key strengths and weaknesses, and how to control the race based on each athlete's capabilities.

Through this research and previous studies, it is observed that 400-meter runners often attempt to divide the race distance mostly in terms of energy expenditure and distribution.

It is evident that their effort distribution focuses on four main areas representing the basic distance of the race, comprising two curves and two straights. Most runners increase their speed on each straight, with a preference for the first straight over the second due to fatigue accumulation at the end of the race. At the same time, speed moderation is noticed on curves due to mechanical factors including centrifugal force and attempts to change body mechanics and effort distribution during the race.

The researchers structured their training around three axes. The first involved exercises specific to step technique for a distance of 40 meters, including a set of ABC exercises aimed at developing specific coordination for the legs and arms, thus regulating stride length parameters.

The second axis involved interval distance exercises (90, 80, 70, 60, 50, 40 meters) with specific markers placed at the last 40 meters for foot placement and flight of both feet, using small training hurdles for step regulation.
The third and very important axis involved running on slopes with an incline of (5-20) degrees for both ascending and descending, aimed at increasing stride length (resistance) during ascent and stride frequency (assistance) during descent as a primary objective. (See Appendix 1 for the content of exercises designed according to the targeted objectives.)

Regarding the first axis, the researchers agree with Adel and Sofyan that running basics can be addressed through ABC exercises to improve acceleration, balance, coordination, and speed capabilities, thereby enhancing running techniques if performed with correct movement. These exercises are determined by the type of event and thus have mutual effects on performance such as muscle strength, reaction speed, contraction speed, and their coordination (Tangkudung & A., 2018, p. 31).

The researchers believe these exercises have a clear impact on improving stride length for the targeted interval distance, especially since these exercises were given at the beginning of the training unit, making their effect more potent due to the restfulness of the neuromuscular system and readiness for activity.

Through mentioned findings, it is found that such exercises serve multiple purposes and develop capabilities related to agility and coordination in addition to strength and speed. In most research, there are mutual relationships between these capabilities and performance speed or achievement time, legitimizing the training of runners with exercises that bear these capabilities to develop their performance, which was implemented using ABC exercises within the interval distances. Hence, Ritdorf and Syafruddin note the mutual effects in performing ABC exercises such as muscle strength, reaction speed, contraction speed, and coordination (Ritdorf, 2009; Syafruddin, 2011).

The researchers agree with Priyono and Giartama that the relatively required physical component for running is speed, which according to the concept of sprinting means running as fast as possible, achieved through practicing exercises for acceleration, balance, and coordination, possible through ABC exercises. A study showed significant effects of these exercises in improving sprint results for (100) m, (200) m, and (400) m distances, finding an increase in running speed for short distances closely associated with basic movement training of ABC (Priyono, 2019, p. 3; Giartama, 2018, p. 13).

Regarding the second axis, the researchers agree with Maher et al. that interval distances in training according to race distance segmentation have a significant effect on developing relative times and performance techniques, thereby improving achievement levels (Shlash, Al-Amiri, Al-Awadi, & Al-Fadhlí, 2023, pages 543-554).

Thus, the effect of the designed exercises became evident through the significance of the differences, noting that in one of the variables, there were no significant differences in stride length in the first straight of the 300-meter performance due to the statistical insensitivity of differences caused by the small sample size. However, differences between means were noted in favor of the post-test mean. Regardless, the specificity of the distance and the runners' accustomed practice of dividing the race distance remain the most significant factor in determining the required execution.
The researchers distributed the optimal stride length for each runner according to the runner's height (see Appendix 2) using James Hay's equation for adjusting the optimal stride length (Hay, translated by Al-Ankari, 2009, page 225).

Regarding the third axis, slope training, the researchers dealt with this mechanical characteristic as a main part of each training unit in the three weekly sessions. Running on slopes is considered running over natural and artificial inclines, both ascending and descending at various angles to develop physical capabilities including strength and speed for different distances appropriate to the event type and athlete's capabilities. Slope training ascending provides a type of resistance effective on the thigh muscles (anterior-posterior) and calf muscles physiologically, while mechanically, it provides kinetic momentum to the runner, exerting a doubled stride length than that during normal running on flat ground.

Previous research confirmed that stride length and frequency success through increased muscle group strength associated with running, resulting from increased external resistance applied to these muscles, aligns with the researchers' goal of improving stride length and frequency through slope training.

Inclined training is a form of training aimed at developing physical qualities related to the type of sport, including speed, strength characterized by speed, explosive strength, and speed endurance, among other special qualities for runners in general and 400-meter event runners in particular.

The researchers believe that downhill training on slopes provides a type of assistance aimed at speed development, emphasizing that natural speed with control over arm action and free leg movement (flying) should be maintained, focusing on the natural stride length as in running on flat ground.

The researchers, in agreement with Maher and others, in addition to the biomechanical benefits of stride length and frequency from slope training, view it as foundational in developing a range of physical qualities including muscular strength, explosive power, muscular flexibility, and developing body posture (body angles) and the effective use of the upper body part and physical effort regulation (Shlash, Al-Mashhadani, & Al-Ruwaishdi, 2022, pages 295-315).

The main part of the unit begins with basic movement ABC exercises, followed by a series of special exercises according to defined interval distances, targeting the last 40 meters with distinctive markers to accustom the runner to touch those markers with each step or cross the small training hurdles in an attempt to create adaptations for the runners as much as possible, then proceeding to slope exercises with an incline of (5-20) degrees ascending and descending. (See Appendix 3 for the model of a training unit prepared within the general curriculum).

The researchers, in agreement with Bruce and Thier, believe that slopes are the best method for developing instantaneous strength or special quick strength related to the type of skill, contributing to increased recruitment and stimulation of muscle fibers to participate in muscular work and enhancing their neuromuscular coordination within and between muscles (Gradfwnts & Gambettes, 1983, p. 91).
The researchers worked on training load fluctuation at a ratio of (1:2) within the general curriculum, with Sunday and Tuesday being high intensity days, whereas Thursday being a low-intensity day (see Appendix 4 for the training fluctuation schedule).

Conclusions:

1. ABC exercises play a crucial role in improving performance technique (stride length and frequency) for the first and second straights of the 400m sprint.

2. Exercises based on segmenting the race distance have a clear effect on regulating stride length and frequency for 400-meter event runners.

3. Slope exercises have a clear impact on improving stride length during ascent and stride frequency during descent due to resistances and assistances.

Recommendations:

1. The researchers recommend applying these exercises to other categories and runners of other events due to their utmost importance for them.

2. The researchers recommend adopting James Hay's equation (runner's height × 1.22) for adjusting the optimal stride length for sprinters.
References


Priyono. (2019). Effect of balance coordination running acceleration exercise on improving learning ou


Appendix (1)

The Fundamental ABC Technique Exercises

<table>
<thead>
<tr>
<th>Code</th>
<th>Exercise Content</th>
<th>Training Objective</th>
<th>Mechanical Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABC 1</td>
<td>A-skips: Alternating high knee lifts for 40m</td>
<td>General preparation of the runner and technique adjustment</td>
<td>Path control through performance angles</td>
</tr>
<tr>
<td>ABC 2</td>
<td>B-skips: Alternating knee lifts with thrust for 40m</td>
<td>General preparation of the runner and technique adjustment</td>
<td>Path control through performance angles and stride length adjustment</td>
</tr>
<tr>
<td>ABC 3</td>
<td>C-skips: Alternating knee lifts at a 45-degree angle for 40m</td>
<td>General preparation of the runner and technique adjustment</td>
<td>Path control through performance angles and stride length adjustment</td>
</tr>
<tr>
<td>ABC 4</td>
<td>D-skips: Knee lifts with thrust using one leg for 40m</td>
<td>General preparation of the runner and technique adjustment</td>
<td>Path control through performance angles and stride length adjustment</td>
</tr>
<tr>
<td>ABC 5</td>
<td>E-skips: Medium knee lifts with one leg for 40m</td>
<td>General preparation of the runner and technique adjustment</td>
<td>Path control through performance angles and stride length adjustment</td>
</tr>
<tr>
<td>ABC 6</td>
<td>Happy Feet: Running on toes for 40m</td>
<td>General preparation of the runner and technique adjustment</td>
<td>Path control through performance angles and stride length adjustment</td>
</tr>
<tr>
<td>ABC 7</td>
<td>1.2.3’s: Three hops on the right then three on the left for 40m</td>
<td>General preparation of the runner and technique adjustment</td>
<td>Path control through performance angles and stride length adjustment</td>
</tr>
</tbody>
</table>
The Fundamental Running (RU) Exercises for Interval Distances (90, 80, 70, 60, 50, 40 meters)

<table>
<thead>
<tr>
<th>Code</th>
<th>Exercise Content</th>
<th>Training Objective</th>
<th>Mechanical Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ru1</td>
<td>Sprint from starting blocks for 40m with step control markers</td>
<td>Develop reaction time, block clearance time, and acceleration onset</td>
<td>Control movement path through performance angles and stride frequency adjustment</td>
</tr>
<tr>
<td>Ru2</td>
<td>Sprint from starting blocks for 50m with step control markers</td>
<td>Develop reaction time, block clearance time, and acceleration onset</td>
<td>Control movement path through performance angles and stride frequency adjustment</td>
</tr>
<tr>
<td>Ru3</td>
<td>Sprint from starting blocks for 60m with step control markers</td>
<td>Develop reaction time, block clearance time, and specific speed</td>
<td>Control movement path through performance angles and stride length adjustment</td>
</tr>
<tr>
<td>Ru4</td>
<td>Sprint from a standing position for 70m with step control markers</td>
<td>Develop specific speed</td>
<td>Control movement path through performance angles and stride length adjustment</td>
</tr>
<tr>
<td>Ru5</td>
<td>Sprint from a standing position for 80m with step control markers</td>
<td>Develop specific speed and speed endurance</td>
<td>Control movement path through performance angles and stride length adjustment</td>
</tr>
<tr>
<td>Ru6</td>
<td>Sprint from a standing position for 90m with step control markers</td>
<td>Develop specific speed and speed endurance</td>
<td>Control overall path, stride length, and frequency</td>
</tr>
<tr>
<td>Ru7</td>
<td>Sprint from a standing position for 40m</td>
<td>Develop initial acceleration phase</td>
<td>Control acceleration path, stride length, and frequency</td>
</tr>
<tr>
<td>Ru8</td>
<td>Sprint from a standing position for 50m</td>
<td>Develop initial acceleration phase</td>
<td>Control acceleration path, stride length, and frequency</td>
</tr>
</tbody>
</table>
Ru9 | Sprint from a standing position for 60m | Develop specific speed | Control maximum speed path, stride length, and frequency
Ru10 | Sprint from a flying start for 40m | Develop maximum speed | Control acceleration path, stride length, and frequency
Ru11 | Sprint from a flying start for 50m | Develop maximum speed | Control acceleration path, stride length, and frequency
Ru12 | Sprint from a flying start for 60m | Develop maximum speed | Control maximum speed path, stride length, and frequency

The Fundamental Running (RUS) Exercises on Slopes Ascending and Descending from 5 to 20 Degrees

<table>
<thead>
<tr>
<th>Code</th>
<th>Incline Percentage</th>
<th>Exercise Content</th>
<th>Training Objective</th>
<th>Mechanical Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>RUS1</td>
<td>20 degrees</td>
<td>Running 30-40m uphill</td>
<td>Develop initial acceleration</td>
<td>Stride length - Instantaneous push</td>
</tr>
<tr>
<td>RUS2</td>
<td>20 degrees</td>
<td>Running 30-40m downhill</td>
<td>Develop initial acceleration</td>
<td>Stride frequency - Instantaneous push</td>
</tr>
<tr>
<td>RUS3</td>
<td>15 degrees</td>
<td>Running 40-50m uphill</td>
<td>Develop initial acceleration</td>
<td>Stride length - Leg strength</td>
</tr>
<tr>
<td>RUS4</td>
<td>15 degrees</td>
<td>Running 40-50m downhill</td>
<td>Develop initial acceleration</td>
<td>Stride frequency - Leg strength</td>
</tr>
<tr>
<td>RUS5</td>
<td>10 degrees</td>
<td>Running 50-60m uphill</td>
<td>Develop secondary acceleration</td>
<td>Stride length - Power agility</td>
</tr>
<tr>
<td>RUS6</td>
<td>10 degrees</td>
<td>Running 50-60m downhill</td>
<td>Develop secondary acceleration</td>
<td>Stride frequency - Power agility</td>
</tr>
<tr>
<td>RUS7</td>
<td>10 degrees</td>
<td>Running 60-70m uphill</td>
<td>Develop maximum speed</td>
<td>Stride length - Specific coordination</td>
</tr>
<tr>
<td>RUS8</td>
<td>10 degrees</td>
<td>Running 60-70m downhill</td>
<td>Develop maximum speed</td>
<td>Stride frequency - Specific coordination</td>
</tr>
<tr>
<td>RUS9</td>
<td>5 degrees</td>
<td>Running 70-80m uphill</td>
<td>Develop special speed endurance</td>
<td>Stride length - Step rhythm</td>
</tr>
<tr>
<td>RUS10</td>
<td>5 degrees</td>
<td>Running 70-80m downhill</td>
<td>Develop special speed endurance</td>
<td>Stride frequency - Step rhythm</td>
</tr>
<tr>
<td>RUS11</td>
<td>5 degrees</td>
<td>Running 80-90m uphill</td>
<td>Develop special speed endurance</td>
<td>Stride length - Kinetic harmony</td>
</tr>
<tr>
<td>RUS12</td>
<td>5 degrees</td>
<td>Running 80-90m downhill</td>
<td>Develop special speed endurance</td>
<td>Stride frequency - Kinetic harmony</td>
</tr>
</tbody>
</table>

Appendix (2)

Adjusting the Optimal Stride Length According to James Hay's Equation

261
<table>
<thead>
<tr>
<th>Runner's Height</th>
<th>James Hay's Equation</th>
<th>Optimal Stride Length at Maximum Speed Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.75m</td>
<td>× 1.22m</td>
<td>2.14m</td>
</tr>
<tr>
<td>1.76m</td>
<td>× 1.22m</td>
<td>2.15m</td>
</tr>
<tr>
<td>1.73m</td>
<td>× 1.22m</td>
<td>2.11m</td>
</tr>
<tr>
<td>1.77m</td>
<td>× 1.22m</td>
<td>2.16m</td>
</tr>
<tr>
<td>1.78m</td>
<td>× 1.22m</td>
<td>2.17m</td>
</tr>
<tr>
<td>1.75m</td>
<td>× 1.22m</td>
<td>2.13m</td>
</tr>
</tbody>
</table>

Appendix (3)

Week Three, Training Unit Eight, Within the Prepared Curriculum

<table>
<thead>
<tr>
<th>Section and Duration</th>
<th>Attributes and Elements</th>
<th>Intensity</th>
<th>Exercise Name</th>
<th>Work Time</th>
<th>Number of Repetitions</th>
<th>Rest Between Repetitions</th>
<th>Rest Between Exercises</th>
</tr>
</thead>
<tbody>
<tr>
<td>35 min</td>
<td>Aerobic</td>
<td>-</td>
<td>800m + accelerations</td>
<td>270 sec</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Flexibility</td>
<td>-</td>
<td>Dynamic</td>
<td>20 sec</td>
<td>3</td>
<td>60 sec</td>
<td>90 sec</td>
</tr>
<tr>
<td></td>
<td>Skill</td>
<td>-</td>
<td>ABC 1</td>
<td>10 sec</td>
<td>3</td>
<td>120 sec</td>
<td>120 sec</td>
</tr>
<tr>
<td></td>
<td>Skill</td>
<td>-</td>
<td>ABC 2</td>
<td>10 sec</td>
<td>3</td>
<td>120 sec</td>
<td>120 sec</td>
</tr>
<tr>
<td></td>
<td>Skill</td>
<td>-</td>
<td>ABC 3</td>
<td>10 sec</td>
<td>3</td>
<td>120 sec</td>
<td>120 sec</td>
</tr>
<tr>
<td></td>
<td>Skill</td>
<td>-</td>
<td>ABC 4</td>
<td>10 sec</td>
<td>3</td>
<td>120 sec</td>
<td>120 sec</td>
</tr>
<tr>
<td>46.5 min</td>
<td>Acceleration</td>
<td>85%</td>
<td>Ru1</td>
<td>4 sec</td>
<td>2</td>
<td>90 sec</td>
<td>120 sec</td>
</tr>
<tr>
<td></td>
<td>Acceleration</td>
<td>95%</td>
<td>Ru2</td>
<td>4 sec</td>
<td>2</td>
<td>120 sec</td>
<td>120 sec</td>
</tr>
<tr>
<td></td>
<td>Stride Length</td>
<td>90%</td>
<td>Ru5</td>
<td>8 sec</td>
<td>2</td>
<td>180 sec</td>
<td>300 sec</td>
</tr>
<tr>
<td></td>
<td>Stride Frequency</td>
<td>85%</td>
<td>Ru6</td>
<td>9 sec</td>
<td>2</td>
<td>180 sec</td>
<td>270 sec</td>
</tr>
</tbody>
</table>
Appendix (4) The Schedule for the Prepared Curriculum and Periodization Across Weeks and Units

<table>
<thead>
<tr>
<th>Weeks</th>
<th>Intensity Used</th>
<th>Sunday (Date)</th>
<th>Tuesday (Date)</th>
<th>Thursday (Date)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>80%</td>
<td>75% - 3/9</td>
<td>85% - 5/9</td>
<td>80% - 7/9</td>
</tr>
<tr>
<td>Week 2</td>
<td>90%</td>
<td>85% - 10/9</td>
<td>95% - 12/9</td>
<td>90% - 14/9</td>
</tr>
<tr>
<td>Week 3</td>
<td>85%</td>
<td>80% - 17/9</td>
<td>90% - 19/9</td>
<td>85% - 21/9</td>
</tr>
<tr>
<td>Week 4</td>
<td>90%</td>
<td>85% - 24/9</td>
<td>95% - 26/9</td>
<td>90% - 28/9</td>
</tr>
<tr>
<td>Week 5</td>
<td>100%</td>
<td>95% - 1/10</td>
<td>105% - 3/10</td>
<td>100% - 5/10</td>
</tr>
<tr>
<td>Week 6</td>
<td>95%</td>
<td>90% - 8/10</td>
<td>100% - 10/10</td>
<td>95% - 12/10</td>
</tr>
<tr>
<td>Week 7</td>
<td>100%</td>
<td>95% - 15/10</td>
<td>105% - 17/10</td>
<td>100% - 19/10</td>
</tr>
<tr>
<td>Week 8</td>
<td>90%</td>
<td>85% - 22/10</td>
<td>95% - 24/10</td>
<td>90% - 26/10</td>
</tr>
</tbody>
</table>