Ciencia Digital
www.cienciadigital.org

ISSN: 2602-8085
Vol. 3, N°2, p. 78-97, abril - junio, 2019

Contributions to the physical-pedagogical control of the sports performance of 400m flat runners

Contribuciones al control físico-pedagógico del rendimiento deportivo de los corredores de 400 m planos.

Raynier Montoro Bombú [1], Víctor Hernández Toro[2], Patricio Ortiz Ortiz [3]& Washington Castro Acosta[4],

Recibido: 10-02-2019 / Revisado: 15-02-2019 /Aceptado: 04-03-2019/ Publicado: 14-06-2019

Resumen

DOI: https://doi.org/10.32/cienciadigital.v3i1.947

La carrera de 400 metros planos en todos los eventos de atletismo ha sido durante mucho tiempo un punto de atracción por las características biológicas que se desempeñan en esta modalidad deportiva. A su vez esta prueba ha suscitado mucho interés por parte de los entrenadores que buscan diversos recursos para conocer los factores limitantes del rendimiento, así como los test físicos-pedagógicos más importantes para el control del rendimiento en las diferentes etapas de entrenamiento. Con el objetivo de Contribuir en la teoría al control físico-pedagógico del rendimiento deportivo de los corredores de 400 m planos en sus diferentes etapas de entrenamiento, realizamos una revisión bibliográfica con ponderación de datos principales en diferentes bases de datos dentro de las que se encuentran Scopus, Ibecs, Scielo, Dialnet, Latindex y Sportdiscus. Para desarrollar esta revisión bibliográfica nos enfocamos fundamentalmente en el indicador físico-

[1] Universidad Técnica de Ambato Carrera Pedagogía de la Actividad Física y Deportes. Ambato, Ecuador, email (r.montoro@uta.edu.ec)
[2]Universidad Técnica de Ambato Decano de la Facultad de Ciencias Humanas. Ambato, Ecuador, email (vhernandez3347@uta.edu.ec)
[3]Universidad Técnica de Ambato Carrera Pedagogía de la Actividad Física y Deporte. Ambato, Ecuador, email (patriciogortizo@uta.edu.ec)
[4]Universidad Técnica de Ambato Carrera Pedagogía de la Actividad Física y Deporte. Ambato, Ecuador, email (w.ecastro@uta.edu.ec)

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pedagógico del rendimiento deportivo. Al mismo tiempo nos apoyamos en los métodos revisión de fuentes documentales el Análisis y Síntesis e Inducción-Deducción, los cuales permitieron la exploración de diferentes artículos y analizar, sintetizar e inducir independientemente las concepciones relacionadas con sus factores, además permitió sintetizar su aparato teórico-cognitivo y establecer en el plano teórico los test para el control del rendimiento en las diferentes etapas de la preparación. Se obtiene como principales resultados aportes sobre las pruebas más influyentes en el control el rendimiento en los corredores de 400 m planos, así como tareas para el control en esta disciplina e indicaciones metodológicas que permite adecuarse como elementos de contante revisión por parte de los entrenadores que se desempeñen en esta modalidad deportiva.

Palabras claves: Rendimiento Deportivo, Atletismo de velocidad, Corredores de 400 m planos. Test pedagógicos.

Abstract.

The 400-meter race at all athletics events has long been a point of attraction for the biological characteristics of this sport. At the same time, this test has aroused great interest on the part of the coaches who seek various resources to know the factors limiting performance, as well as the most important physical-pedagogical tests for the control of performance in the different stages of training. With the objective of contributing in the theory to the physical-pedagogical control of the sports performance of the 400 m runners in their different stages of training, we carry out a bibliographic review with weighting of main data in different databases within which they are located. Scopus, Ibecs, Scielo, Dialnet, Latindex and Sportdiscus. In order to develop this bibliographic review, we focus mainly on the physical-pedagogical indicator of sports performance. At the same time we relied on the methods review of documentary sources, Analysis and Synthesis and Induction-Deduction, which allowed the exploration of different articles and analyze, synthesize and independently induce conceptions related to their factors, also allowed to synthesize their theoretical apparatus- cognitive and establish in the theoretical plane the tests for the control of the performance in the different stages of the preparation. It is obtained as main results contributions on the most influential tests in the control of the performance in the 400 m flat corridors, as well as tasks for the control in this discipline and methodological indications that allows to be adjusted as elements of constant review by the trainers that they perform in this sport modality.

Key words: Sports Performance, Speed Athletics, 400m flat runners. Pedagogical tests

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Introduction

The control process is one of the most influential aspects in the process of sports training, its continuous application becomes necessary for the acquisition of high sports performance, prestigious authors such as Harre (1973), which describes the stadiums of control, Zatsiorski (1989) who gives form and content to the different types of pedagogical and biomechanical controls, as well as Cintra (1992) who applies different tests for the control over the different processes and their implication in several sports.

These investigations are largely due to the fact that today it is unthinkable to effectively manage all the components of training with the application of control methods Grosser & Starischka (1989) The current changes in training condition alter the traditional to prevail the effectiveness of the process (Absaliamov & Timakova, 1990)conditioned by the availability of data in the control, so it is important to have information about the athlete, the variation of their ability of work, the state of the organism under training, the level of development of the physical qualities, the degree of mastery of the techniques, the magnitude of the load, the change of sporting results, etc.

From experimental research established in contemporary sport, many disciplines have discovered and explained the particularities of the behavior of the human organism that is trained in the specific conditions of sports practice. (Oña, 2002) have also been studied extensively the mechanisms that ensure the adaptation of the training, basing the validity or otherwise of means and methods to achieve functional improvement. (Calderón, Benito, Meléndez & González, M. 2011).

In recent decades, a new methodological direction for scientific research in sport has been formed (Anguera & Hernández, 2015) which incorporates the most varied observations made in sports practice and fundamental scientific research. Together with the deepening of knowledge about the norms, principles, regularities and laws that govern the training process, the investigations have deepened the influence of control on performance Montoro & De la Paz (2014). Others have associated it from career economics, energy expenditure at a given submaximal race speed Saunders, Pyne, Telford & Hawley (2004). Thus, Svedenhag (2000) identified 13 determinants of race economy (specialty distance, training and tuning, terrain slope, temperature, air and wind, fatigue, ventilation, stride width, stiffness / elastic components, other biomechanical factors, gender, age and emotional / psychological state), but none of these factors studied, despite being limiting factors, can identify the shortcomings in the training process nor can it predict which are the strong and weak aspects in the discipline. In turn, Saunders, et al. (2004) grouped and divided into 5 large groups of indicators for control in careers (training, environmental, physiological, biomechanical and anthropometric). And although the factors discussed have an impact on the career economy, and this in turn on performance, the career economy is still one more within the physiological

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factors that affect performance (Basset & Howley, 2000) but it does not guarantee with all veracity the performance control function.

On the other hand, scientific knowledge that is conferred about the load-control relationship of performance is of great importance for coaches, since it is the basis of the optimal amount of training necessary to improve performance (Avalos, Hellard, & Chatard, 2003); (Foster, Florhaug, Franklin, Gottschall, Hrovatin, Parker, Doleshal, & Dodge, 2001); (Chaverra, Gaviria & Gonzalez, 2018). Currently there is no common theory of the training control process that describes the type, quantity or model of a specific training control that is optimal to achieve a certain response to the proposed load for a Banister athlete Calvert, Savage & Bach (1975). The main knowledge that exists is basically empirical. However, there is consensus (Banister, Morton & Clarke, 1997) about the existence of a dependency between training and performance, which refers to a dose-response correlation Viru (2003) Athletics coaches have also been given the means of control that will allow them to comply with the goal outlined. In fact, the existing training literature includes a large number of control tests with an acceptable level of safety, which provide information on the progress of the training process and make it possible to assess the level of functional adaptation of the organism being trained. Such is the case that Jiménez-Reye & González-Badillo (2012). They carry out a study of Control of the load of training through the CMJ in speed tests (...) to optimize athletic performance in athletics. (Monitoring training load through the CMJ in sprints and jump events for optimizing performance in athletics). This began the study with a follow-up of the physical performance of the athletes during a period of 71 weeks evaluated through the performance obtained in the CMJ test and the training load used weekly. The CMJ test was carried out on Mondays of each week, after having rested on Sunday, and 5 jumps were made. At the same time, the coaches on that same day in which the athletes performed this test gave us detailed information about the training followed by the athletes in the previous week to collect the data of the weekly training load together with the CMJ test data. . But the study maintains a single test for a long time and does not differentiate its usefulness depending on the stages of preparation. Another contribution made by Oña, A et al. (1994) where they make a description of a computerized system of automatic processing for the optimization of sports performance based on the control of information. The system presented is oriented in this direction, providing very interesting expectations that are specified in the design of a precise, flexible system applicable to a wide range of situations. It is necessary, however, to achieve a greater degree of interaction between the answers given by the athletes and the information provided by the machine, to provoke the simultaneous modification of the athlete through the self-regulation of their processes. Furthermore, the indicators of when they should be used are not expressed at all. Other researches more focused on medicine also make contributions to the control of performance, this time Rodríguez, Garcia, Sarmiento & of Saa, Rodríguez, Vagabonded & da Silva. G. (2012) experiment in an evaluation of the muscular response as a control tool in the field of physical activity, health and sport, they use a high precision mechanical sensor placed directly on the skin at a constant pressure and pre-

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established for each protocol. The creators of this tool initially proposed previous pressures of the end of the sensor (113 mm2) of approximately 0.2 N / mm (ranges between 0.1 and 0.5 N / mm), being recommended the adequate calibration and the use of references visuals on the sensor to establish the pressure before stimulation. This research has an interesting and valid validity for the update that the coaches need but in another order of ideas, it does not provide information about the most used tests for the control of the training itself. So far the forms of control studied, do not offer a more complete view of the most appropriate tests for these runners, at what time of the season apply them, as well as the most suitable, even It becomes evident to think whether the extrapolation of tests of other sports with the same type and functional orientation, will provide the same information for each of the sports specialties. Aspect that although we did not address in this article, it would be good to deepen in other investigations. In this sense, the objective of this article is: Objectively to select the physical-pedagogical control tests in the sports performance of 400 m flat runners in their different training stages. For this, it is proposed to separate the tests at different times according to the preparation objective. Therefore we distinguish it for its better understanding in tests for general preparation and tests for special preparation accompanied by methodological indications that regulate its application.

For the selection of the physical-pedagogical control tests in the different moments of the season, the quality criteria that a physical test must meet according to Fetz *&* Kornexl (1976) were taken into consideration; MacDougall (1993), as well as Haag *&* Dassel (1995) & Martínez (2006). Criteria that were modified for this article based on the objectivity of the tests presented. We assume for its description and presentation: 1. Name of the test, 2. Procedure, 3. Objectives, 4. Validity and 5. Instruments used. We do not disregard other factors such as reliability, usefulness, relevance and specificity, but we take it into account as elements of reliability, but not of description and presentation.

The aforementioned criteria allow pedagogical control to be applied not only to evaluate the results achieved, but also to determine the possible deficiencies and potentialities, as well as the causes that slow down and optimize the scope of the objectives proposed in training or competition.

In this sense, the present research proposes the use of tests with different guidelines for the control of performance, which were selected according to their feasibility from the weighting of criteria reflected in the revised bibliography. These tests are separated according to the aforementioned preparation stage. Table 1.

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Dimensions	Addresses	Type of address	Parameters E. P General	Parameters E. P Special
Strength	Explosive strength	Conditioner	Length jump without impulse stroke (m). Bullet drive of 4 Kg. (F) and 5 Kg. (M), back to the area.	Length jump without impulse stroke (m). Bullet drive of 4 Kg. (F) and 5 Kg. (M), back to the area.
	Maximum strength	Conditioner	ABS Half-squat: 1RM (Kg) Force lying down (Kg.) Max force of the Biceps-femoral (Kg.)	ABS Semi-screed: 1RM (Kg.) Force lying down (Kg.) Max force of the Biceps-femoral (Kg.)
Rapidity	Rapidity of reaction with displacement	Conditioner		Time in 10 m (m / s)
	Anaerobic Power Alactacid	Determinant	100m race with 50m steering wheels	100 m race with 50 m flyers
Resistance	Aerobic Capacity	Conditioner	60 m Total distance in the TVP progressive speed test: (m)	
	Aerobic power	Conditioner	Race of 1000m. With time control every 200m.	Race of 1000m. with time control every 200 m.
	Resistance to the Force.	Determinant		60 m race with ballast from 4m to 33% of the maximum leg strength. And time control every 20m.
Resistance to speed. (Specific))	Alactac Anaerobic Capacity	Determinant	Race of 200 m (m / s)	Race of 200 m (m / s)
	Lactacid Anaerobic Power	Determinant	300m + 100m	300m + 100m
	Lactacid Anaerobic Capacity	Conditioner	Race of 500 m (m / s) Race of 600 m (m / s)	Race of 400 m (m / s)

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Flexibility		Conditioner	Flexibility of the spine	Flexibility of the spine
	Technique	Conditioner		Analysis of the 400m race with time control every 50m.
Resulting tests	Effectiveness	Conditioner		Analysis of the 400m race with time control every 50m.
	Tactic	Determinant		RV= (t dr / n) – t pt
	Rational	Determinant		CR= t dr / t rc

Table 1. Physico-pedagogical tests with different functional orientations for performance control in 400 m flat corridors.

Source. Msc. Raynier Montoro.

The application of these tests are not straitjackets of strict compliance for the coaches, but a methodological guide of tests to analyze the physical-pedagogical dimensions that determine and condition the performance of the 400m runners, in different moments of the season. The inclusion of any test that provides the necessary information at a given time of preparation can be planned and executed according to the desired result, always respecting the methodological indications declared.
Now for a better understanding of the tests we will establish a summary of some tests and their descriptive structure based on the criteria set out above.

Example for Strength Tests.
Name of the test: Long jump without impulse race. This test has been studied by different authors such as Reid, Quinn & Crespo (2003) & Galiano (1992) in their talent selection programs. Procedure: The student placed on a line previously marked on the ground and with his feet shoulder-width apart and his arms upwards, made a concentric movement of arms and legs and will jump as far as possible. The best result of two jumps is selected. Objective: Measure the explosive strength of the legs. Validity: Both feet must be even behind the line, the drop surface must be the same for all athletes, in the fall they will not rest their hands on the ground. It will be measured from the take-off line to the most lagging place of fall. The distance will be measured in meters and centimeters. A meter and an annotator will control the test. Instruments: Tape measure.

Name of the test: Bullet drive with two hands facing the area. Test studied by different authors such as Montoro, Quizhpe, Zapata & Espinoza (2018), as well as García & Jiménez (2018). Procedure: The student placed on a line previously marked on the ground and with his feet shoulder-width apart and the bullet placed in the palm of his hands, performed a concentric movement of arms and legs downwards and then propelled the bullet in front as far as possible. Objective: Measure the explosive strength of the arms. Validity: Both feet

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must be even behind the line, the bullet will be 4 kg for the ladies and 5 kg. For knights, it will be measured from the impulse line to the place of fall of the implement. The distance will be measured in meters and centimeters. A meter and an annotator will control the test. Instruments: Tape measure, bullet of 4 and 5 kg of weight.

Example for speed tests.
Name of the event: Started with 10m race. In this test researchers like Martínez (2006). Kovacs, Pritchett, Wickwire, Green & Bishop (2007) have made various contributions, among which is its application for distances of 5 to 20 meters. Procedure: The student placed on a line previously marked on the ground, is placed in three-point snatch and the sound of an acoustic stimulus reacts by running a 10m race in the shortest possible time. Objective: To measure the speed of simple reaction with displacement. Validity: The test will be carried out with a suitable wardrobe and footwear, it will be done on a synthetic track. The time will be taken by the same person in all cases. Instruments: Digital stopwatch and tape measure.

Name of the test: Alactacid Anaerobic Power. This is a universal test used by many sports disciplines. Procedure: From the start of three points, make a 100m race to the maximum of possibilities. Objective: Measure the speed of displacement in 100m. Validity: Only one race will be held on a synthetic track, which the athlete previously placed behind the starting line, placed in a three-point start, will wait for the sound of an acoustic stimulus. The clothing and footwear must be suitable for the test, there will be only one timekeeper, it will be covered by the final straight of a synthetic track. Instruments: Digital chronometer and synthetic track.

Example for resistance tests.
Test name: Cooper test. Test prepared by Cooper (1968) still in force and used by different authors such as Michael & Kenneth (2013) in his study on this test in young athletes. Procedure: The one 400m track to the start voice will run through lane 1 as far as possible in 12 minutes. Objective: Measure aerobic capacity Validity: Only one race will be done, the costumes and footwear must be suitable for the test, there will be only one timekeeper, a whistle sound will be made every 4 min. Instruments: Digital stopwatch and whistle.

Name of the test: Test of 1000m. Taking from Fetz, F. et al. (1976). Procedure: The one 400m track to the start voice will run through lane 1 two and a half laps to the track to cover a distance of 1000m. Objective: Measure aerobic power. Validity: Only one race will be held, all athletes must run in the first lane, the costumes and footwear must be suitable for the test, there will be only one timekeeper and one scorer. Instruments: Digital chronometer.

Example for the tests of resistance to speed (Specific).
Name of the test: Test of 300 + 100m. This is a test derived from the 400 meter flat test. It was developed in fusion of the experience gained as a coach where we recommend that when we are close to major competitions do not apply the test of 400 m, but look for tests closer to

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reality to avoid alterations either positive or negative in the competitive stage. Author's tale as Aparicio (1998). They use it in other sports for other purposes. Procedure: The one 400m track to the start voice will run the first 300m. After this, 5 sec. to stop the race after the 300 m mark, the pulse is taken in 10 seconds and 5 seconds are given. More to start a 100m race to the finish. Both races must be done in the shortest possible time. Objectives: To measure the lactic acid anaerobic power from a modeling of the 400m-plane race. Validity: Only one race will be held, the costumes and footwear must be suitable for the test, there will be two timekeepers one placed in the 300m and another in the goal. Instruments: Digital chronometer.

Example for flexibility tests.
Test name: Spine flexibility test. Another of the tests studied in different literatures Benavent, Tella, González-Millan, Colado (2007) address them and establish adjustments that are applied in this review. Procedure: Seated on the floor with the legs extended to the front, without shoes, with the feet placed on the inside edge of the wooden box that serves to measure the maximum flexion performed. After this, a deep ventral flexion of the trunk is performed without flexing the legs. The position must be maintained at least one second and the measurement will be taken by the last finger that lies on the wooden box. Objective: Measure the spine flexibility. Validity: The legs must remain extended, it is required that the arms during the flexion of the trunk remain extended evenly. Instruments: Millimeter wooden drawer.

Example for the tests resulting from the work other tests. These tests were elaborated as a proposal of the investigations of Zatsiorski (1989) in his book of Sports Metrology. These tests are the result of the same tests applied previously and also provide coaches with a very accessible view of the controls applied. They are:

From the 300 + 100 m test with time control. Procedure: After this, the 50m sections will be evaluated to compare the fastest and slowest sections comparing them with the most weighty directions in this discipline. From here the analysis of the test will lie. Reviewing the strategies used in the race, the tactical structure of the runner. Objective: Analyze the effective technique and rational tactics. The same previous descriptive standards are maintained.

The tests of Reserve of speed and Coefficient of special resistance. They will be applied through the Speed Reservation Formulas: RV = (t dr / n) - t p. Where: t dr is the time of the distance traveled by 400m, n is the number of times the standard distance (50) is traveled and t p is the best time in that distance. As well as the formula of resistance coefficient: CR = t dr / t p. Where: The indicators remain the same as in the Speed reserve. Objective: Analyze the Speed Reserve and the Individual Resistance Coefficient of the athlete. The lower the CR and the RV, the greater the level of special resistance of the runners, in the same way you

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can compare this data with the best runners for the category in which the test is applied. (Zatsiorski, 1988).

In conclusion the application of these physical aptitude tests, it is necessary to have a group of knowledge, which highlights the possibility of carrying out this application at appropriate times, in favorable conditions and that guarantees the standardization of the applied controls. In this sense, methodological indications were prepared. To carry out these indications, the protocol of Howley & Franks (1992) adapted by Vila (1993) and reorganized by the author of the research was assumed. Where it is considered that: 1.The preparation to apply the test should be as accurate as possible. (This refers to the fact that all the examiners who are going to initiate an exercise plan must be evaluated by means of a stress test (maximum or submaximum) .This includes knowledge on the part of the evaluator about physical activities carried out the day before, if they smoke, ingestion of alcohol or drugs, medications, as well as the last meal, which was and when 2. The place where the test is performed, must be clean, without obstacles, good ventilation, and the temperature must be maintained at comfortable values. 3. Only personnel who are applying the test should remain in place. 4. The subject must know in advance what the test consists of and what its purpose is. 5 They should be applied in the morning and away from the ingestion of food. 6. Emergence of symptoms (pain, cyanosis, dyspnea, palpitations), before which it is interrupted immediately. 7. In the case of female athletes, the last day of the previous menstruation should be taken into account. 8. Apply the tests immediately after heating. 9. Do not apply tests designed for force capabilities in accordance with those designed for speed capabilities. 10. Do not apply tests designed for short-term resistance capabilities in conjunction with those designed for medium or long-term capabilities. 11. Do not train the resistance of medium or long duration on the days of application of the tests or on the alternate days in which other addresses are being controlled. 12. The application of flexibility may coincide with the evaluation of the other addresses. If it is designed in such a way that there is such a coincidence, the heating is carried out, then the address is evaluated, and then the other test is carried out.13. Do not perform the coordination evaluation the day after the F.max or long-term resistance tests.14. The coordination can coincide with the evaluation of any other motor capacity, provided that it is carried out after the warm-up and before the other motor-capacity test.

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