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Original article

Biomechanical pattern of the first phase of the 100 m race for junior sprinters

Patrón biomecánico de la primera fase de la carrera de 100 metros para velocistas juveniles

Padrão biomecânico da primeira fase do sprint de 100 metros para sprinters juniores

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ABSTRACT

The specialized studies on the 100 meters have taken into account for the biomechanical analysis of the technical execution, both the dynamic and kinematic characteristics of the movements, which reveal the importance of the start and first steps in this test. In Cuba, there has been a setback in the quality of the 100 m. sector. Cuban athletes do not appear in the finals of this athletic discipline in games at Pan-American, Olympic and World level. There are many causes that justify the lack of elite sprinters at the present time, but taking into account the importance that is given to the first phase of the 100 meters flat race, it was proposed as an objective to propose a biomechanical pattern for youth sprinters, especially from the School of School Sports Initiation "Héctor Ruiz" of Villa Clara. The following methods were used at the theoretical level: inductive-deductive, analysis and synthesis, systemic structural approach and modeling. From the empirical level, the following methods were used: documentary review, observational methodology, survey, interview, expert criteria, users and techniques for the biomechanical study. In this study, the proposal of a biomechanical pattern of the first phase of the 100 m. race for juvenile sprinters was achieved, based on the characteristics of the athletes in their adolescence and the competitive activity.

Keywords: Running phase; Biomechanical pattern; Technical improvement; Sprinters.

RESUMEN

Los estudios especializados sobre los 100 metros planos han tenido en cuenta para el análisis biomecánico de la ejecución técnica, tanto las características dinámicas como las cinemáticas de los movimientos, las cuales develan la importancia de la arrancada y primeros pasos en esta prueba. En Cuba, se ha visto un retroceso en la calidad del sector de los 100 m., pues los atletas cubanos no figuran en las finales de esta disciplina atlética en juegos a nivel Panamericano, Olímpico y Mundial. Muchas son las causas que justifican la carencia de velocistas élites en los actuales momentos, pero teniendo en cuenta la importancia que se le confiere a la primera fase de la carrera de 100 metros planos, es que se planteó como objetivo proponer un patrón biomecánico para los velocistas juveniles, en especial de la Escuela de Iniciación Deportiva Escolar "Héctor Ruiz" de Villa Clara. Se utilizaron como métodos del nivel teórico: el inductivo-deductivo, el análisis y síntesis, el enfoque sistémico-estructural y la modelación. Del nivel empírico, se emplearon: la revisión documental, la metodología observacional, la encuesta, la entrevista, el criterio de expertos, usuarios y técnicas para el estudio biomecánico. En este estudio, se logró la propuesta de un patrón biomecánico de la primera fase de la carrera de 100 m. para velocistas juveniles, sustentando en las características de los atletas en su adolescencia y de la actividad competitiva.

Palabras clave: Fase de carrera; Patrón biomecánico; Perfeccionamiento técnico; Velocistas.

RESUMO

Estudos especializados sobre os 100m levaram em conta para a análise biomecânica da execução técnica, tanto as características dinâmicas como cinemáticas dos movimentos, que revelam a importância do início e dos primeiros passos neste evento. Em Cuba, houve um declínio na qualidade dos 100m, já que os atletas cubanos não aparecem nas finais desta disciplina atlética nos Jogos Pan-americanos, Olímpicos e Mundiais. Há muitas causas que justificam a falta de velocistas de elite no momento, mas levando em

conta a importância dada à primeira fase da prova plana de 100m, foi proposto como objetivo propor um padrão biomecânico para os velocistas jovens, especialmente da Escola de Iniciação ao Esporte Escolar "Héctor Ruiz", em Villa Clara. Os seguintes métodos foram utilizados no nível teórico: indutivo-dedutivo, análise e síntese, abordagem sistêmico-estrutural e modelagem. No nível empírico, foram utilizados os seguintes métodos: revisão documental, metodologia observacional, pesquisa, entrevista, julgamento de especialistas, usuários e técnicas para o estudo biomecânico. Neste estudo, a proposta de um padrão biomecânico da primeira fase da prova de 100 m para velocistas juvenis foi alcançada, com base nas características dos atletas em sua adolescência e na atividade competitiva.

Palavras-chave: Fase de corrida; Padrão biomecânico; Melhoramento técnico; Sprinters.

INTRODUCTION

Athletic speed events are complex disciplines that depend on multiple factors of conditional type, decision making and movement control, the importance of which will vary according to the duration of the event. Running is a particular type of locomotion that man performs in order to move quickly, but in sprinting it is not only about moving quickly, but also about coordinating all the aspects of this locomotion in such a way that a distance is covered as quickly as possible.

The shorter the distance to be covered, the greater the contribution of this phase in the final result of the event, serve as an example that, in the men's 100 m. final of the 2016 Olympic Games, the difference between winning or not winning a medal was separated by 0.02 sec. In the final of the World Championships in Beijing 2015, the bronze medal was decided by photo finish with a difference of one thousandth of a second (0.001s.).

Mackala K. (2013) analyzed in the different phases of the race (acceleration, maximum speed and deceleration) the speed, amplitude and frequency of a group of eight high level sprinters throughout a 100 m. sprint test to verify the influence of these variables on the phases of the race and technical efficiency, which reinforces the idea of the importance of this phase.

The specialized studies, for the most part, have taken into account for the biomechanical analysis of the technical execution, both the dynamic and kinematic characteristics of the movements studied. However, there is a poor treatment of the low start in its fourth step, since most of the studies have been directed to the postural characterization of the same and confer greater importance to the start and others like Baumann (1976); Mero, Komi and Gregor (1992), who study the reaction time and Baumann (1976), in addition, who studies the characteristics of force.

Within the analysis of the starting technique of the cleats and execution of the movement during the race, it will benefit the team and coach not only because it will get an improvement in the times and within the scope of the game is given the main technical gesture as the goal is to achieve the shortest possible time during the competition; this will bring an increase in the competitive level of the athlete which will allow him to have the scope to give a better result.

In Cuba, there has been a setback in the quality of the 100m. Cuban athletes do not appear in the finals of this athletic discipline in games at Pan American and Olympic level.

Many are the causes that justify the lack of elite sprinters at the present time, but taking into account the importance given to the first phase of the 100 m. flat race, it is that the present study is made, especially in youth athletes, since most of the specialized literature has been made on the basis of international elite athletes.

Among the authors who have written about teaching the technique of the 100 m. flat races, are Palacios and Villalobos (2017) who propose the use of alternative technical exercises for the dynamics of the low start. On the other hand, Fis and Serantes (2019) propose a system of basic exercises for sprinters of 400 meters flat, category 15-16 years male EIDE (School of Sports Initiation), provincial Ciego de Avila. In the case of Huanaco (2019), he proposes a teaching-learning methodology for sprint races (100, 200 and 400 m.), which focuses on explanations about technique. López and Bilirs (2015) propose methodological exercises to enhance the acceleration phase in 100 m sprinters.

In this same sequence, Ríos and Tejeda (2016) propose a system of exercises for the coordination between the phases of the 100 m. flat race during special physical preparation, which they represent by means of a model. Burruel *et al.,* (2016) make a kinematic analysis of the starting technique in 100 m. flat in university runners and Zorrillo and Arguelles (2018) propose exercises to improve the transitional steps in athletes of category 10 -11 years of athletics, of the special area *Pablo de la Torriente Brau.*

As can be seen, the cited authors do not show which are the technical demands imposed by the characteristics of the competitive activity to the athletes in a single document because studies have been found that deal in a dispersed way with indicators that characterize this activity. In the same way, the biomechanical characteristics that model or establish a pattern of the technique of the first phase of the 100 meters flat race of juvenile sprinters, aspects that guide an optimal improvement of this phase of the technique, have not been found.

Taking into account the lack of a reference that models the first phase of the 100 meters flat race in juvenile athletes, it was proposed as an objective, the presentation of a biomechanical pattern for this test, which will allow coaches to have a reference adjusted to the characteristics of adolescence, which serves as a guide in the improvement of the first phase of this athletic discipline.

For the processing of this pattern, we also consulted other very useful documents in working with the methodology and data processing (Campistrous and Rizo, 2006; Romero, 2007; Lluch, 2012; Anguera and Hernández, 2013; Fernández and López 2014; Sánchez and Palma 2017).

After analyzing this previously exposed literature and trying to solve this limitation from the practical theoretical point of view, the collective of authors of this work has as objective: to propose a biomechanical pattern for juvenile sprinters, especially from the School Sports Initiation "Héctor Ruiz" of Villa Clara.

MATERIALS AND METHODS

Among the theoretical and empirical level methods were:

The analytical-synthetic was used in the decomposition of the object of study in the main elements that make it up to determine its particularities and, through synthesis, integrate them to discover their relationships and general characteristics.

The inductive-deductive allowed starting from general theories to explain particular facts about the biomechanical characteristics of the first phase of the 100 m. flat race, which then will allow arriving to other theoretical contributions in the proposal of technical pattern of the 100 m. flat for juvenile athletes.

The systemic approach was used to analyze the biomechanical characteristics of the technique of the 100 m. flat as an integral reality, formed by elements that interact with each other, as well as for the design of a technical pattern of the 100 m. flat for youth athletes, which keeps a systemic approach among its elements.

The modeling made it possible to determine the biomechanical characteristics that establish the pattern of the technique of the first phase of the 100 meters flat race in juvenile sprinters, from a representation of this reality from biomechanical parameters.

The documentary review was applied with the aim of assessing the current state on the biomechanical characteristics of the technique of the first phase of the race, of the 100 meters flat race.

Official documents were reviewed such as the Integral Program of Athlete (Pipd) of Speed and the Adaptations to the Integral Program of Preparation of the Athlete 2017-2020, the training plans (graphic and written), class planning, among other documents.

Units of analysis:

- Review of the Comprehensive Athlete Program (Pipd) for Speed and the 20172020 Comprehensive Athlete Preparation Program Adjustments.
- Review of training plans (graphical and written) and training session plans.

Observational method:

In the last decade, there has been a relevant increase in the interest in the use of observational methodology in the field of sport, since in many sports (football, basketball, handball, tennis, swimming, athletics, judo, polo) studies have been carried out with the use of this methodology, which has already been mentioned in the introduction to this article. In this methodology, systematic observation was used because the information was grouped based on previously established criteria on the technique of the first phase of the race, which allowed an assessment to be made on the improvement of this.

The observational methodology requires, throughout the process, to pay attention to different stages: (I) problem delimitation and observational design proposal, (II) data collection, management and optimization, (III) data analysis and (IV) interpretation of results.

The qualitative interview was applied to directors of Villa Clara (Head of the Provincial Technical Commission of Athletics, Head of the EIDE Chair) and directors of Sancti Spíritus (Athletics Methodologist, Technical Head and Commissioner). This was applied in order to obtain information about the conceptions, experiences and needs, as well as the points of view related to the improvement of the technique of the first phase of the race, of the 100 meter race and the need to have a biomechanical pattern according to the characteristics of these athletes in adolescence.

The survey was applied to the athletics coaches who work in the EIDE of Villa Clara and Sancti Spíritus. A questionnaire was elaborated with the objective of exploring the knowledge of the teachers about the improvement of the technique of the first phase of the 100 meters race in the juvenile category and the need to have a biomechanical pattern according to the characteristics of these athletes in adolescence.

The triangulation strategy allowed at each stage the collection and analysis of data from different sources, to contrast and interpret them, as well as to check whether the information provided by one source is confirmed by others. Methodological triangulation was used to analyze the data from the plurality of methods used simultaneously or sequentially, offering a different perspective on the study. For the collection of information, a protocol was structured for this purpose and processed through content analysis.

Open and participative techniques: a PNI (positive, negative and interesting) was applied to the coaches to verify the successes and failures obtained in relation to the proposal of biomechanical pattern first phase of the 100 meters flat race in juvenile sprinters.

Biomechanical procedures:

Four steps were selected from the start, with their angles of the position of the trunk and legs in the ready and start position, the angles of the previous step and subsequent take-off and length of each step.

A Panasonic camera was used and anatomical indicators were placed on the athletes, according to the clothing of the subject, the background of the capture space and the type of lighting, easily distinguishable from the rest of the environment and visible for the greatest amount of time for the cameras.

The lighting was provided by the natural light of the outdoor track and a space was created to capture the first four steps (approximately five meters).

In the processing of the movements, Kinovea was used, which is free software for video and image analysis, dedicated to sport. This tool is widely used by teachers and coaches to analyze sports movements of different specialties.

Kinovea is a software program for image analysis, designed for the analysis of sports technique to explore and comment on a biomechanical action. This tool allows modifying and managing the video in a simple way, using a system of windows, contextual menus and graphic icons: writing data on the image, to the marking of axes, time calculations using stopwatches, calculation of angulations, measurement of distances and trajectory tracking. Mathematical-statistical: allowed the processing of the information obtained. The SPSS statistical package was used to calculate the mean, deviation, variability coefficient, mean deviation, mean + deviation, mean +1/2 of the deviation.

User criteria:

The IADOV technique was used for the evaluation of user satisfaction. A questionnaire is used with a total of five closed and two open questions, whose relationship is unknown to the subject.

The number resulting from the interrelation of the five closed questions indicates the position of each subject on the satisfaction scale, that is, their individual satisfaction. The satisfaction scale used is as follows:

1. Clear satisfaction.
2. More satisfied than dissatisfied.
3. Not defined.
4. More dissatisfied than satisfied.
5. Clear dissatisfaction.
6. Contradictory.

This technique also allows us to obtain the group satisfaction index (ISG), for which we work with the different levels of satisfaction that are expressed on a numerical scale that ranges from +1 to -1 in the following way:

Scale Result

- + 1 Maximum of satisfaction.
- 0.5 More satisfied than dissatisfied.
- 0 Undefined and contradictory.
- - 0.5 satisfied.
- -1 Maximum dissatisfaction.

Group satisfaction is calculated by the following formula (Equation 1).

$$ISG = \frac{A\,(+1) + B\,(+0.5) + C\,(0) + D\,(-5) + E\,(-1)}{N} \quad (1)$$

In this formula, A, B, C, D, E represent the number of subjects with individual index and where N represents the total number of subjects in the group.

The group index yields values between +1 and -1. Values between -1 and -0.5 indicate dissatisfaction, values between -0.49 and +0.49 indicate contradiction, and values between 0.5 and 1 indicate satisfaction.

The IADOV technique also includes two additional open-ended questions. These are:

- What importance do you attach to the indicator system?

- What aspects, in your opinion, enhance or limit the use of this system of indicators?

The research is carried out in the context of the EIDE of Villa Clara and Sancti Spíritus. Among the subjects of the research, there are all the athletes who make up the population of flat sprinters who belong to the juvenile category of both provinces. Of the eight athletes, a random sample of six was taken. A second population formed by the six speed coaches of the EIDE of Villa Clara, plus two coaches of the EIDE of Sancti Spíritus for a total of eight coaches. A third population formed by the six methodologists of the central provinces (Villa Clara and Sancti Spíritus) and the two members of the Biomechanics group of the Faculty of Physical Culture of Villa Clara.

RESULTS AND DISCUSSION

Diagnosis of the current state of the need to have a biomechanical pattern according to the characteristics of the speed athletes of the EIDE of Villa Clara

The study of the Comprehensive Athlete Program (Pid) of speed and, in particular, the contents and methodological guidelines for Flat Speed, as well as the adjustments to the Comprehensive Athlete Preparation Program 2017-2020 (Sánchez and Palma 2017), reveal that it does not have a biomechanical pattern according to the characteristics of youth speed athletes that contributes and guides the improvement of the technique of the first phase of the race of these sprinters, which is decisive in the good sports results.

Regarding the review of the written training plans and the content of the training sessions, there are means related to the teaching of technique and, in few cases, tasks in terms of improvement are mentioned. In addition, they do not have a biomechanical pattern according to the characteristics of speed athletes of the EIDE of Villa Clara and Sancti Spíritus.

With the results of the interview to the provincial commissioner, methodologist and technical chief of Athletics of the provinces of Villa Clara and Sancti Spíritus, it was possible to verify that:

The 100% of the interviewees refer that they feel oriented by the Integral Program of Athlete (Pid) of Speed for the improvement of the technical elements of the first phase of the 100 meters race, although they clarify that other exercises that would lead to the improvement should be collected or taken into consideration, that is to say, that sometimes the teacher must experiment his own creativity when not collecting or taking into consideration other exercises that would lead to the improvement.

They believe that the problems that most affect the improvement of the technical elements of the first phase of the 100m race are the following:

- Inefficient work on the conditional physical capacity of explosive strength, if the athlete is to perform a more powerful start.
- Few means available for further training.
- Little systematization of sports training with athletes.

- Inefficient work on complex coordination skills such as motor learning and agility, without neglecting others.
- Lack of biomechanical standards according to the characteristics of youth speed athletes.

The 100 % of the interviewees state that they would like speed trainers to have a biomechanical pattern according to the characteristics of the speed athletes of the EIDE of Villa Clara and Sancti Spíritus.

Results of the survey to trainers of Villa Clara and Sancti Spíritus provinces

The 50 % of the trainers state that there is no difference between teaching and improvement, i.e. one cannot be separated from the other as the two aspects are as a whole.

The other 50 % say that there are differences because it is not the same to teach, than to perfect these elements and, much more, in this juvenile category that is the prelude to the first level.

As can be seen, there is not a total clarity by the coaches surveyed, from teaching to improvement, since most of the bibliography deals with teaching, which is a different category from improvement, although we recognize that the latter is a consequence of the former, each stage has different objectives, methods, means and procedures.

The 100 % of the coaches state that they have methodological steps to perfect the technique of the elements of the first phase of the race in the 100 meters flat sprint. Twenty-five percent say that it is provided by the Integral Program of the Athlete, the other 25 % that it is provided by the provincial or national technical commission and 50 % by the specialized bibliography, which shows ignorance of the source of acquisition of this information, since the truth is that the Integral Program of Preparation of the Athlete does not contemplate a content in this respect, only two indications in function of the improvement and the bibliography, in a great percentage, speak more of teaching than of improvement.

The 50 % of the trainers state that the aspects to take into account to guide the improvement of the technique of the elements of the first phase of the race, in the 100 meters flat are: psychological, anthropometric, biomechanical and physiological; another 50% consider only the biomechanical and the physiological. However, they do not take into account the need to have a biomechanical pattern according to the characteristics of sprint athletes of the EIDE of Villa Clara and Sancti Spíritus.

The 50 % of the coaches consider that the factors that limit an adequate improvement of the technical elements of the first phase of the 100m race are the incorrect teaching in the lower categories and the lack of systematicity of the sports training process.

The other 50 % of the interviewees agree that this could be due to: poor preparation of the teacher when performing the methodological exercises, not understanding the energy systems that act in order to improve the race or incorrect selection of the talents, however, they do not see the need to have a biomechanical pattern according to the characteristics of the speed athletes of the EIDE of Villa Clara and Sancti Spiritus, since this makes possible to analyze the technique from the fulfillment of the standards

corresponding to an adolescent who practices this test and who has not reached the elite.

Finally, the data of the diagnosis point to the need for changes, both in the methodological order and in the preparation and performance of the speed trainers of the EIDE of Villa Clara and Sancti Spíritus, regarding the improvement of the technique of the first phase of the race for juvenile sprinters, based on a biomechanical pattern that responds to the characteristics of sprinters who are in their adolescence.

Determination of the biomechanical characteristics that make up the pattern of the first phase of the 100 meters race of the EIDE youth sprinters

The determination of the biomechanical pattern of the first phase of the 100 meters race of the juvenile sprinters of the EIDE served as a guide, both for the coach and for the athlete, because the closer the individual technique of the athlete to this pattern, then it will be in the presence of a perfected technique.

The analysis of the first phase of the race in 100 m. flat runners was made by means of a procedure elaborated by a group with the participation of professors of the Biomechanics group and specialists of athletics of the Faculty of Physical Culture of the Central University "Marta Abreu" of Las Villas.

The procedure consisted of the following steps:

- Step 1: filming using the cameras, positioned frontally and laterally to the runner's action.
- Step 2: digitizing the images with the use of the photogram.
- Step 3: synchronization of the data obtained from each of the cameras.
- Step 4: obtaining results.
- Step 5: statistical processing and análisis.

Instrument and techniques for data collection and analysis

A Panasonic digital camera was used to record the images, with support for subsequent analysis on a computer using the biomechanical program Kinovea.

The recorded images collected a set of actions performed by the runners under study during the training session.

Four steps were selected from the start, with their angles of the position of the trunk and legs in the ready and start position, the angles of the previous step and subsequent take-off and length of each step.

Presentation of the pattern of the first phase of the 100m race of the EIDE junior sprinters

The first phases of the race are fast, but wide, as wide as it allows this position of marked inclination that the athlete has in these moments and as long as this amplitude does not go in detriment of the speed progression.

This first phase of running must be progressive in terms of the distance between supports, so that there is no "sinking" and that each step is wider than the previous one.

The part that occupied in this study, according to Vittori (2003), is called the start of action: it is the part of the race in which the runner takes off from the starting blocks after the shot made by the judge of the race, trying to start the race in the most efficient way and with the highest speed that the runner can reach. It is possible to find in it two well differentiated and consecutive parts in time, such as: the reaction to the shot and the impulse of the runner on the blocks, as well as the first supports of the race, this last part was the object of analysis in the subjects investigated.

Establishment of criteria or axes of the instrument

In the following tables, the different criteria or axes of the instruments related to the ready position in the cues, exit of the cues and race steps are reflected with their indicators (list of behaviors).

In the recording and coding of the activity, it will be relevant to consider the objectives and the contexts in which the study is located. In this study, the recording of the observation sessions was available, which is why the methodological operation of recording was deployed in the recording-viewing(s)-recording operation itself from the recording.

For the determination of the technical pattern in the different biomechanical indicators of the first phase of the 100 m. flat race, the limiting magnitude of the result that serves as a basis for including the juvenile sprinters in the classification ranges was determined, on the basis of the means and standard deviations of the universe studied (Zatsiorski, 1989).

In this sense, the means and standard deviations of the universe studied were used, manipulating the values of the mean + deviation, mean - deviation and mean + half of the deviation, selecting the appropriate value and taking as a reference the technical model of specialized athletes (Zatsiorski, 1989).

The tables show the individual results of the athletes, as well as the standard deviations in each of the indicators studied (Table 1, Table 2, Table 3 and Table 4).

Table 1. - Result of the ready position indicator on low start-up

Athletes	Angle between the quadriceps femoris leg		Extension of arms	Angle of the line from the head to the hip and the horizontal	Head position
	Front block	Rear block			
1	107	131	173	19	**Correct**
2	102	105	155	27	**Incorrect**
3	75	110	172	30	**Correct**
4	112	112	175	27	**Incorrect**
5	85	94	176	22	**Correct**
Media	96.20	110.40	170.20	25.00	
Deviation	13.96	12.04	7.73	3.95	
Variability Coefficient	0.15	0.11	0.05	0.16	
Mean - Deviation	82.24	98.36	162.47	21.05	
Mean+Deviation	110.16	122.44	177.93	28.95	
Mean + 1/2 of the deviation	**103.18**	**116.42**	**174.07**	**26.97**	

Table 2.- Result of the block output indicator

Atletas	Angles formed between the thigh and the right and left leg		Position of the trunk and head with respect to the horizontal	Front and rear arm angles	
	PA	PP		D	T
1	163	71	20		150
2	173	73	37	64	
3	178	76	37		159
4	168	96	51	79	
5	167	69	21	60	
Media	169	77	33	67	154
Deviation	5.19	10.932	9.78	11.57	8.18
Variability Coefficient	0.03	119.5	0.13	0.35	0.12
Mean-Variance	164	66.068	67.22	21.63	59.49
Media+Desviación	174	87.932	86.78	44.77	75.85
Mean + 1/2 of the deviation	172	82.496	81.89	38.98	71.76

Table - 3. Result of the step angle indicator

Athletes	Subsequent take-off	Previous step	Trunk tilt
1	165	36	47
2	2	149	32
3	3	166	26
4	4	169	38
5	5	156	29
Media	161.00	32.20	51.60
Deviation	7.40	4.40	11.38
Variability Coefficient	0.05	0.14	0.22
Mean - Deviation	153.60	27.80	40.22
Mean+Deviation	168.40	36.60	62.98
Mean + 1/2 of the deviation	164.70	34.40	57.29

Table 4. - Result of the step length indicator

Athletes	Step 1	Step 2	Step 3	Step 4
1	0.76	1.07	1.36	1.22
2	1.14	1.00	1.12	1.38
3	0.95	1.12	1.38	1.10
4	0.90	0.90	1.10	1.11
5	0.96	1.10	1.22	1.22
6	0.76	1.07	1.36	1.22
Media	0.94	1.04	1.24	1.21
Deviation	0.12	0.08	0.12	0.10
Variability Coefficient	0.13	0.08	0.09	0.08
Mean - Deviation	0.82	0.96	1.12	1.10
Mean + Deviation	1.06	1.12	1.35	1.31
Mean + 1/2 of the deviation	1.00	1.08	1.29	1.26

The results achieved by the different athletes in each indicator of the first phase of the 100 meter flat race allowed, through the use of means and standard deviations, to form the biomechanical pattern of the first phase of the 100-meter race of the EIDE youth sprinters, which was tried to be in accordance with the characteristics of adolescents, since the level of demand is below that imposed on athletes, the model based on elite athletes, that is, the indicators contemplate values between the averages and the technical model based on highlevel athletes.

Technical model of athletes specialized in the different positions and movements in the first phase of the 100m flat race

As mentioned above, the technical model of specialized athletes in the different positions and movements in the first phase of the 100-meter flat race was used as a reference to determine the pattern of the technique of the different positions in the first phase of the 100-meter flat race in youth athletes, so that the level of demand in each indicator would not move away from the technical model of specialized athletes and, in turn, would not be so demanding on the athletes who would not achieve it.

Description of the technical model of athletes specialized in the different positions and movements in the first phase of the 100 m. flat race.

Ready position

At the voice of "Ready!", gently raise and advance the hips until they exceed the height of the shoulders (which at that moment, at the same time, slightly exceed the starting line). The angle of the front leg is 90 degrees and that of the back leg 120; the two calves are sensibly parallel and the feet are strongly resting on the heels. Bergamini (2011) explains that the athlete lifts the knee off the ground and forces to raise the hips and shift the center of gravity up and forward. While Borzov (1978) cites that the back leg angle is 100 degrees and a back leg angle is 129 degrees. Baumann (1976) compared 100m athletes with personal bests of 10.2-10.6s and established that the proportion of total body weight supported by their hands in this phase was 82-73 %. And the worse their personal best was, the less body weight their hands supported (athletes of 11.6-12.4 supported 67-52 % of their body weight respectively).

At the ready signal, the athlete raises his hips upwards, to the front, and higher than the shoulders, separating the knee from the track; by this action, both legs are semi-flexed, the front one at 90º and the back one between 125º and 135º, which allows him to exert the necessary pressure on the blocks, the shoulders move a little forward the starting line and the weight of the body is distributed on the four supports, the neck relaxes and all the athlete's attention is concentrated on the actions that must be performed at the sound of the shot.

Pushing and pulling of the blocks

Forceful extension of the strong leg while the knee of the free leg moves forward. The arms face their respective legs while maintaining 90º of flexion. Both the trunk and the head are placed in continuation of the strong leg. Immediate search for support below the projection of the center of gravity (Tejera, 2006). At the shot, the athlete pushes with both legs simultaneously and at maximum strength, throwing forward the arm of the forward leg. The back leg (because it is less flexed) extends quickly, giving way to the longer work of the front leg. The arms work in coordination with the legs in an active forward-backward movement.

The athlete's hands leave the track approximately 0.15-0.20 s after the starting shot. It is a reflex action; the athlete pushes on the blocks, while the hands and arms are separated from the track, producing an imbalance and the start-up. The back leg moves forward bent and pushing first on the block, while the front leg extends pushing with energy, at the same time, the arms push inversely to the legs, but with energy, balancing the movement of the legs and the trunk. The stronger the push, the greater the reaction and speed of exit, as Newton's third law plays a very important role in these actions.

Transitional steps

In the first phase of the race, of the race after the start, the sprinter adopts an inclination of approximately 45º. The first and second steps are placed behind the vertical of the centre of gravity and the following steps are placed in front of it, with a dynamic action of the legs and feet on the track, an action that should not be reduced voluntarily. Little by little, the body is raised as the length of the steps increases until it reaches the position of the normal race, this occurs between 15 and 25 meters.

Steps: In studies of skilled athletes, the average length from the first to the fourth step behaves as follows:

- Step 1: 85 cm.
- Step 2: 110 cm.
- Step 3: 133 cm.
- Step 4: 147 cm.

Johnson and Buckley (1998) found knee angles at the instant of contact of 140 degrees, followed by a period of flexion and then extension up to 157 degrees in sub-elite sprinters. The first step culminates in a full extension of the leg of the anterior block and the thigh rises at an angle greater than a right angle to the extended leg, i.e. the thigh does not reach horizontal to project forward Johnson and Buckley (1998) (Table 5).

Table 5.- Pattern of the first phase of the 100 m sprint of the junior sprinters

Positions and movements	Indicators	Specialized athlete model		EIDE youth runners' technical coach	
Ready	Angle between leg and quadriceps femoris			Angle between leg and quadriceps femoris	
	A) Rear block	120º-135º C		116º-122º C	
	B) Front block	90º-100º C		80º-100º C	
	Angle of the line from head to hip to horizontal			26º-28º C	
	Extension of arms	175º -180º.		174º-177º.	
	Head position	Look one meter forward		Look one meter forward	
Thrust at block outlet	Leg angles of the legs	PA	PP	PA	PP
		180 º	75 º	174 º	67 º
	Position of the trunk and head with respect to the horizontal	45º		44 º	
	Angle of the arms	D	T	D	T
		90 º	90 º	75 º	80 º
Pitch angles	Subsequent take-off	175º -180º.		164º-168ºC	
	Leg with front step in relation to the horizontal			27 º	
	Trunk tilt	45 º		40 º	
Steps	Step 1	85 cm		82 º	
	Step 1	110 cm		108 º	
	Step 1	133 cm		129 º	
	Step 1	147 cm		131 º	

A PNI was carried out with the following results:

Positives

a) To have a technical pattern for the first phase of the 100m race of the Eide junior sprinters.
b) Correspondence of the technical pattern of the first phase of the 100m race of the junior sprinters of the Eide, with the characteristics of adolescents.
c) The fact of constituting a guide for the technical pattern improvement of the first phase of the 100 meters race of the juvenile sprinters of the Eide.

Negatives

a) No negative aspects were found.

Interesting

a) The way in which the technical pattern is constructed for the first phase of the 100m race of the Eide junior sprinters.

The IADOV technique, for the evaluation of user satisfaction, made it possible to obtain the group satisfaction index (ISG), for which we work with the different levels of satisfaction that are expressed on a numerical scale ranging from +1 to - 1 as follows:

When calculating the overall satisfaction index, a score of 0.95 was obtained, which indicates that there is a high level of satisfaction.

As we have been able to appreciate, there is a favourable criterion both from trainers and managers or introductory users about the proposal, so it can be applied in similar environments.

CONCLUSIONS

Finally, it is important to emphasize that the specialized literature is enriched because although the universe studied is small and limits the scope of the result, it has not been found in the literature studied biomechanical standards that respond to athletes who are not elite, hence its significance and importance especially for having a proposal that takes into account the characteristics of adolescence.

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The authors have participated in the writing of the work and analysis of the documents.