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Original article

The development of coordination in weightlifters in the category 13-14 years

El desarrollo de la coordinación en levantadores de pesas, en la categoría 13-14 años

O desenvolvimento da coordenação em levantadores de peso na categoria de 13 a 14 anos de idade

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ABSTRACT

In the 13-14-year-old category of the weightlifting sport, the training of technical skills and the development of capacities are the main objectives. In the observations made to the training, deficiencies were observed in the execution of the classic exercises, due to insufficiencies in the coordination of the movement phases. In order to solve this scientific



problem, the objective is to assess the results of the application of pedagogical actions for the development of coordination in weightlifters of the 13-14 years category. Actions were applied that favored the development of contents directed to the planning and training of the coordinative capacities in the methodological preparations and exercises of general and special physical preparation; in addition, a test was applied to evaluate the coordination of the phases of the classic snatch exercise in the training process. Methods of the theoretical level such as analysis-synthesis, systemic -structural and inductive-deductive and empirical methods such as observation, document analysis, survey and experimentation, as well as mathematical and statistical methods were used. The results of the application of the actions and the system of exercises for the development of coordination in weightlifters of the 13-14 category were considered novel, reflecting an increase in speed in the execution and movement coordination, as well as an increase of the scores of the technical evaluation in relation to previous school courses, which led to a better placement of the province's weightlifters in the national competition.

Keywords: Coordination, training, evaluation, planning.

RESUMEN

En la categoría 13-14 años del deporte levantamiento de pesas, la formación de habilidades técnicas y el desarrollo de capacidades constituyen objetivos principales. En las observaciones realizadas a los entrenamientos, se apreciaron deficiencias en la ejecución de los ejercicios clásicos, debido a insuficiencias en la coordinación de las fases de movimiento. Para dar solución a este problema científico, se define como objetivo valorar los resultados de la aplicación de acciones pedagógicas para el desarrollo de la coordinación en levantadores de pesas de la categoría escolar. Se aplicaron acciones que favorecieron el desarrollo de contenidos dirigidos a la planificación y entrenamiento de las capacidades coordinativas en las preparaciones metodológicas y de ejercicios de preparación física general y especial; además, se aplicó un test para evaluar la coordinación de las fases del ejercicio clásico arranque en el proceso de entrenamiento. Se utilizaron métodos del nivel teórico como el análisis-síntesis, el sistémico-estructural y el inductivo-deductivo y



empíricos como la observación, el análisis de documentos, la encuesta y la experimentación, además de métodos matemáticos y estadísticos. Se consideraron novedosos los resultados de la aplicación de las acciones y el sistema de ejercicios para el desarrollo de la coordinación en los pesistas de la categoría 13-14 que reflejaron incremento de la velocidad en la ejecución y la coordinación del movimiento, así como un aumento de las puntuaciones de la evaluación técnica con relación a cursos anteriores, lo que propició una mejor ubicación de los pesistas de la provincia en la competencia nacional.

Palabras clave: Coordinación, entrenamiento, evaluación, planificación.

RESUMO

Na categoria de levantamento de peso de 13-14 anos, o treinamento de habilidades técnicas e o desenvolvimento de capacidades são os principais objetivos. Nas observações feitas durante as sessões de treinamento, foram constatadas deficiências na execução dos exercícios clássicos, devido a insuficiências na coordenação das fases do movimento. Para solucionar esse problema científico, o objetivo foi avaliar os resultados da aplicação de ações pedagógicas para o desenvolvimento da coordenação em levantadores de peso da categoria escolar. Foram aplicadas ações que favoreceram o desenvolvimento de conteúdos voltados para o planejamento e treinamento das capacidades coordenativas nas preparações metodológicas e exercícios de preparação física geral e especial; além disso, foi aplicado um teste para avaliar a coordenação das fases do exercício clássico de partida no processo de treinamento. Foram utilizados métodos teóricos como análise-síntese, sistêmico-estrutural e indutivo-dedutivo, bem como métodos empíricos como observação, análise de documentos, pesquisa e experimentação, além de métodos matemáticos e estatísticos. Os resultados da aplicação das ações e do sistema de exercícios para o desenvolvimento da coordenação nos levantadores de peso da categoria 13-14 foram considerados novos, pois refletiram um aumento na velocidade de execução e coordenação de movimentos, bem como um aumento nas pontuações da avaliação técnica em relação aos cursos anteriores, o que levou a uma melhor colocação dos levantadores de peso da província na competição nacional.



Palabras-clave: Coordinación, entrenamiento, evaluación, planeamiento.

INTRODUCTION

In all ages, physical exercises have been performed to improve bodily capabilities. In the Greek and Roman civilizations and later in the Middle Age, it was intended to be faster, stronger and more resistant and for this it was trained.

Studies on sports performance, since the last century, demonstrated the need for the development of physical capacities. Physical preparation constitutes one of the fundamental components within the preparation of the athlete, especially in schoolchildren and youth and covers a good part of the time of comprehensive preparation, since it guarantees mastery of skills, their effectiveness in competition and development of basic skills in sports performance.

All this physical activity is based on motor capacities, which are classified into three fundamental groups: conditional, coordinative and mobility, so that performance behaves in different ways in athletes, including loads and the functional state of the organism. The physical preparation, is constituted in the development of the general and specific motor capacities of the athletes and greatly influences the conditioning or adaptation of the athlete towards the chosen sport. Cadierno (2000) states that:

High results in the contemporary world depend on an adequate level of development of Physical Preparation, because the stronger and more laborious the athlete's body is, the better it assimilates the training load, the faster it adapts to it and preserves the sporting form longer time. Without a good General Physical Preparation, it is not possible to carry out a competition maintaining in an effective and prolonged way the technical-tactical demands that are required for victory. (p. 1).

Coordination treated in general can be classified as intra- and intermuscular. Depending on the muscle relationship, whether internal or external, intermuscular coordination refers to the proper participation of all the muscles that are involved in the movement. According to



Dorochenko *et al.* (2017) coordination training decreases energy expenditure, therefore, the use of unnecessary strength and the feeling of fatigue decreases.

The current Cuban weightlifting sports preparation model is based on the principles of training periodization, including different elements taken from the classics of sports training theory and methodology. It is considered that the development of general and special motor capacities is decisive in the development of the weightlifter in the school stage. The Beltrán & Colina (2015) criteria have been strengthened with studies carried out by researchers who have used applied sciences to demonstrate these theoretical foundations.

In Cuba, in the year 1981, the Plans and Programs for the massive and special sports areas and school sports initiation schools were elaborated, the contents of Physical preparation were focused on the sport athletics with the races for speed and endurance, races raising the knees, on the back and hitting the buttocks; as well as long jump with and without high and triple impulse.

The Athlete Preparation Programs entered into force since 1988 and constitute tools for the methodological work of the coaches of this sport and fundamental guide and governing document for the different sports institutions that sport has in Cuba. They have a validity of four years that allows, at the end of each period, to update it and incorporate elements that replace the less successful aspects; for this, the criteria of specialists at different levels are taken into account.

In these documents until 2007, the concept that the weightlifter's general physical preparation is made up of athletics, gymnastics and sports games exercises that are included in the training with a view to developing speed, endurance, strength, flexibility and agility was maintained.

In the current Comprehensive Sports Preparation Program, de Cuervo *et al.* (2016) expresses:

(...) General physical preparation consists of the development of motor capacities that do not correspond to the specific needs of weightlifting, but which development directly or indirectly influences the success of sports activities. General physical



preparation is particularly important when working with athletes in school categories, in which it forms a solid base of abilities and skills that contribute to their further development in this sport. (p. 39).

In this Program, for the first time, the need to develop coordination capacities is recognized and as part of the technical preparation it is oriented:

To learn the rhythm in the Snatch and Clean and Jerk exercises, it is convenient to perform these to the count of "one-two"; a long "one" for the preparatory phases (first phases of the pull in the snatch and the lean or semi-flexion and braking in the clean and jerk from the chest) and a short and accentuated two *for* the most important phases (final phases of the pull in the snatch and clin, or the serve in the clean and jerk from the chest) (p.45).

Likewise, it is recognized that coordination is particularly important when working with athletes of school categories, in which it forms a solid base of capacities and skills that contribute to their subsequent development.

In the training of school weightlifters, technical preparation becomes more important, from the second stage of the selection of sports talents and after the teaching process is completed, where the speed with which they master the main technical fundamentals is very important of the classic and special exercises. This is due to the widespread opinion that to be a good weightlifter it is necessary to master the technique of classical exercises from an early age.

When referring to the sports technique, organization and direction of the athlete's movements, it is convenient to keep in mind not only the movements and the relative displacement of the body, but also the regulation of the elements presents in that field of strengths. For Verjoshanky (2002) "(...) it is the system of movements organized for the resolution of a specific motor task, which in a series of sports modalities is strongly determined by the rules of the competition" and also expresses "(...) the technique sport is above all the coordination of muscular efforts" (p. 92).



The technical sequence of the phases of competitive exercises in weightlifting requires explosive movements and full use of the athlete's possibilities is necessary. The movement system must not attend to superfluous details and must guarantee the mobilization of the necessary energy potential that makes it possible to apply the highest speed of the phases to the implement.

The improvement of the technique must be translated not only in the restructuring of the external kinematic system of movements or its individual details, but above all in the alignment of its biodynamic structure with a new and higher level of motor possibilities of the athlete. Another consideration to take into account and which is raised by the aforementioned author "It is important to be aware that in each sporting activity the coordination capacities can be used effectively only if certain conditions are met:

- Functional improvement of the bodily mechanisms of movement in correspondence with their role in the execution of the sporting exercise.
- Increase in the power and capacity of the sources of energy input for the work of the muscles" (p. 96).

Nieto, León and Cuervo (2020) described the biomechanical characteristics of technical execution in the 1516-year-old category, through video recording and data processing with the human movement analysis program Human, version 5.0 and on the basis of the deterministic biomechanical model developed for this technical element. Among the indicators analyzed were the technical phases of the clin, the angles of the hip, knees and ankles in the limit positions of the draw in the clin, the center of pressure of the foot, trajectory and speed of the bar and the distribution of the efforts in each one of the halon phases.

Chaud and Nuñez (2020) review the technical evaluation systems that have been used by the Cuban weightlifting federation in national school games. The study justifies and recommends how the process of introducing computer technologies and sports biomechanics should be as sciences that study movements in sport in technical evaluation of the school weightlifter.



Meanwhile, Cano, Coronado (2019) compare the start in athletes and used the Kinovea 0.8.24 program; on the other hand, Cordoba (2023) uses this program to measure trajectory, horizontal displacements, vertical displacements, speed and acceleration of the palanquet and the angular positions of the trunk and knees in the limit postures of the movement.

Likewise, Arévalo Chinchada and Romero (2021) characterize the technical starting movement and identify the differences between elite athletes and novices, through the peak variables of estimated maximum speed, meters per second in each phase of the movement, center of gravity of the weightlifter in each phase and the trajectory of the bar; in this study, the snatch technique is biomechanically characterized. For The realization of this methodological principle is essential to establish from the very beginning, the necessary relationship of the problems of technical and physical preparation and, most important, to systematically perfect the sports technique, in correspondence with a growing level of special physical preparation of the athlete.

Hence, it is easy to conclude that these conditions can be effectively guaranteed thanks to the means of special preparation in strength. A light weight can be lifted, from a technical point of view, even if its various elements have not been fully assimilated, but as the weight increases, the technique changes, and all the more, the greater the weight, for this reason it is necessary to gradually increase the weight. weight of the crowbar as it is learned and thus consolidate the correct technique of the execution of the movement.

The increase in the level of special physical preparation must precede in-depth work focused on perfecting technical mastery. The training process in weightlifting extends over many years and depends on the athlete's aptitude for the sport in question.

In the author's opinion, coordinative capacities are closely related to the successful development of the physical preparation and the technique of the weightlifter, they regulate the action and not only the teacher, since in the snatch the phases of the slower or faster movement are carried out coordinating the rhythm verbally or by clapping, which is essential in school categories where the technical gesture is learned and consolidated.



In addition, it is considered that the success of the preparation depends on systematic training, which contributes to the formation of motor habits and the acquisition of optimal physical preparation and makes it possible to apply the most rational preparation methods, taking into account the characteristics of the athletes. On the other hand, the classification of the exercises consists of a structure of logical and differentiated ordering so that the understanding of these is legible and describable in the proper use that it can have in any sporting activity.

Rojas (2019) refers that the classification of the exercises allows to orient the teaching-learning processes assertively and correctly from the conception of the technical and physical preparation, since the sports results depend on a good work of strength development and this preparation in turn is conditioned to a solid technical execution.

From the above, it is assumed that it is necessary to study the training process of coordinative capacities. in the classic exercises of lifting weights from tasks by age categories; consequently, the objective is to assess the results of the application of pedagogical actions for the development of coordination in the weightlifters of the "Virgen Felizola" Sports Complex, in Santiago de Cuba.

The research responds to the demand of the Cuban Weightlifting Federation about the need to improve the process of sports preparation of the school weightlifter. The proposed actions contribute to perfecting the snatch exercise technique and can be applied to all beginners in this sport.

MATERIALS AND METHODS

To carry out the scientific observation, a team made up of six weightlifting teachers was formed, of them two are trainers of the Combinado Voluntario Deportivo (CVD) and two of the Sport Initiation School (EIDE) in Santiago de Cuba, the provincial methodologist and a professor of la Physical Culture Faculty (FCF). The researcher was a direct part of the observation.



The average work experience of the sample was 31.8 years. 100% was made up of university graduates with a degree in Physical Culture; two are weightlifting coaches at CVD and two are lifting coaches at EIDE, which represented 33.3%, in each case; one is a provincial weightlifting methodologist and one is a weightlifting professor at the FCF, which represented 16.6 %. Two hold the scientific category of Master in Science.

The observation guide used has 10 indicators related to planning and the evaluation of good or bad according to the criteria of the observers. The observations were made from the month of December of the 2016-2017 school course, they allowed to record the ways of working in the training of the coordination capacities by the coaches and the behavior of the weightlifters in relation to the fulfillment of the objectives, contents, dosing and load distribution.

The observation was carried out with the objective of verifying if treatment was given to the rhythm capacity within the daily training of the weightlifters in 16 training sessions, six corresponded to the general preparation stage, six to the special preparation stage and four to the competitive period.

The following actions were observed:

- To impart the contents directed to the planning and training of the coordinative capacities in the methodological preparations.
 - Select the general and special physical preparation exercises for the development of coordination for weight lifters.
 - Apply the exercises according to the periods of preparation.
 - Evaluate at the beginning and end of the preparation of movement coordination.
- The test for the evaluation of the coordination of the classical exercises is applied.



The snatch exercise was selected, as it is the exercise where mastering the technique is essential to achieve good results and requires optimal coordination between the different phases of the movement for its execution.

It was worked with a population of 20 practitioners of the 1314-year-old male category. A sample composed of eight intentionally selected subjects was selected. The practitioners were in the second year of the category and were shortlisted to form the team that represented District 3 "Antonio Maceo" in the municipal competition. In the competitions, the execution of the technique of the classic exercises was evaluated, as well as the speed, stability and resistance.

To assess the results of the application of pedagogical actions for the development of coordination in weightlifters, two measurements were taken: the first, in the fourth week of October 2018, the second and last was carried out in the fourth week of February of 2019, prior to the provincial competition.

Iming was carried out with the objective of evaluating the rhythm and coupling of the phases of the classic snatch exercise, the crowbar was placed perpendicularly, in line with the filming camera and the execution of the exercise was recorded; to do this, the athlete adopted the starting position and made three attempts, from which the best result was chosen. Only completed exercises were assessed.

- The pedagogical tests were carried out after the special warm-up.
- Three attempts were made and the best ones were chosen.
- Recording started from the starting position and stopped at the fixation.

The videos obtained were processed using the Kinovea computerized program. The evaluation scale elaborated on the speed of execution of the movement and the duration of the phases was applied, based on average values, taken from Cuban athletes of high sport mastery.



Form of qualification: phases of the movement to be evaluated (previous impulse, damping and final impulse) in seconds, scale with ranges of excellent, good, regular and low.

Phase duration time:

- 2nd phase (pre-impulse and damping) 0.4 0.5 m/ sec.
- 3rd phase (final impulse) 0.11 0.14 m/ sec.
- 4th phase (end of final push and glide without support) 0.16 0.14 m/sec.

From a study carried out in 2018, a table was prepared for the athletes participating in the first category National Championship (Table 1).

Table 1. - Scale to evaluate the duration of the phases

	2nd phase (sec.)	3rd phase (sec.)	4th phase (sec.)	Assessment
Phase duration time	$0.4 \leq x \leq 0.5$	$0.11 \leq x \leq 0.14$	$0.14 \leq x \leq 0.16$	Excellent
	$0.5 < x \leq 0.8$	$0.14 < x \leq 0.16$	$0.16 \leq x \leq 0.20$	Good
	$0.8 < x \leq 0.12$	$0.16 < x \leq 0.20$	$0.20 \leq x \leq 0.24$	Regular
	> 0.12	> 0.20	> 0.24	Low

For this comparison, a statistical processing was carried out on the measurements at the two moments, to know the mean and the standard deviation, which made it possible to assess the results of the tests. The data was processed using the Microsoft Office 2007 Excel Program.

RESULTS AND DISCUSSION

The observations were made in the gym of the "Virgen Felizola" Sports Complex of the Santiago de Cuba Municipality, where the following insufficiencies were observed:

- 100 % of the trainers did not plan coordination training in the training plans for weightlifters.



- 70 % of the coaches did not have an instrument to evaluate coordination, so the systematic evaluation of this capacity was not carried out.
- 70 % of the coaches valued the execution technique of the classic exercises, through observation according to the scale indicated by the national direction.
- The applied survey revealed that:
- 100 % of the coaches considered that it was important to work on coordination from the 11-12 years category and that in the 13-14 category it served as the basis for the consolidation of the technique of the classic exercises, as one of the objectives to work on. these ages.
- Coordination training was not addressed in the methodological preparations.
- 100% expressed that they use observation as an instrument to evaluate coordination, in the execution of classic exercises.
- 82.0 % of the coaches stated that the evaluation of the observation was based on the use of their own criteria and on the evaluation scale of the Athlete Preparation Program.
- 100 % of the coaches stated that they did not know of any test or test to measure the state of coordination in weight lifting.
- It was considered by 100 % of the respondents the non-existence of an official orientation for the evaluation of coordination training, only the orientations provided through the la Provincial weightlifting Commission and the research project directed by the author (Table 2).



Table 2. - Results obtained in the pedagogical test applied in the month of October 2018

Division	2nd phase	3rd phase	4th phase	Assessment
46	0.10	0.17	0.21	Regular
50	0.13	0.22	0.25	Low
\bar{X}	0.115	0.195	0.23	Regular
S^x	0.021	0.035	0.028	
62	0.8	0.15	0.18	Good
62	0.8	0.14	0.18	Good
66	0.11	0.19	0, 23	Regular
66	0.10	0.15	0.18	Good
\bar{X}	0.455	0.157	0.192	
S	0.398	0.221	0.399	Good
70	0.15	0.23	0.25	Low
70	0.11	0.22	0.20	Regular
-	0.13	0.21	0.22	Regular
\bar{X}	0.02	0.00	0.03	

In the first measurement of the speed of the starting phases, carried out in October 2019, it was possible to verify that two practitioners belonged to the small categories, four to the medium categories and two to the heavy category (Table 3).

- One of the athletes reached the evaluation of good, two of regular and two of low.
- On average, the small and medium categories were evaluated regularly.
- The standard deviation showed that there is little dispersion between the results.



Table 3. - Results of the pedagogical test carried out in the month of February 2019

Division	2nd phase	3rd phase	4th phase	Assessment
46	0.7	0.13	0.18	Good
50	0.7	0.15	0.18	Good
-	0.7	0.14	0.18	Good
§	0.0	0.025	0.8	
62	0.8	0.14	0.17	Good
62	0.7	0.13	0.17	Good
66	0.10	0.17	0, 20	Regular
66	0.10	0.13	0.17	Good
-	0.42	0.14	0.17	
§	0.1	0.13	0.0	Good
70	0.13	0.18	0.20	Low
70	0.10	0.19	0.18	Good
-	0.11	0.19	0.19	
S	0.02	0.00	0.14	Regular

In the second measurement carried out in February 2019, it was observed that the athletes remained in the weight categories (divisions), six athletes achieved the qualification of good, one of regular and one low, which meant the evolution of the eight athletes.

In general, an increase in speed was observed in the execution of the movement and an improvement in the capacity to coordinate the starting movement. The athlete who achieved the low rating belongs to the heavy category and evolved from the low to regular rating; these athletes showed a slower evolution and obtained the lowest score in the first measurement. The decrease in the execution times of the movement phases showed an increase in the fluidity and coordination of the competitive exercises.

In general, it can be seen that the results of the application of actions for the development of coordination in weightlifters of the 13-14 (M) category reflected:



- In relation to the results achieved by the implementation of the study carried out with the application of the test, the rhythm of execution was visualized and it was estimated that by means of the clearer visualization of the movements, the technical deficiencies can be appreciated more clearly.
- The optimal time that was given to each phase of the classic snatch exercise, was inherent to the rhythm and coordination capacities closely linked to the technical execution of this exercise in the 1314-year-old category, in this way the pertinent corrections were made, which gives rise to a new resultant quality.
- It is considered it was overcome, the way of observation, evaluation and correction of technical errors proposed by the authors who elaborated the National Program for the Comprehensive Preparation of the Athlete and the National Weightlifting Commission in force for the sport in the studied category characterized by a high degree of empiricism and subjectivity.

This work aims to improve the weight lifting training methodology, which is why it constitutes a benchmark in terms of improving the coordination capacity of the starting movement. In its essence, it has taken the best of the research that preceded it and addresses, with high scientific rigor, the issue of starting techniques. (Játiva *et al.*, 2021). However, for its complementation at the axiological level, other works that better guide the weightlifter in their relationship with the ethical-social environment must be taken into account. (Rodríguez, *et al.*, 2018).

It is also considered that it can contribute not only to the area of weight lifting as a sport, but also as a physical activity that can help the rehabilitation of patients who need to improve coordination, balance and other physical abilities, as well suggested by the works of Urios *et al.* (2003) and Arismendi *et al.* (2020).

This work coincides with the need to maximize not only coordination, but its relationship with other capacities, pondering the power, strength and skills needed by many individuals who find weightlifting a very effective resource to compensate for their challenges in physical disability. (Salas, *et al.*, 2009; Forero, 2020).



CONCLUSIONS

The results of the application of actions for the development of coordination in weightlifters of the 13-14 (M) category were considered novel which stated:

Increase in the speed in the execution of the movement, which improves the coordination capacity in the snatch exercise and achieves a better use of the kinematic chains, which in turn allows a better technical performance of the exercise, as well as a better position in the competition of the weightlifters and the province.

Increase in the scores of the technical evaluation of the snatch exercise in relation to previous courses, which led to a better placement of the weightlifters and the province in the national competition.

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