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Original article

Theoretical validation of endurance-strength exercises for the combined sport climbing test, junior-senior category

Validación teórica de ejercicios de resistencia-fuerza para la prueba combinada de escalada deportiva, categoría juvenil-senior

Validação teórica de exercícios de resistência-força para o teste combinado de escalada desportiva, categoria juvenil-sênior

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ABSTRACT

Strength endurance is the physical capacity to maintain strength at a constant level for the duration of a given sporting gesture, a determining capacity in many sports, where sport climbing is no exception; therefore, the theoretical-practical study that contributes to improve this capacity in sport climbing will allow improving the management of sport training in this sport. The objective of this work is to theoretically validate a proposal of physical exercises for endurance-strength training, in the combined sport climbing test, in an age range between 16-21 years old. The applied research is of theoretical-descriptive type of correlational order and qualitative base, with a study of criteria, of 13 specialists in four items (originality, quality, specialization and objectivity) that evaluate theoretically in two moments a group of specialized physical exercises to enhance endurance-strength. As results, it is presented that all the evaluable categories increased quantitatively and qualitatively as part of the post-test, in originality (pre-test:



two points; post-test: four points; $p=0.000$); in quality (pre-test: three points, post-test: four points; $p=0.000$); in specialization (pre-test: three points, post-test: four points, $p=0.000$) and in objectivity (pre-test: four points; post-test, five points; $p=0.001$). The proposal of endurance-strength exercises for the combined sport climbing test theoretically complies with the assumptions of originality, quality, specialization and objectivity; it is a satisfactory proposal, according to the theoretical criteria of the specialists consulted.

Keywords: Sport climbing; Combined test; Endurance-strength.

RESUMEN

La resistencia a la fuerza es la capacidad física de mantener la fuerza a un nivel constante mientras dure un gesto deportivo determinado, capacidad determinante en muchos deportes, donde la escalada deportiva no es excepción; por tanto, el estudio teórico-práctico que contribuya a mejorar dicha capacidad en la escala deportiva permitirá mejorar la gestión del entrenamiento deportivo en dicho deporte. El objetivo de este trabajo es validar teóricamente una propuesta de ejercicios físicos para el entrenamiento de la resistencia-fuerza, en la prueba combinada de escalada deportiva, en un rango etario comprendido entre 16-21 años. La investigación aplicada es de tipo teórico-descriptiva de orden correlacional y base cualitativa, con estudio de criterios, de 13 especialistas en cuatro *ítems* (originalidad, calidad, especialización y objetividad) que evalúan teóricamente en dos momentos un grupo de ejercicios físicos especializados para potenciar la resistencia-fuerza. Como resultados, se exponen que se incrementaron cuantitativa y cualitativamente todas las categorías evaluables como parte del postest, en originalidad (pretest: dos puntos; postest: cuatro puntos; $p=0.000$); en calidad (pretest: tres puntos, postest: cuatro puntos; $p=0.000$); en especialización (pretest: tres puntos, postest: cuatro puntos, $p=0.000$) y en objetividad (pretest: cuatro puntos; postest, cinco puntos; $p=0.001$). La propuesta de ejercicios de resistencia-fuerza para la prueba combinada de escalada deportiva cumple teóricamente con los supuestos de originalidad, calidad, especialización y objetividad, es una propuesta satisfactoria, según el criterio teórico de los especialistas consultados.

Palabras clave: Escalada deportiva; Prueba combinada; Resistencia-fuerza.

RESUMO

A resistência à força é a capacidade física de manter a força a um nível constante enquanto durar um gesto desportivo determinado, capacidade determinante em muitos desportos, onde a escalada desportiva não é excepção; portanto, o estudo teórico-práctico que contribua para melhorar essa capacidade na escala desportiva permitirá melhorar a gestão do treino desportivo no desporto. O objetivo deste trabalho é validar teoricamente uma proposta de exercícios físicos para o treinamento da resistência-força, na prova combinada de escalada esportiva, em uma faixa etária compreendida entre 16-21 anos. A pesquisa aplicada é de tipo teórico-descriptivo de ordem correlacional e base qualitativa, com estudo de critérios, de 13 especialistas em quatro itens (originalidade, qualidade, especialização e objetividade) que avaliam teoricamente em dois momentos um grupo de exercícios físicos especializados para potenciar a resistência-força. Como resultados, é exposto que todas as categorias avaliáveis aumentaram quantitativa e qualitativamente como parte do pós-teste, em originalidade (pré-teste: dois pontos; pós-teste: quatro pontos; $p=0.000$); em qualidade (pré-teste: três pontos, pós-teste: quatro pontos; $p=0.000$); em especialização (pré-teste: três pontos, pós-teste: quatro



pontos, $p=0.000$) e em objetividade (pré-teste: quatro pontos; pós-teste, cinco pontos; $p=0.001$). A proposta de exercícios de resistência para o teste combinado de escalada desportiva obedece teoricamente aos pressupostos de originalidade, qualidade, especialização e objetividade; é uma proposta satisfatória, de acordo com os critérios teóricos dos especialistas consultados.

Palavras chave: Escalada desportiva; Teste combinado; Resistência-força.

INTRODUCTION

Climbing is a sport that has its own characteristics that differ in many ways from the rest of the sports, which show several performance-determining variables and, therefore, particularities in the application of methods in a specific way and training contents in a general way (Marín-Quiles, 2017; Asakawa & Sakamoto, 2019; Seifert, Wolf, & Schweizer, 2016; Laval & Sitko, 2019). Sport climbing has a specific complexity within the competitive system, which demands a technical body trained in the main processes that support sport training in the different training categories.

The particularity of this sport discipline demands from climbers a high level of physical performance to meet the planned competitive results, (Sánchez, Torregrossa, Woodman, Jones, & Llewellyn, 2019; MacKenzie, et al., 2020). These results will not be possible without proper planning of the physical load, in particular, of the determinant capacities that govern the specific training of this sport.

Combined climbing refers to a very young discipline that includes speed climbing, difficulty climbing and bouldering and has a classification and a final, with a maximum of 8 climbers per gender. The athlete must compete, both in classification and final, in speed, bouldering and difficulty, in that order. After that, the results of the three disciplines are multiplied and the winner is the climber with the lowest score.

If a climbing competition is analyzed, there is a loss of performance in the athletes, in the last test called combined. This is due to the wear and tear involved in participating in the three previous tests (speed, difficulty and block), which implies, among other aspects, the need to improve the training of the endurance-strength capacity, in the climber, which allows improving the technical-tactical performance in training and competition, as stated in. The endurance-strength is necessary in the climber to maintain the grip for a prolonged time, given that this capacity allows maintaining the strength at a constant Marín-Quiles, (2017) level for the duration of the sporting gesture (Manso, 1999; Morales & González, 2015).

Numerous studies have evaluated both maximal strength and upper body strength-endurance in various sports. For the case of scaling, studies have focused primarily on hand grip strength and endurance and finger strength, (López Rivera, 2014; Sitko & Laval, 2019; Baláš, Pecha, Martin, & Cochrane, 2012; Salehodin, Abdullah, & Yusoff, 2018) where the hand dynamometer is the most commonly used method to assess hand grip strength in most sport climbing work.

Hand grip strength in climbers has usually been assessed on both hands or on the dominant hand of the subject. Taking into account the use of both hands in the execution of this sport, it is recommended to always evaluate both hands (España-Romero, et al., 2009).



The performance of climbers in the different tests requires strict compliance with the annual planning in order to obtain good results. This demonstrates the importance of researching the methodological procedures and the demands required by training, competition as such, the knowledge and application of conditioning capacities to reach optimal performance, as well as the design and selection of the content of the athlete's preparation (Calero., 2018).

The Sports Concentration of Pichincha (CDP in Spanish) participates every year in the National Sports Games, in 18 sports disciplines of different categories: minors, pre-juvenile, juvenile and under-23; these games are organized by the Secretariat of Sports and are part of the evaluation for the Provincial Federations of Ecuador. Among these 18 sports disciplines is sport climbing, a sport that has four modalities: speed, difficulty, block and combined (which consists of participating in the first three modalities in a single day). This discipline has achieved very good results at national and international level. Given the current importance of the sport under study for the Ecuadorian environment and given the needs of methodological updating, derived from updated scientific studies, it is useful to previously establish the contents of the sport preparation of the climber; this can be determined from the practical point of view, but previously validated theoretically by specialists as a previous step to establish optimal training strategies.

In this sense, the purpose of the research is to theoretically validate a proposal of physical exercises for endurance-strength training in the combined test of sport climbing, in an age range between 16-21 years old.

MATERIAL AND METHODS

A theoretical-descriptive research of correlational order and qualitative basis was carried out, intentionally selecting a group of sport climbing specialists, with internal and external experience, presenting the following assumptions to be included in the research:

1. At least a third degree in Physical Activity and Sport Sciences or related. If completed, two points.
2. Practical experience in the sport of climbing of at least ten years. If completed, four points.
3. Verifiable competences in physical-sport preparation, qualifications, various certificates. If completed, four points.

Additionally, a test based on ten points was carried out to select the specialists according to the requirements demanded; a self-assessment was carried out which allowed the exclusion of any subject who did not reach the minimum qualification of eight points and 13 specialists were distinguished out of a possible 25.

The specialists will theoretically analyze a proposal of physical exercises to enhance endurance-strength in the combined test of sport climbing for climbers between 16-21 years of age (both sexes). The analyses will be made in two moments: the first one comprised a proposal with four physical exercises of endurance-strength, based fundamentally on the principle of specialization and the training vision, according to the characteristics of the sport studied. The second moment of analysis was applied after



correcting the deficiencies detected by the specialists, ten endurance-strength exercises were included in the proposal.

The qualitative variables or items evaluated by the specialists are as follows:

1. *Originality*: level of existing reproducibility with other physical exercises available in the national and international literature.
2. *Quality*: inherent properties of the whole content of the athlete's preparation that has been designed to implement the purpose of the present research. The approach to the similarities of the sport is taken into account.
3. *Specialization*: whether the content of the proposed preparation complies with the principle of sports training, which is specific to the studied sport.
4. *Objectivity*: related to the practical possibilities of being implemented the proposal, in a sports training model.

The final proposal of physical exercises to enhance endurance-strength in the combined sport climbing test for the age range of the study presented the following basic characteristics:

1. Ten physical exercises were included as part of the content of the sport preparation, in order to enhance endurance-strength.
2. Some fundamental principles of sports training were prioritized, such as the principle of individualization, specialization, specificity, consciousness, gradual increase of the sports load, systematicity and periodization.
3. Guidelines were established to adapt the contents of the sport preparation, according to the needs and possibilities of the pedagogical training environment of the climbers studied (available implements and facilities, first aid, time available for the preparation, economic resources of the climber, among others of lesser interest).
4. The sports training background of each climber to be trained was defined (sports longevity, experience in other sports, experience in sport climbing, among others), a useful aspect to validate the application of the necessary workloads to form an optimal sports training plan for the climber.

For the evaluation of the items, a Likert-type scaling of five categories was selected, as indicated by [Hernández, Fernández, & Baptista, \(2010\)](#) and a quantitative and qualitative value was assigned to each point, as described below:

- 1 point: bad.
- 2 points: fair.
- 3 points: good.
- 4 points: very good.
- 5 points: excellent.



To compare the evaluations made by the specialists at the two moments of designing the specialized physical exercise plan, the Signs test was implemented ($p \leq 0.05$), since there was no normal distribution of the data.

RESULTS AND DISCUSSION

Table 1 shows the data obtained from the evaluation carried out by the specialists in two moments after the intervention proposal was evaluated; in the "Originality" variable, the pretest determined a mean or average in the criteria issued by the 13 specialists, of two points (regular), which raised the quantitative and qualitative value to four points as part of the posttest (very good).

In the variable "Quality", the specialists evaluated the item at an average of three initial points (good), the quantitative value was increased, and, therefore, qualitative, when evaluating the intervention proposal in its second moment, in a superior way (four points; very good). In the variable "Specialization", the initial collective evaluation was set at three points (good), increased as part of the post-test to four points (very good) after refining the intervention proposal. Finally, in the item or variable "Objectivity", the initial collective rating was four points (very good), which was also increased to five points as an average (excellent) in the post-test; this last variable of analysis was the one with the highest score reached in the two moments of evaluation (Table 1).

Table 1. - Criteria issued by specialists

Items	Originality		Quality		Specialization		Objectivity	
	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest
1	2	3	3	5	3	5	4	5
2	3	3	2	4	4	4	4	5
3	2	3	3	4	3	5	3	4
4	3	5	3	4	4	5	4	4
5	4	5	3	4	4	5	5	5
6	3	4	2	3	3	5	4	5
7	2	3	4	4	4	5	5	5
8	2	3	3	4	3	4	4	5
9	1	3	3	4	2	4	4	5
10	2	3	4	5	3	4	4	5
11	3	4	2	4	2	3	4	5
12	2	4	2	3	2	4	3	5
13	2	3	1	3	3	4	4	5
□	2	4	3	4	3	4	4	5



Table 2. - Sign test statistics

	Test Statistics ^a			
	Originality Posttest – Pretest	Quality Posttest – Pretest	Specialization Posttest – Specialization Pretest	Objectivity Posttest – Objectivity Pretest
Exact meaning (bilateral)	,000 ^b	,000 ^b	,000 ^b	,001 ^b

Caption: ^aSigns test; ^bbinomial distribution used.

When comparing the data obtained in the four variables or qualifiable items (Table 2), in all cases, significant differences in favor of the post-test were evidenced, as established by the Sign test for two related samples.

Under this context, the present research allowed to have a system of exercises oriented to the improvement of the endurance-strength in the climbers of the combined test in the fundamental, which will start from a diagnostic evaluation and will propose different methods and methodological requirements for the training of the endurance to the strength, with a view to the competition of the combined test, having as theoretical-practical support different primary sources of research such as the one provided in [López Rivera \(2014\)](#) and [Marín-Quiles \(2017\)](#), which is supported by the theory of the work of the endurance to strength and the theoretical and methodological foundations on climbing training, as indicated in [MacKenzie et al., \(2020\)](#), in [Sitko & Laval \(2019\)](#) and in [España-Romero et al., \(2009\)](#).

CONCLUSIONS

As a conclusion, it is stated that the intervention proposal was satisfactorily evaluated in its second moment of design, after improving the scope of the first intervention proposal, according to the criteria of the evaluating specialists. The proposal of endurance-strength exercises for the combined test of sport climbing theoretically complies with the assumptions of originality, quality, specialization and objectivity; it is a satisfactory proposal, according to the theoretical criteria of the consulted specialists.

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Conflict of interests:

The authors declare not to have any interest conflicts.

Authors' contribution:

Luis Fernando Cañadas Gómez de La Torre: Conception of the idea, literature search and review, instrument making, Instrument application, compilation of information resulting from the instruments applied, statistic análisis, preparation of tables, graphs and images, database preparation, general advice on the topic addressed, drafting of the original (first version), review and final version of the article, article correction, authorship coordinator, translation of terms or information obtained, review of the application of the applied bibliographic standard.



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