

Effect of a didactic proposal on strength and flexibility in a sample of skateboarders

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Published online: October 31, 2022

(Accepted for publication October 15, 2022)

DOI:10.7752/jpes.2022.10291

Abstract:

Background: speed skating continues to expand its research needs, given the growing interest in knowing the factors related to sports performance at early ages. Objective: to evaluate the effect of a didactic proposal oriented towards the development of strength and flexibility, seeking to improve the technical foundation of the spagatta in a sample of Colombian skaters aged 12 and 13 years old. Method: The selected sample comprised 18 children between 12 and 13 years of age (transition category) with an age of 12.55 ± 0.68 years, a body mass of 44.94 ± 6.68 kilograms and a height of 153.49 ± 7.12 centimeters, who were divided into a control group (n:9) and an experimental group (n:9). Quantitative approach study, quasi-experimental design and descriptive study type, with a pseudo-random intentional sampling. Quantitative approach study, descriptive study type and quasi-experimental design. The statistical data were processed using the ® program version 4.1.0 in different phases; descriptive analysis, an Anova analysis of variance and the correlation method. The significance value was set at p value <0.01. Results: In relation to the objective established for the present investigation, significant differences were found for each of the variables under study, related to the static test right leg front Spagatta p=0.000, static left leg front Spagatta p=0.000, Squat Jump p=0.004, flexibility in the Sit and Reach test p=0.001 and in Kinovea p=0.000 to measure the technical foundation of the spagatta. Discussion: Thus, the didactic proposal of the present research is based on the search for alternatives for learning the technical basis of spagatta. In this sense, there are several investigations aimed at the variability of methods to promote learning in speed skating. Conclusion: The effect of the didactic proposal focused on the development of strength and flexibility for the improvement of the technical foundation of the spagatta in skaters of 12 and 13 years old, was effective, significantly improving the strength, flexibility and amplitude of the skater's technical foundation.

Key Words: sport, learning, benchmarking, measurement method, ability.

Introduction

Roller speed skating has had a great expansion worldwide derived from its competitiveness in which in turn, the evolution of sports science has been increasing its concern in many sports such as cross-country skiing (Andersson, Noordhof & Lögdal, 2020; Noordhof et al., 2021) and figure roller skating (Radman, Ruzic, Padovan, Cigrovski & Podnar, 2016), however, roller skating has not yet benefited from research input, mainly in the sport-specific technique, it was determined that there is no optimal technique in speed skating (Savinykh, Stoliarova, Stovba, Khomenko & Kurchenkov, 2022). For this reason, evaluating the effect of a didactic proposal based on strength and flexibility on the technical foundation of spagatta is necessary to continue understanding this sport discipline.

Thus, racing skating is characterized by the overcoming of an endurance in the shortest possible time, in which the sport technique plays a determining role (Becerra Patiño, Gasca Rodríguez, Díaz Rodríguez & Rojas Leguizamón, 2020; Meyer et al., 2021; Sun, Guo, Liu & Tao, 2022), product of this, this technical skill is related to strength and motor behavior (Konings et al., 2016; Menting et al., 2019) and flexibility (Avrillon et al., 2019) seeking to express a running tactic (Bullock et al., 2008). Thus, the technical foundation depends on physical and coordinative capacities derived from the interaction of anatomical-functional elements (Cherepov, Epishev, Bykov, Stoliarova & Stovba, 2019).

Similarly, due to the nature of the technical foundation of spagatta, it is revealed how the most influential physical capacities of this sport action that prevails in the finish are strength and flexibility. Along the same lines, strength and flexibility have been extensively studied in sport (Gómez-Landero Rodríguez, López Bedoya & Vernetta Santana, 2013; Cejudo, Sainz de Baranda, Ayala & Santonja, 2014), finding that the strength index does not correlate with the score obtained in the Sit and Reach test (Delgado-Martín, Garoz-Puerta, Miguel-Tobal & Martínez-de-Haro, 2020; Muñoz et al., 2019). However, flexibility has been shown in other studies to be a determinant capacity for sports performance (American College of Sports Medicine, 2018), due to

the fact that ranges of motion (ROM) are essential to mobilize the body segments (López-Bedoya, Vernetta-Santana, Lizaur, Martínez-Patiño & Ariza-Vargas, 2019) involved in any sporting gesture. On the other hand, the skater's strength correlates with the execution of a squat (De Greef, Elferink, Sierksma & Visscher, 2011) taking into account the position maintained during the displacements, being thus, the finishing gesture the one that is able to hold the back skate in a non-conventional posture; Similarly, flexibility is crucial in this gesture (Carneiro et al., 2015) to perform a wide flexion and extension of the hip and thus, try to cross the finish line first.

On the other hand, there are investigations aimed at determining the anthropometric profile in Colombian child skaters, concluding that athletes do not present good aerobic and anaerobic power, existing in turn, a lack of flexibility that directly influences the sports performance and the technique of execution of the basic fundamentals of skating (Montealegre, 2018). There, the development of strength and flexibility allows on the one hand, to maintain adequate ranges of motion, and therefore, a benefit product of physical exercise that improves physical qualities such as muscle strength, joint flexibility and general endurance, creating a motor stock oriented to provoke better responses to physical stimuli (Mocanu & Bobrescu, 2021; Nogueira et al., 2019) and a work directed towards the prevention of injuries, for which reason, the present research considered the creation of a didactic proposal focused on the development of strength and flexibility, seeking with this, an improvement of the technical foundation of spagatta.

Material & methods

Participants

The selected sample comprised 18 children between the ages of 12 and 13 years (transition category) with an age of 12.55 ± 0.68 years, a body mass of 44.94 ± 6.68 kilograms and a height 153.49 ± 7.12 centimeters, which were divided into control group (n:9) and experimental group (n:9). Quantitative approach study, quasi-experimental design and descriptive type of study, with pseudo-random purposive sampling. Each participant met the inclusion criteria, which were: a) meet the established age (12 and 13 years), b) have at least two years of experience practicing, c) have participated in at least three competitions with professional skates, d) attend 90% of the didactic proposal, e) not have suffered injuries in the lower or upper extremities in the last 12 months and f) not suffer from any health condition. Initially, a meeting was held with the parents and coaches of the club to socialize the didactic proposal, the objectives of the study, methodology, benefits and possible risks. Subsequently, the parents voluntarily agreed to participate by signing the informed consent form. It should also be noted that the didactic proposal was governed by the principles established by the Declaration of Helsinki (World Medical Association, 2013) and considering resolution number 8430 of 1993 of the Colombian Ministry of Health, which establishes the scientific, technical and administrative standards for health research using noninvasive procedures. The variables to be evaluated were: strength, flexibility and amplitude of the spagatta.

Instruments

The instrument used to evaluate strength was the My Jump 2 application (Balsalobre, Glaister & Lockey, 2015), which allows to evaluate the jump from squat position (SJ), the reliability of the My Jump 2 application is (intraclass correlation coefficient = 0.997, $p < 0.001$; Bland-Altman bias = 1.1 ± 0.5 cm, $p < 0.001$) and validity for height ($r = 0.995$, $p < 0.001$) (Balsalobre et al., 2015) (Balsalobre et al., 2015). To evaluate flexibility, the Sit And Reach test was used flexibility in the specific gesture in spagatta was evaluated from the frontal or through spagatta test and, finally, the amplitude of the technical foundation of spagatta was used the Kinovea software to determine the distance reached in spagatta, a validated program oriented to obtain angles, distances and coordinates (Puig-Divi et al., 2019; Fernández-González, Cuesta-Gómez, Miangolarra-Page & Molina-Rueda, 2022). Finally, each of the data were consigned in an Excel sheet, to be later processed with the ® program.

Procedure

The didactic proposal consisted of 18 intervention sessions with a pre and post evaluation session. It was designed with reference to the principles of sports training for the improvement of physical capacity (Bernal-Reyes, Peralta-Mendivil, Gavotto-Nogales & Placencia-Camacho, 2014), the pedagogical principles proposed by Correia, Carvalho, Duarte, Pereira & Davids (2017), the developmentalist pedagogical model, an alternative model for its construction and, ultimately, the planning related to density, intensity, volume and duration of the load was developed with reference to Bondarchuk's contemporary integrative model since the sessions were planned with progressive exercises and games, taking into account the principle of individuality and active and conscious participation.

Statistical analysis

The statistical analysis of the present investigation was carried out on the basis of two main elements, using the software ® version 4.1.0. Initially, a two-way Anova analysis of variance was performed in order to determine the reliability of the results obtained through the statistical significance method. Before that, the difference of all the evaluations and in both groups, between the initial evaluation versus the final evaluation, was found. Finally, through the correlation coefficient, the connection found between all the tests performed is established in order to determine the interrelation between the tests used in the didactic proposal.

Results

The results of the present study are expressed in a descriptive and graphic manner, and for this purpose a series of tables and images are used to answer the objectives set forth. The first thing that can be observed is how the experimental group is lower than the control group, so it can be affirmed that the experimental group finished with greater flexibility in the frontal spagatta test for right and left leg, as well as for the Sit and Reach test, Squat Jump and distance analysis of the technical foundation of the spagatta with kinovea (see table 1).

Table 1. Overall difference in data between initial vs. final evaluation in control and experimental groups.

	Spagatta right (cm)	Control group				Spagatta Right (cm)	Experimental group			
		Spagatta Left (cm)	SJ (cm)	Sit and Reach (cm)	Kinovea (cm)		Spagatta Left (cm)	SJ (cm)	Sit and Reach (cm)	Kinovea (cm)
Average	-0,311	-0,211	0,145	-0,177	-10,777	-4,36	-3,14	3,97	0,755	25
Des Vest	0,86	0,87	2,64	0,43	12,91	0,82	1,24	2,32	0,61	14,91
Minimum	-1,6	-1,7	-2,59	-0,8	-29	-5,7	-4,8	0,3	0,2	5
Pn 25%	-0,9	-0,8	-0,82	-0,5	-21	-5,1	-4,1	2,47	0,4	16
Pn 50%	-0,2	-0,1	-0,39	-0,3	-13	-4,3	-3,6	4,73	0,5	26
Pn 75%	0,3	0,5	-0,01	0,2	1	-4,1	-2,3	4,95	1	33
Maximum	0,8	0,8	6,87	0,4	7	-3,2	-1	7,75	2	54

Note: SD (standard deviation), Pn (percentile), Frontal right (frontal spagatta test or traverse test), SJ (Squat Jump).

The analysis of all the variables reveals that there are significant differences, which are associated with the effect of the didactic proposal. Thus, they reveal significant differences for the spagatta right leg test ($p=0.000$), spagatta left leg test ($p=0.000$), Sit and Reach ($p=0.001$), squat jump ($p=0.004$) and kinovea ($p=0.000$) (see table 2).

On the other hand, the correlation matrix found in table four shows the relationship between each of the evaluations and the impact that the exercises performed to improve one test have on the other tests and evaluations (see table 3).

Thus, for example, as can be seen in the correlation between the static spagatta test with the right leg bent forward and the same test, the correlation is 100% because the same test is being related. This means that all the actions and exercises that were performed during the didactic proposal to improve the static spagatta test with the right leg had a 100% impact on this test.

The static test with the right leg and the static test with the left leg have a correlation of 81%. In another instance, the frontal spagatta test with right leg and the Squat Jump strength test have a minimal or null correlation (-60%), which means that the hip flexibility evaluated with the frontal spagatta test with the right leg forward, will definitely not improve much with actions oriented at the same time towards the improvement of the strength with the Squat Jump.

Table 2. Significance value of each of the evaluations between the control group and the experimental group.

Evaluation	(p) value	Statistical significance
Spagatta Right leg	0,000	True
Spagatta Left leg	0,000	True
Squat Jump	0,004	True
Sit and Reach	0,001	True
Kinovea	0,000	True

The Spagatta test with the right leg and the Sit and Reach test have a correlation of -60%. This means that although these two are oriented towards the evaluation and improvement of flexibility, there is really not much relationship between them, because they impact on very different muscle groups.

In turn, the flexibility test of the front spagatta with right leg and the evaluation of spagatta through the Kinovea software have a correlation of 77%, concluding that indeed the flexibility of the hip can be a determining factor for the improvement of the technical foundation of spagatta.

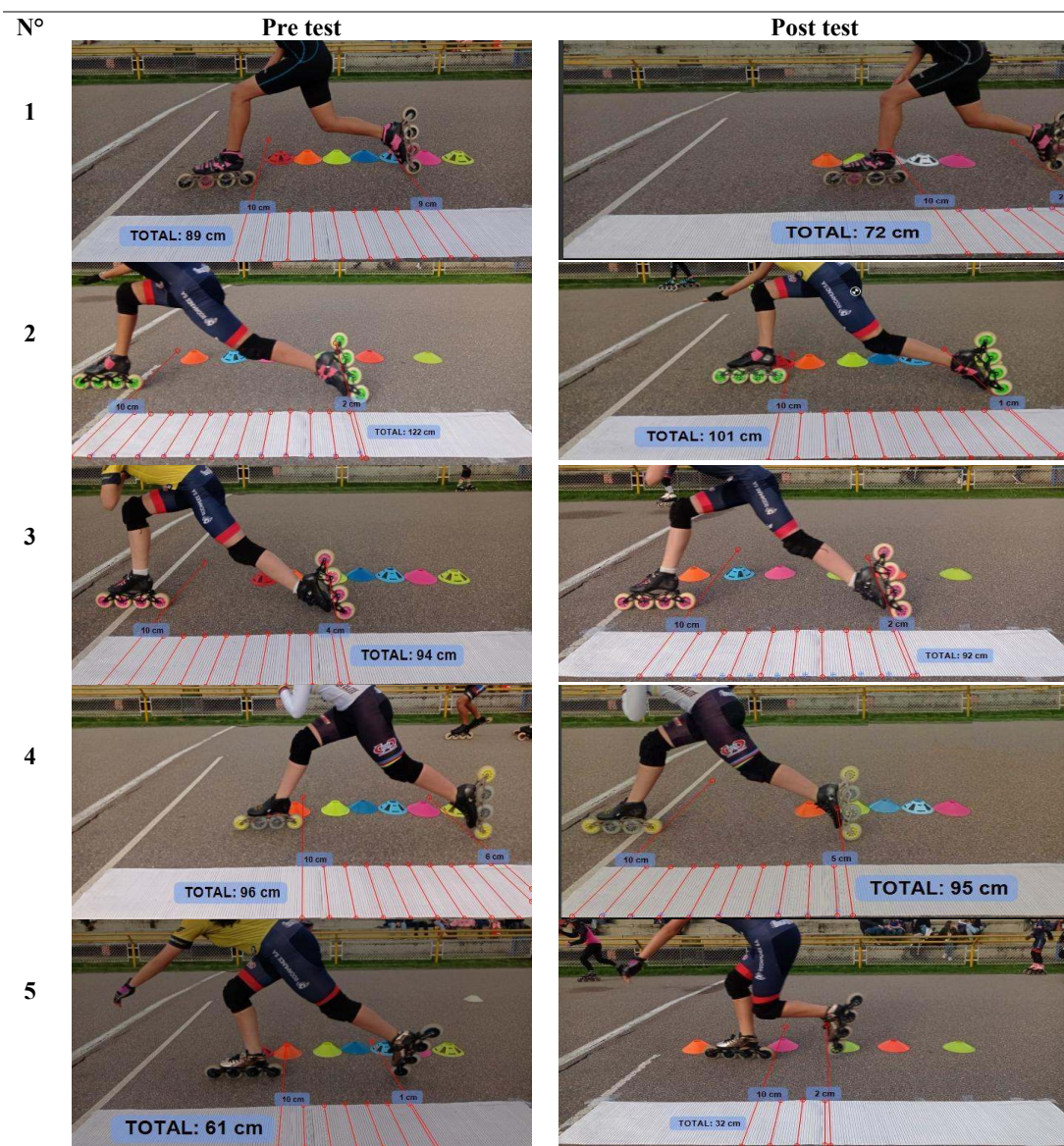
Another correlation worth highlighting is, for example, that between the strength test from Squat Jump and the Sit and Reach test, which have a correlation of 77%, which means that the actions taken to improve the Squat Jump test could positively impact the Sit and Reach test by 77%.

Table 3. Correlation coefficient between the different tests and evaluations performed.

	Correlation Matrix				
	Spagatta Right leg	Spagatta Left leg	Squat Jump	Sit and Reach	Kinovea
Spagatta Right leg	100%	81%	-60%	-60%	77%
Spagatta Left leg	81%	100%	-55%	-62%	75%
Squat Jump	-60%	-55%	100%	77%	42%
Sit and Reach	-60%	-62%	77%	100%	45%
Kinovea	77%	75%	42%	45%	100%

On another point, the correlation between the Squat Jump test and the evaluation of spagatta through Kinovea, is only 42%, which means that perhaps the relationship between Squat Jump and spagatta in movement is not as noticeable or significant as one would expect. The same happens with the correlation between the Sit and Reach test and the Kinovea evaluation, since they have a correlation of 45%, a figure that, although it is perhaps not the expected one, recognizes in 45% the relationship that may exist between the flexibility evaluated with the Sit and Reach test and the spagatta in movement evaluated through Kinovea (see table 3). Finally, figures one and two show the photographic evidence of the before and after of each of the eighteen athletes who took part in the study. Figure one shows the changes from the initial and final evaluation for the control group and figure two for the experimental group.

Figure 1. Difference between the technical basis of the initial and final spagatta of the control group.



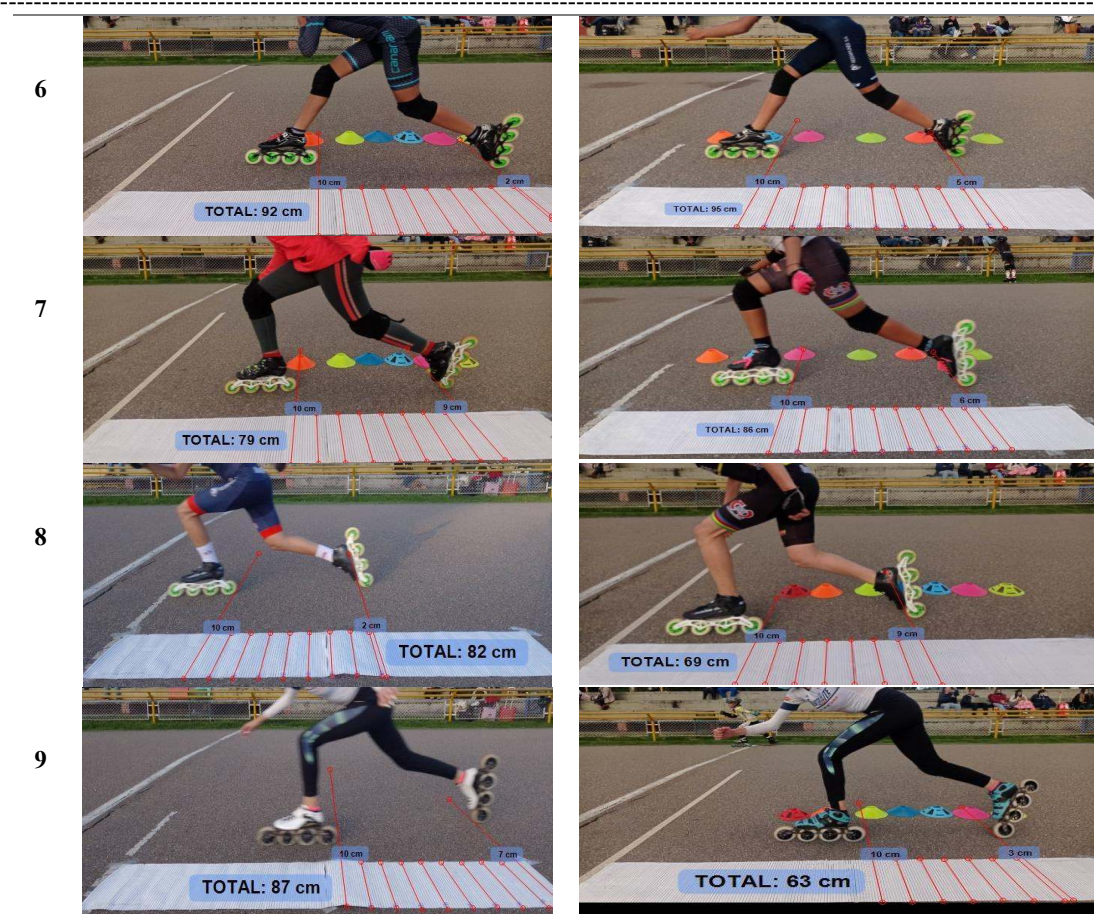
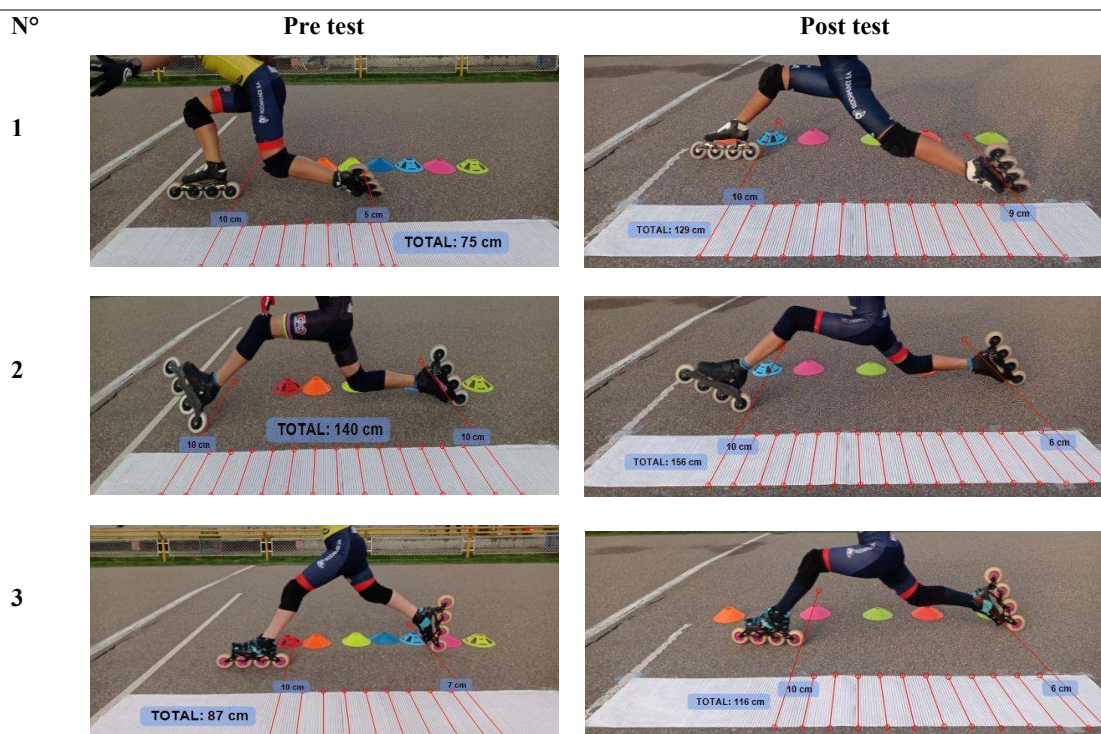


Figure 2. Difference between the technical basis of the initial and final spagatta of the experimental group.



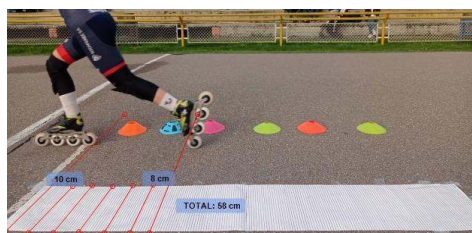
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5



6



7



8



9



Dicussion

From the results obtained within the research project, it can be seen that the implementation of a didactic proposal in the development and improvement of a technique is really important in the integral process of the athlete, as stated by Ramos-Pérez, González Fernández, Burgueño & Morente-Oria (2021) propitiating

didactic units that allow and facilitate adequate learning, is essential when teaching the basic fundamentals of skating (Vila, Guitart, Riera & Díaz, 2007).

Thus, the research developed by Rodriguez, Vera and & Vera (2018) proved that both didactics and methodology from proper planning brings significant improvements, in this research statistically significant changes in speed from a methodological proposal were evidenced. A similar case to that found in the present research where an intervention mediated by a didactic proposal generated significant improvements in flexibility, strength and amplitude of the technical gesture of the spagatta. On the other hand, Blanco (2019) in his systematic review states that speed skating needs a structured training of its physical abilities, where, in turn, these are integrated to the specific technical fundamentals of the sport, for this reason, the present research considered a didactic proposal oriented not only to the stimulation of physical abilities, but, at the same time, considered the specific technical foundation of spagatta, being this dependent on strength and flexibility.

Based on the fact that the development of the capacity of strength is necessary for the execution of the whole movement, we find that González-Badillo & Ribas (2002) relate the greatest relative growth of strength with the maximum peak of growth, between the ages of 12-13 years until more or less 15 to 17 years. From there, we can compare the results obtained in our proposal where it was evidenced that there was a significant improvement in the strength test (Squat Jump) at an age of 12.55 ± 0.68 years. In sum, taking into account this reference age, it is key to highlight that it is necessary to start with controlled progressions, as stated by Afonso et al. (2021) when mentioning that strength has an important role in the future training of the athlete, but it should begin with pedagogical progressions that combine the amplitude of movement with the articular ranges required for that specific gesture. With this, the strength program at these ages must be properly structured and adapted from the didactics, given that, as stated by Peña, Heredia, Lloret, Martín & Silva-Grigoletto (2016), the stimulation of strength should prioritize coordination work that aims not only to improve muscle strength, but the set of basic motor skills. In this case, relating physical abilities with technical fundamentals, for this reason, the didactic proposal of the present research considered such methodological guidelines for the stimulation of strength and coordination. On the other hand, some authors agree that the stage of greatest trainability or sensitive phase of flexibility is between 9 and 14 years of age (Alter, 2004), being diverse the methods for its stimulation. By virtue of this, the Sit and Reach test was used seeking to measure flexibility, since, according to Carrasco, Sanz-Arribas, Martínez-de-Haro, Cid-Yague & Martínez-González-Moro (2015) this test linearly measures the force result generated by the agonist muscles that are requested and, at the same time the antagonist muscles that are opposed. Thus, the results found in the present study reveal that the correlation between the Squat Jump and the Sit and Reach test is 77%, suggesting that the actions performed to improve in the Squat Jump Test could positively impact the Sit and Reach test and the Sit and Reach in the squat jump test.

The study conducted by Montealegre (2018) on the anthropometric profile in Colombian skaters, states that the athletes who participated in this study do not present good aerobic and anaerobic power, just as in which a lack of flexibility is highlighted, capabilities that directly influence sports performance and the execution technique of the basic fundamentals of skating, taking into account that it is a primordial factor to improve the range of motion and to prevent injuries. For this reason, one of the conclusions of the present study reveals that a structured didactic proposal on strength and flexibility can favor the development of technical fundamentals in skating athletes. In the same sense, the Kinovea software has been used mainly to analyze human movement in sports settings, especially to determine the reliability and validity in the analysis of spatiotemporal parameters (Fernández-González et al., 2022). Also, in 2019 a study was conducted by Puig-Diví to validate this software in the measurement of distances and angles from different perspectives, to which the results showed that Kinovea is reliable when measuring from a perspective of 90° to 45° and with a distance of 5 meters between the camera and the recorded object. The present study, performed the measurement of the distance in the amplitude between the last wheel of the front skate to the first wheel of the rear skate executing the technical gesture of the spagatta, this shot was made from a perspective of 85° and at a distance of 1 meter between the camera and the recorded subject, yielding equally reliable results by allowing from the utilities of the software to count centimeter by centimeter the total distance in the amplitude of the gesture of each subject. In conclusion, with the results found in this research regarding the didactic proposal to improve the technical foundation of the spagatta and in relation to the other studies analyzed, it can be determined that there are several factors that can influence the learning and teaching of a technical gesture in speed skating, so it should take into account the sensitive stage of the athlete, the category, the level of expertise in the sport, the objectives and the ability of the athlete to learn and understand all the different manifestations of an action at a given time.

Conclusions

In relation to the objective established for the present research, significant differences were found for each of the variables under study, related to the spagatta front right leg test $p=0.000$, spagatta front left leg $p=0.000$, Squat Jump $p=0.004$, flexibility in the Sit and Reach test $p=0.001$ and in Kinovea $p=0.000$ to measure the technical foundation of the spagatta. With this, it can be determined that the didactic proposal proposed, applied in populations similar to the one intervened in the present study, guarantees that the technical gesture of the spagatta will be effectively improved in the skaters.

The relationship between the evaluation of the spagatta in movement and the flexibility tests reveals that this physical capacity is extremely influential if the intention is to improve the spagatta in skaters because the amplitude of the articular ranges is directly proportional to the amplitude in the execution of the spagatta. However, the Sit and Reach test does not prove to be the most suitable to evaluate spagatta flexibility because of its low correlation with this technical gesture. To evaluate spagatta flexibility, the frontal spagatta test is the most accurate. The effect of the didactic proposal focused on the development of strength and flexibility for the improvement of the technical foundation of the spagatta in skaters of 12 and 13 years of age, was effective, significantly improving strength, flexibility and the amplitude of the skater's technical foundation, thus opening the possibility to continue expanding the research and of course, to approach it from other perspectives with different variables and possibilities, all in favor of education, personal and professional growth and the development of Colombian and world skating.

Recommendations

It is recommended that prior to the application of the didactic proposal, efforts be made to evaluate or improve the motor patterns of the athletes, since they are in a sensitive phase where motor development is still essential for their development. It is even recommended to create a proposal to intervene directly towards the improvement of the motor patterns of 12 and 13 year old skaters. Finally, it is important to highlight the need to continue with the research towards speed skating as a sport discipline and as a lifestyle. Furthermore, to continue research on the technical foundation of the spagatta, because, ultimately, among the four main phases of speed skating, the arrival gesture is the most forgotten and the one that is given the least attention, being perhaps one of the most important and the one that can make the biggest difference in the field of performance skating.

Conflicts of interest

The authors have no conflict of interest

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