Combined plyometric exercises for the reactive strength of a women's soccer team

Abstract

In women's soccer, strength is considered a determining capacity, for which its empowerment is an essential part of the content of sports preparation. Plyometrics combined with technical-tactical actions is important to improve levels of reactive force in the lower limbs of female soccer players (Under-18) in jumping actions to head, challenge the opponent for the ball, sprint in short stretches, stand out with pike and ball interception, as well as in one-on-one duels. Therefore, the objective of the research was to design combined plyometric exercises to improve the reactive strength of the lower limbs of the Villa Clara U-18 women's soccer team. Different methods were used, such as inductive-deductive, documentary analysis, measurement, analysis-synthesis, interview and specialist criteria. Results related to the diagnosis of the levels of reactive force in the lower limbs of the players are obtained, both from the physical point of view and the design of exercises with the combination of levels zero and one of plyometrics in different similar technical-tactical actions. to the conditions of the game. The combined plyometric exercises were structured and the results of the evaluation of the specialists regarding the formal quality and the usability of the proposal are very satisfactory.

Keywords: combined plyometrics, reactive strength, training, Soccer.

Introduction

Sports training is a pedagogical, complex and specialized process that requires an integrating scientific direction of each of the components of the teaching-learning process to obtain sports results (Almeida, 2022). In Soccer as a team sport, movements are executed according to the different game actions. It is a sport in which actions occur with intermittent and discontinuous characteristics where strength plays a fundamental role, which is why it is classified as a team sport with specialized sports preparation content. (Calero, 2019; Arroyo, Cruz and Estupiñan, 2019; Almeida, 2022)

In recent decades, sports researchers have been analyzing the different factors that influence motor learning and sports performance. These investigations have intensified, emerging new proposals for the development of physical abilities and the technical-tactical actions of the athlete, as an alternative to traditional and reductionist methodologies, which conceive the training process, based on repetitive movement patterns in a closed context. (Martin and Camacho, 2021)

In this regard, in team sports, the use of plyometrics has generated wide interest for coaches seeking to increase the performance of physical abilities and the competitive effectiveness of their players (Raya, 2017). Initially it was considered as a training method reserved for athletes at the highest level of competition. However, at present it has been gaining in popularity and effectiveness in the training of lower categories, seen as a dynamic element in the development of strength. Internationally, in the specific case of Soccer, physical trainers and coaches are incorporating plyometric training into their training sessions with good results (Vargas, 2019, Trecroci, et al., 2022).

According to De Pedro (2016), plyometrics is a method of developing reactive force that uses the stretch-shortening cycle of the muscle to increase the force produced by the musculoskeletal system. It also states that there are two types of plyometrics in terms of their aggressiveness on the athlete's joints, low-impact and high-impact, which aim to optimize the athlete's ability to increase strength. Contrary to what has been described above, soccer coaches in Cuba currently see plyometrics from a very reductionist vision, considering it simply as exercises that mainly use the athlete's own weight in different types of jumps.

As a consequence of this, in Cuba, specifically in women's soccer, there are very few works on plyometrics at an early age, since many coaches and methodologists still consider this training method dangerous and detrimental to young or poorly trained athletes, which generates great controversy and a great scientific methodological challenge. Various bibliographies demonstrate the importance of using plyometrics as a satisfactory way to develop reactive strength in athletes. In this sense, there are the works developed by García and Suárez (2019); Harper, Forsdyke and Thomas (2017) and even more specifically the importance of their training in Soccer, is evidenced in the works of Yépez and Ramírez (2019) and Garavito and García (2019).

In this line of thought, research has been carried out on how to enhance the reactive force in youth soccer players, such as those developed by Ramírez et. al., (2018). Based on the criteria of the aforementioned authors and for the purposes of this research, although plyometrics is considered as the cycle of muscle shortening and lengthening in the shortest period of time possible, it is undoubtedly very important with the different levels of manifestation. Of the same.

Hence, it coincides with Vargas (2019) who affirms that combined plyometrics is the result of mixing it with coordination, combining its levels, with transfer of low-impact work and technical-tactical actions. If the context of women's soccer in the Villa Clara province is analyzed, it is currently one of the most prominent sports in the Initiation Sports School (ISS) of the province.

However, from the analyzes carried out by the Provincial Association and the Technical Commission of this sport, in addition to the reports derived from the Methodological Preparations, it was determined that regardless of the competitive result in the School Games, the women's team of the U category -18 years has presented difficulties in jumping to head (offensive and defensive), fighting for the ball with the opponent, sprinting in short stretches, getting clear with a spike and interception of balls and 1 vs 1 duels (offensive and defensive).

All these characteristics reveal the difficulties they present with respect to the insufficient level of reactive force in the lower limbs of the players, despite being a determining capacity of sports performance (García and Suárez, 2019). Being a team where almost all of the players come from the lower category, they have been having difficulties with the strength in the lower body. Hence, the objective of the research was to design combined plyometric exercises to improve the reactive strength of the lower members of the Villa Clara U-18 women's soccer team.

Materials and methods

During the research process, we worked with three populations. A population made up of the four women's soccer coaches of the ISS of Villa Clara, all in a range of between 10 and 20 years of experience and graduates of a Degree in Physical Culture. A second population made up of the 16 technical directors belonging to all the teams participating in the 2020 School Games. We also worked with an intentional sample of 13 players from the ISS Villa Clara women's soccer under-18 team in the year 2020, selected from a population of 16 because they were the players from the Under-15 category and who reached the higher category presenting the aforementioned deficiencies in relation to the reactive force in the lower limbs.

A third population made up of 11 specialists to determine the relevance of the proposed exercises. The specialist criterion was considered taking into account the following

characteristics: having at least 10 years of experience as a women's football coach, having a scientific category of Specialist, Master's or Doctor in Physical Culture Sciences, having worked in women's football for training sports or linked to it in some way for at least 5 years and have been linked to a research project or publication related to the work of strength or plyometrics.

Different methods and techniques were used such as: document analysis, interview and specialist criteria. Methodological workshops and brainstorming were used as research techniques. The investigation went through three stages, the first allowed the systematization of the theoretical-methodological foundations of the investigation.

In the second stage, the objective was to design a proposal for combined plyometric exercises for reactive strength in the Villa Clara women's soccer under-18 team. The diagnosis of the current state of the reactive force of the lower members of the ISS Villa Clara women's soccer team under-18 was made. The interviews were applied to the 4 coaches and different tests and measurements to the players. Subsequently, the proposal was elaborated in correspondence with the results obtained from the diagnosis. For this, we worked with the population of the 16 Technical Directors of the teams from each of the provinces, in two work sessions of the Methodological Workshop within the framework of the 2020 School Games. To achieve a more viable job, we worked with this population divided into 2 groups. One corresponded to the western region (provinces from Pinar del Rio to Villa Clara) and another to the eastern region (provinces from Sancti Spíritus to Guantánamo).

The third stage evaluated the proposal of combined plyometric exercises for reactive strength. For this purpose, the proposal was put to the consideration of the specialists, which they had to analyze from aspects such as: relevance, formal quality, objectivity and importance of the same. It was carried out in a group methodological meeting with the specialists to assess the exercises proposed in the previous phase.

Results and discussion

As a result of the first stage of the investigation, the position of the authors was defined in the theoretical criteria cited by different bibliographic sources with respect to women's

soccer, training planning, physical abilities (emphasizing strength), as well as the plyometrics as a method for its development and assuming the concept of combined plyometrics offered by Vargas (2019).

When verifying the feasibility of combined plyometrics to improve the reactive strength of the lower limbs of U-18 women's soccer players, the four ISS coaches of Villa Clara in the interviews conducted, offered affirmative answers and argued them, based on the characteristics of the players in terms of age and their biological and psychological development.

When analyzing other answers offered, they express the advantages of applying the reactive force based on the game actions for which the players must be well prepared, especially in the lower limbs. They recognized the disadvantage that these have in terms of the age difference with respect to other players and that this work could help to equate their performance patterns.

In the second stage of the investigation, the results of the diagnosis of the reactive force of the lower limbs of the players that were selected were obtained, which is shown in table 1. Here it is important to point out that since there are no other investigations on These players, when evaluating the results with the criteria of the Provincial Association, the averages that were obtained do not satisfy the demands requested for the sub-18 category.

Table 1. Initial state that the athletes have regarding the reactive force of the lower limbs.

# P	S.V (m)	T.D.S.V (m)	S.L. s/i (m)	circumf. thigh (Centimeters)		circumf. twins (Centimeters)	
				Izq	Der	Izq	Der
1	2.08	0.23	1.67	32	33.5	28.4	28.7
2	1.86	0.23	1.38	33.6	34	35.5	35.5
3	2.05	0.23	1.48	34	32	28	27.5
4	2.07	0.24	1.59	30	30.5	30.5	31
5	2.16	0.17	1.53	38.5	39	38.5	39
6	2.28	0.24	1.45	35	35.5	30	30
7	1.94	0.22	1.5	34	34.6	27.2	27.4
8	1.86	0.24	1.4	32.5	33.5	32.5	33.5

9	1.92	0.21	1.54	30.5	31	22.5	22
10	2.08	0.25	1.7	35.5	35.5	29	29.6
11	1.93	0.18	1.45	36	36.5	36	36.5
12	2.04	0.22	1.39	33	34	26.5	25
13	1.91	0.24	1.55	31	31	31.5	31.7
Average	**2.08**	**0.22**	**1.51**	**33.6**	**33.9**	**30.5**	**30.6**

Legend: (T.D.S.V) Total takeoff in the Vertical Jump. (S.V) Vertical Jump. (S.L. s/i) Long jump without impulse.

During the work sessions of the Methodological Workshop, the exercise proposal was designed. The starting point for the determination of the combined plyometric exercises for the reactive force in the lower limbs of the selected players is based on the conceptions raised by Anselmi I and II cited in Labandeira (2014) that raises the work of plyometrics in 4 levels. Levels 0 (zero) and 1 (one) were taken from them for the conformation of these exercises, taking into account the characteristics of the players described in the diagnosis made. The frequency of work must be 3 days a week with a space of 48 hours between one work day and another to guarantee recovery.

Combined plyometric exercises to improve the reactive strength of the lower limbs according to the level of plyometrics.

Plyometric exercises Level 0: They are composed of small jumps made with one foot and both feet with displacement in a distance of 10 to 12 meters, varying the direction and modality for each series. The series are of maximum volume and end with the feeling of fatigue in the calf. The athletes will train barefoot to contribute in this way to obtaining better results in strengthening the muscles of the plantar arch. These jumps will be made from the front and return from behind a distance between 10 and 12 meters for the development of the front and rear muscles of the lower limbs. These exercises will be executed at the end of the workouts. For the work of jumps, the organization will be used basically in which 10 cones or signs will be placed at a distance of 50 cm between them and a cone at each end, preferably of a different color at a distance of 1 meter. Activities to be carried out: front jump with one foot, front jump with two feet and side jump with

two feet. Organization of zigzag jumps: zigzag jumps with one foot and zigzag jumps with two feet.

Organization and content for plyometric work level 0 + coordination.

- Lateral tapping: It will be done to the left and right on the same cones or signals to later enter the jumps.
- Diagonal tapping: It will be done to the left and right, always ending in the center of the signals and then entering the jumps.
- Frontal Rattling: It will be done towards the front and back to repeat the exercise and then enter the jumps.
- Ladder: It will be carried out towards the front with different exercises to later enter the jumps.
- Rope (Switzerland): Small height jumps will be performed on the rope at a height less than or equal to the internal malleolus bone. It can be done with swiss or with the terrain lines to later enter the jumps.
- Quadrilateral: It will be located on the ground and can be drawn with cones or signs 50 cm wide at grass level. The jumps will be carried out uninterruptedly and always returning to the center of the ring to later enter the jumps.
- Organization and content for plyometric work Level 0 (zero) jumps on slopes: The jumps established for the level will be performed, but with the use of an inclined slope.

Organization and content for plyometric work Level 1: For this level, what is indicated in Labandeira (2014) will be used. Each series will count between 8 and 10 jumps. It is convenient to change the exercise every three series to avoid generating overload patterns that can lead to joint pain. Each day of level 1, 3 series of 8 -10 repetitions of 10-15 different exercises are performed. On days of 250 jumps, 8 exercises will be performed, on days of 300 jumps 10 exercises, and on days of 350 jumps, 12 exercises. The weekly jump volume will increase every week since they are multi-hop, which is why the jump volumes are so high.

Table 2. Variation of the volumes of jumps for Level 1

Weeks/Day	Monday	Wednesday	Friday	**Total**
Weeks **1**	300	250	300	850
Weeks **2**	300	300	300	900
Weeks **3**	350	300	300	950
Weeks **4**	350	350	300	1000
Total	1300	1200	1200	3700

Source: Labandeira (2014)

The first day (Monday) is characterized by working on jumps of moderate intensity made with three implements: the rope, the ladder and the ring. Different exercises will be structured according to the recommended amount, performing them with breaks of between 30" and 120" in order to achieve purity of performance, coordination and the minimum possible contact time. On the second (Wednesday) day, a key tool for plyometric work will be used, which are the jumping boxes, with the following standard measurements: 10cm high x 30cm wide and 90cm long. The key exercise of this second day is the prisoner.

For day 3 (Friday) all kinds of multi-jumps are done, with twists, backwards, sideways, the combinations are endless, always with the use of jumping boxes. For the control of the components of the load in the planning, the statements made by Labandeira (2014) are taken as a basis, where it is established that:

- Intensity. It refers to the magnitude of the effort. Plyometric jumps can be divided into different intensities, ranging from the simplest such as jumping rope or on one foot, to overweight jumps in the body. The intensity can also be raised in different ways such as the use of drawers, platforms of different heights or adding previous races.
- Volume. It will be the workload scheduled for a specific period of time such as weeks, months or sessions. The workload will have a direct relationship with the intensity, since the higher the intensity of the plyometric exercises, the lower the programmed volume should be.
- Pause. Plyometric exercises in soccer, like power exercises, are high-intensity exercises that mainly stimulate the nervous system, so ample recovery time will

be necessary between work series. In high-intensity tasks, a longer recovery time (3-5 minutes) will be necessary and in lower intensity tasks, less time (2-3 minutes).

- Frequency and Dosage. Frequency refers to the number of times training is scheduled within a given period, for example, three plyometric workouts in a work week. Dosage refers to how to distribute this frequency throughout the week. An interval of 48-72 between sessions of plyometrics will be optimal and a good warm-up should be done beforehand, activating the central area of the body and the joints. (Front, side, diagonal and back tapping between cones and ladder).

Organization and content for plyometrics work in technical-tactical actions for transfer.

A. Within the technical actions: Pitch, Receptions and deliveries, Starts in fast driving (7 meters).

B. Within the tactical actions: Anticipation and delivery, Head clearance, Head shot on goal, Driving 7 meters hook with center, Shot on goal with the foot.

Description of the content of the breaks according to the working day.

In the Preparatory or Conditioning Period it is proposed:

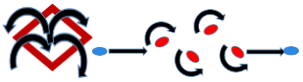
Coordination exercises and level 0 combined with the first day of level 1, both will be worked as established in terms of execution and methodology.

Table 3. Conception of jumps to be used in the Preparatory Period from different combinations.

Combination 1	Combination 2
➢ Plyometric exercises Level 0 + Coordination.	➢ Plyometric exercises Level 0 + Level 1 day 1.
➢ Plyometric exercises Level 0 + Level 1 day 1.	➢ Plyometric exercises Level 1 day 1 on sand and slopes
➢ Level 0 plyometric exercises on slopes	➢ Plyometric exercises Level 1 day 2

Examples of plyometric exercises combined with coordination. Combination 1:

Table 4. Level 0 plyometric exercises + Coordination.

Exercise 1: Lateral tapping with front plyometric jumps  Exercise 4: Diagonal tapping with zig-zag plyometric jumps 	Exercise 3: Ladder with front plyometric jumps  Exercise: Front Plyo Jump Ring with Zig-Zag Plyo Jump 
Exercise 5: Front plyometric jumps on an elevated slope.  .	

Symbology:  Cones or signals.  Quadrilateral plyometric jumps.  jumps

 Displacement. ladder.  rope.  Diagonal

Rattle  Frontal rattling.  Side rattle.

In the Competitive Period:

The combinations of Plyometrics level 1 second day + coordination + transfer to speed or other strength are used through technical-tactical actions, here the volume of jumps and the frequency of level 1 are undertaken. 3 series of 8 -10 repetitions of 10-15 different exercises with rest between series of 30 seconds – 120 seconds. If you do not have the necessary implements, you can perform frontal - posterior and lateral jumps over an obstacle between 15 and 30 cm high and when you fall in the last jump you quickly start the indicated technical or tactical action.

Table 5. Conception of jumps to be used in the Competitive Period from different combinations

Combination 3	**Combination 4**
➢ Level 1 plyometric exercises + Coordination.	➢ Plyometrics exercises Level 1 day 3 + transfer to defensive transitions,
➢ Plyometric exercises Level 1 day 2.	➢ Plyometric exercises Level 1 day 2 + transfer to snatch speed without ball.
➢ Plyometric exercises Level 1 day 3.	➢ Plyometric exercises Level 1 day 3 with transfer to starting speed w/c offensive transition ball.
Combination 5	
➢ Plyometric exercises Level 1 day 3 with defensive actions 1 vs 1 and 2 vs 2 (before dribbling, heading, interceptions or others.	
➢ Plyometric exercises Level 1 day 3 with transfer at the end (knocking on the door).	
➢ Level 1 plyometric exercises on days 2 and 3 with opponent evasion and shot on goal.	

Legend: (S/C) Without and with the ball.

In the following table # 6, examples of polymetry exercises to be developed in Combination 5 are shown.

Table # 6. Example of plyometric exercises Level 1 day 3 with transfer to the end (hitting on the door).

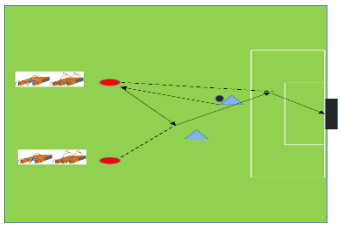


Figure 1. Exercise 1, Plyometric Jumps in Vault Boxes 3 with Transfer to Finish.

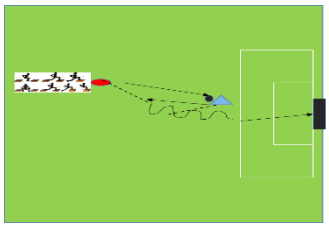


Figure 2. Exercise 2, Plyometric Vault Box Jumps with Transfer to Finish. (1v1).

Symbology:

Defense player. Attacking player. Happens. driving dribble

Movement of the player without the ball.

As a result of the third phase, the criteria of the evaluations made by the specialists were obtained (Table 1). They valued the proposal on the basis of a level of significance established as Very High (MA), High (A), Average (P) or Low (B) which, based on their experience, gave each aspect the following valued aspects. In relation to the Formal Quality criterion, the 11 specialists (100%) give an MA rating to the proposal. Regarding the Importance and Relevance criteria for the development of strength, likewise all the specialists valued it as MA. However, in the Objectivity parameter of its structuring, 9 specialists (81.8%) gave it an MA rating, and 2 (18.2%) gave it an A rating. Therefore, all the ratings offered were between MA and A, which which means a positive assessment of them with respect to the proposal.

The objective of this work was to design combined plyometric exercises to improve the reactive strength of the lower limbs of the Villa Clara U-18 women's soccer team. Justifies the need for them, the results of the diagnosis made to the players where, with respect to the vertical jump, it can be seen that the results are negative, since only 30.8% of the players (4) are above or in the average. This is a value that is interpreted as the possibility of achieving success in the dispute of an aerial ball where it is not possible to exceed 22 cm in height in the jump and must be taken into account as an important indicator to guide the preparation at work. of the strength of the lower limbs in terms of achieving a good competitive result.

The long jump without impulse also exposes the limitations in the reactive force in the lower members of the team, 61% of the players (8) are above average and only 7.7% of the players (1) are in values close to or in the mean. In the circumference of the thigh, both the left and the right, the values obtained show the deficiencies in terms of the physical condition of the players. The results of the measurement of the circumference of the calf show that the highest percentage does not reach the results of the average, which is why they are negative for the purposes of determining the physical condition of these players and therefore the results in the actions of game where they require the quality of the jump with high levels of reactive force.

In Level 0 plyometric exercises, they not only aim at osteoarticular adaptation but also at strengthening the foot musculature and in addition to having proposals aimed at improving coordination and speed (Mocha and Bonifaz, 2016). As a significant element of these exercises, the similarity in movement patterns, necessary energy systems and muscle groups present in the performance of game actions can be mentioned, hence their great utility (Calero, 2019). From the above it can be deduced that the purpose of reactive strength training through combined plyometric exercises in women's soccer is not essentially to build large muscles, as this cannot always be equated with improvements in reactive strength.

On the contrary, reactive strength training should be conceived as an ingredient of great importance for the development of the physical demands of the technical-tactical actions carried out by the players, in order to solve problems in an environment of uncertainty. Thus, reactive strength training should not be developed independently of contemporary trends in the comprehensive preparation of soccer players. The reactive force represents a fundamental ingredient in the technical and tactical actions of soccer executed through the use of accelerations and decelerations, jumping to head, quick changes of direction and shot, duels 1 vs 1 on offense and defense, completion of attacks, actions defenses to avoid the goal, speed in counterattacks, among others (Raya, 2017; Yépez and Ramírez, 2019).

Therefore, in order to maximize the potential of the players, the increases in the reactive force have to be directed towards the specific adaptations of the game (De Pedro, 2016). The highest stride frequency corresponds to the lowest possible contact phase of the leg with the ground and, the highest propulsion, when the leg pushes against the ground to

achieve a powerful forward impulse (Chu & Myer, 2016; Garavito and Garcia, 2019; Vargas, 2019). Therefore, the preparation of the soccer players is revealed, taking into account the contemporary trends of Soccer training in their demand to see the training process in a holistic way, stimulating the use of cognitive development to improve the technical and tactical performance of the soccer player in function of constant improvements in their performance on the court while developing the physical qualities that underpin them.

Finally, it should be noted that the use of combined plyometric exercises for the development of the reactive force of the lower limbs of the soccer players in the sub -18 category of the ISS of Villa Clara is a solution in demand given the existing difficulty. In addition to having as a novelty that they are structured in 5 different combinations of levels 0 (zero) and I of plyometrics with coordination and technical-tactical actions of soccer. These combinations can be planned according to the preparation period in which the team is. This issue is pending to be resolved in the independent practice of the high value level received by the specialists. This research has the limitation that it only remains a proposal, so the practical implementation of these results will continue.

Conclusions

The women's soccer team of the EIDE of Villa Clara, category under -18, presents difficulties with respect to the reactive force of the lower limbs, which present low volume in thighs and calves, increasing the reaction time before the technical-tactical actions of soccer. that limits the achievement of favorable results for performance.

The novelty of the combined plyometric exercises to improve the reactive strength of the lower members of the team studied is that they are structured into 5 different combinations of levels with technical-tactical soccer actions, which can be planned according to the preparation period.

The specialists in their valuations confer a very high level of significance to criteria of formal quality, relevance and importance, also granting a high level of significance to the criteria of objectivity of their structuring, all of which grants their positive validation.

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