

"The 11 +" Warm-Up Program in Female Soccer Players and the Morpho-Physiological Changes Generated after its Implementation

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Abstract

Objective: Use "The 11 +" warm-up program in female players of the National Chilean Sub-17 Football team in order to analyze morpho – physiological variables. The implementation of this training program will generate morpho – physiological changes between players exposed. Federation International Football Association (FIFA) created a training program known as the "11+", designed to amend morpho-functional parameters such as lower extremity alignment, strength, intra, and inter muscular coordination and balance, among others.

Subjects: Information indicates that injuries are a serious cause of concern for the soccer clubs and therefore, it is necessary to introduce the prevention programs.

Methods: 20 female players of the National Chilean Sub-17 Soccer Team, from 14 to 17 years, who trained from March 2017 to January 2018. The "The 11+" warm-up program was considering an independent variable and thigh circumference, jumping ability, speed and balance are considered dependent variables. We use The STATA 11.1 SE (Statistics / Data Analysis) program for the statistical.

Results: After implementing the "The 11+" program, significant changes ($p < 0.05$) were observed in the morphological variables of thigh circumference and functional speed. Concerning the functional variables of jump and balance, favorable but not statistically significant.

Conclusions: Application of the "The 11 +" warm-up program for 3 months in addition to proper training, generated morpho – physiological changes associated with an increase in thigh circumference and an improvement in speed. The practical utility is to improve morpho-physiological characteristics of players in a competitive area and thereby to improve the utility of athletic performance indirectly.

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Introduction

The number of professional and amateur female soccer players has been steadily increasing over the years [9,7].

Soccer is a high intensity and complex contact sport and therefore it is associated with the risk of sustaining injuries during practice. These injuries are associated with a number of consequences for the players and health systems [12]. According to De Loes [8], out of a total of 3,611 athletes from different teams, knee injuries were 3,864, at a total cost of U.S. \$ 4,268,014. The cost per treatment of knee injuries in female soccer players averaged the U.S. \$1,861 per injury. This information indicates that injuries are a serious cause of concern for the football clubs and therefore, it is necessary to introduce prevention programs [8,11].

Studies in professional and amateur female soccer players in Sweden have shown an incidence of up to 24 injuries per 1,000 playing hours and up to 7 injuries per 1,000 hours of training [15].

Analyses of risk factors for soccer players are scarce and a study carried out by Faude [11] sought to identify these factors in elite female soccer players. One of the findings that can be highlighted in the research is the suggestion that anthropometric characteristics are an important indicator when analyzing the risk factors for sustaining an injury. As per the research carried out by the author, ligamentous injuries are the most common; among which the anterior cruciate ligament (ACL) is the most recurrent [8].

The incidence of ACL injuries is higher in women than in men [2]. In soccer, these lesions are commonly seen with a ratio of 9:1, of which approximately 70% of ruptured ACL injuries are not due to contact [2].

In Chile, no record of neither studies nor statistical data on the number of injuries that occur in male and female soccer players have been found. European studies indicate that the application or implementation of structured warm-up programs can contribute to the formation and development of the soccer players to such a point that they would be directly associated to a decrease of injuries [22,23,25].

The Federation Internationale de Football Association (FIFA) created a training program known as the "11+", designed to amend morpho-functional parameters such as lower extremity alignment, strength, intra, and intermuscular coordination and balance, among others [20,22,23,25].

Procedures

A study of a longitudinal, prospective, quasi-experimental, descriptive-analytical nature is considered. The initial sample includes 25 female soccer players of the National Chilean Sub-17 Football Team, which forms a part of the National Association of Professional Football, from 14 to 17 years of age, who trained from March 2017 to January 2018. Written consent as part of the study was applied. The exclusion criteria were as follows: injuries sustained during the implementation of the preventive program which caused the player to refrain from training for 2 or more consecutive weeks and being absent for more than 20% of the training sessions in which the preventive program was applied. According to the previous information, 20 players completed the study. Said players underwent a battery of evaluations before and after the "The 11+" warm-up program was implemented. Some players did not attend the session in which some of the assessments were carried out and due to this factor, the modified SEBT and thigh circumference measurements have not been accurate.

The evaluations that were performed considered morphological parameters by obtaining the thigh circumference (using as a reference base 15 cms. above the upper edge of the patella). The measurement was carried out at both ends with the athlete in a standing position.

In order to assess the functional speed variable, two tests were used: a 10 mt. speed test and a 30 mt. speed test. Two-speed photocells (Globus brand – Ergo Timer model) were used to record the start/stop times. The best time of 3 tests was used and then an average of all the results was taken.

The functional jump ability variable was assessed by 3 test jumps, Abalakov, Counter Movement Jump (CMJ) and Multi-Jump Test. For all tests, a diving platform connected to a recording instrument (Globus-Ergo Tester) was used to record the height

reached by each athlete, and the power of these was obtained for the Multi-Jump Test. For the CMJ and Multi-Jump Tests, the athletes kept their hands at their waist while during the Abalakov Tests, use of the upper extremities was allowed. The best performance out of 3 tests was used, and then an average of all the results was made.

Finally, we used the modified Star Excursion Balance Test (SEBT) for the functional balance variable, which assesses the balance in relation to the lower extremity that is being evaluated. The athlete should be positioned in a monopodal manner on the center of a "Y" drawn on the ground in order to try to reach as far as possible in the different directions that are requested with the extremity that is not supported. The best result of the three tests was used in order to average the results.

The training program applied is known as the "The 11+", consists of performing 15 exercises and the promotion of Fair Play. A soccer ball is required and the duration is 15 minutes. Divided into 3 parts: the first consists of six racing exercises performed at walking speed combined with active stretching and controlled partner contact; the second consists of six groups of exercises that focus on core and leg strength, balance and plyometrics/agility, each with three levels of increasing difficulty; and the last part consists of three racing exercises performed at moderate to high speed combined with change of direction movements.

Statistical Analysis

The STATA 11.1 SE (Statistics/Data Analysis) program was used for the statistical analysis of the study. All the data obtained was distributed in a normal manner. The "Student T" test was used in order to identify any changes in the results.

Results

Players initially evaluated were 25, 5 of them were eliminated from the study due to the aforementioned exclusion criteria. The mean characteristics of the athletes evaluated during the study were: age 15.8 years, weight 56 kilos, height 1.6 meters and BMI 22.5. All the results obtained are shown in the following Table 1.

Discussion

"The 11+" warm-up program has been applied internationally and this study is an implementation on a national scale in order to analyze the results.

In relation to the characteristics of the population under study (weight, height, BMI), there were no significant changes during the 3 months duration of the program.

The soccer players subjected to "The 11+" program for 3 months showed favorable changes in all the morphological and functional variables. Statistically significant improvements in the speed and thigh girth test were observed. Improvements in the jump and balance tests were observed.

Based on the data obtained, it can be seen that there was a statistically significant change in the variable studied after the application of "The 11+", meaning, the thigh circumference increased in comparison to the initial assessment. This change is attributed to the fact that the initial assessment was carried out after the athletes had a rest period (after vacations), which may have had an influence in the loss of muscle mass with the consequent functional atrophy, which was quickly reversed during the time when they were subjected to the warm-up and training program itself.

It is noteworthy to mention that, "The 11+" directly works the strength of the quadriceps and hamstring, and specific functional strengthening exercises [14] are developed. Therefore, both situations that have been described may have had a direct influence on the significant variation of the thigh circumference.

This increase in thigh circumference is associated with an increase in muscle mass (hypertrophy) and thus, greater strength [24]. This condition facilitates greater knee stability during the different external demands it will be exposed to [3] as a result of the different movements that are required during a game (Figure 1). Therefore, greater knee stability would be helpful in reducing the risk factors for non-contact injuries [18].

Based on the data obtained, statistically significant favorable changes were observed in relation to the variable under study after implementing

Table 1. Results Applied Tests.

	Thigh Circumference D°	Thigh Circumference I°	Speed Test 10 m	Speed Test 30 m	Test Abalakov	CMJ JUMP	MULTI JUMP Test	Test SEBT D°	Test SEBT D°
Inicial	47.85 cm	47.25 cm	2.04 seg	4.98 seg	33.96 cm	30.31 cm	28.75 W/kg ²	93.55 cm	93.80 cm
SD	3.31 cm	3.41 cm	0.09	0.2	4.13	3.82	6.77	8.89	7.09
CI 95%	45.94 - 49.77	45.27 - 49.22	2 - 2.09	4.89 - 5.07	32.02 - 35.90	28.52 - 32.10	25.58 - 31.92	88.81 - 98.29	90.01 - 97.58
Final	49.60 cm	49.1	1.8 seg	4.59 seg	34.75 cm	31.79 cm	31.08 W/kg ²	97.88 cm	97.80 cm
SD	2.71	2.69	0.06	0.2	5.17	4.96	6.61	5.98	6.85
CI 95%	48.00 - 51.21	47.55 - 50.66	1.77 - 1.83	4.5 - 4.69	32.32 - 37.17	29.47 - 34.11	27.98 - 34.18	94.69 - 101.07	94.15 - 101.45
<i>p</i>	0.0064 *	0.001 *			0.32	0.089	0.09	0.052	0.07

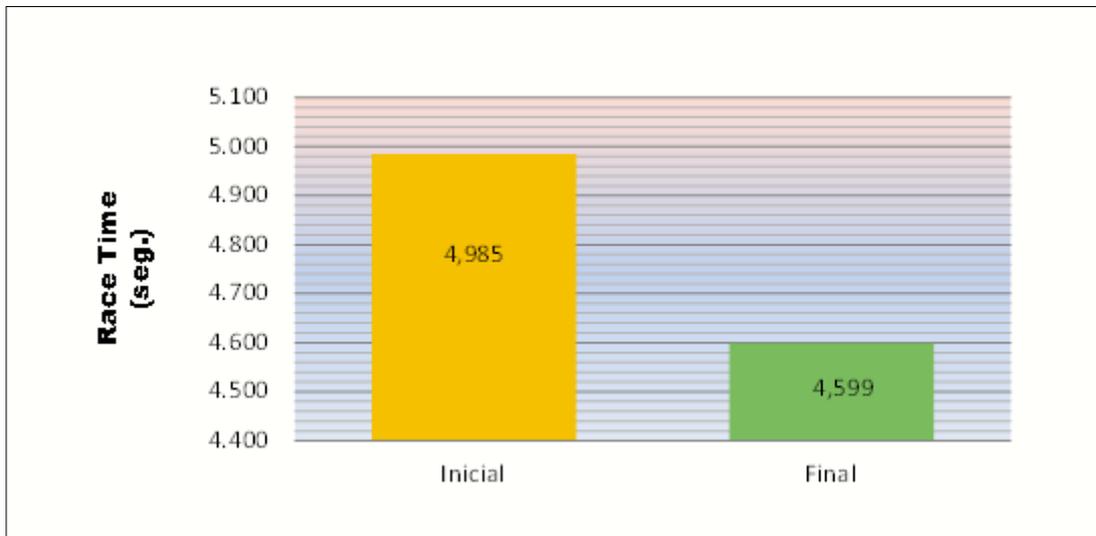


Figure 1. Thigh perimeter results. 14 players were evaluated; the circumference of the right thigh and left thigh were measured during the initial and final phase.

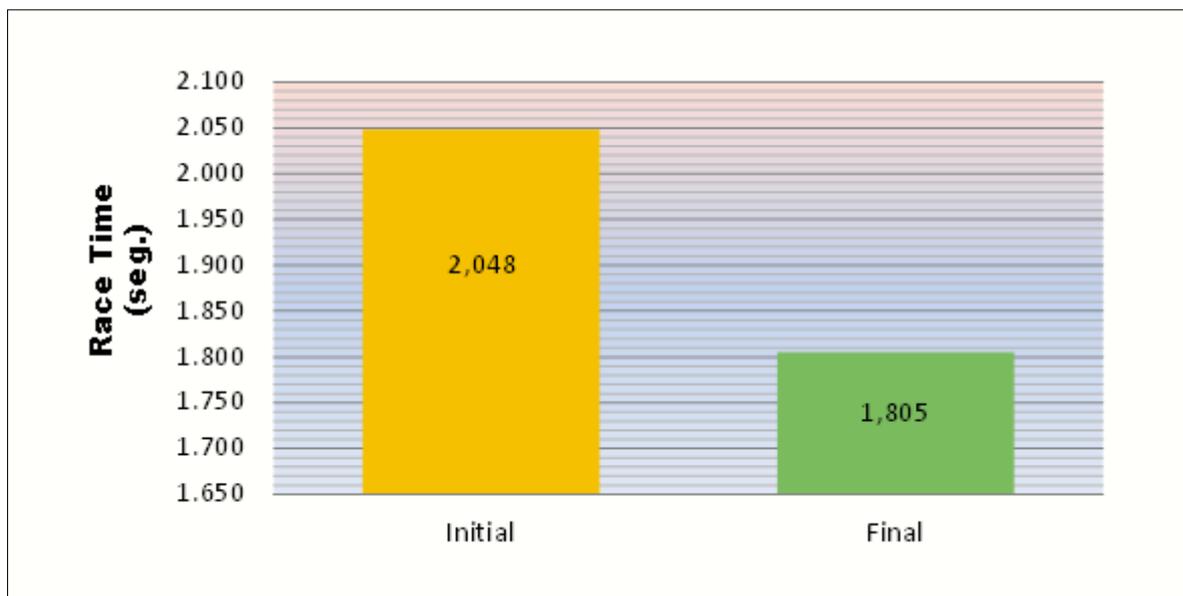


Figure 2. Speed test results. 10 meters. The difference between these averages is statistically significant ($p < 0.0001$).

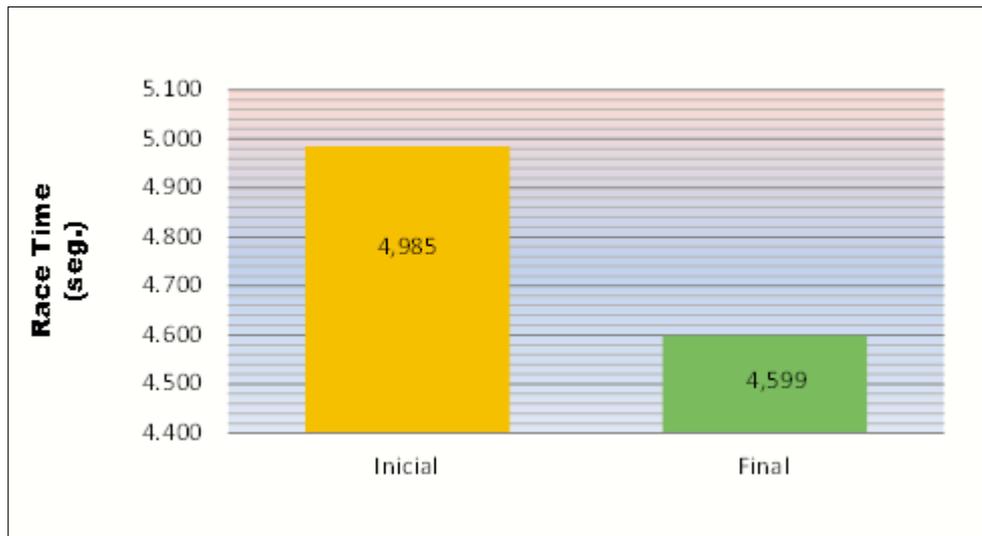


Figure 3. Speed test results. 30 meters. The difference in these averages is statistically significant ($p < 0.0001$).

"The 11+" program, meaning, race times decreased with regards to the initial evaluation. These changes can be attributed to the same reasons discussed in the thigh circumference test since, during a break from training, a decrease in immediate acceleration speed (10 m) and sustained acceleration speed (30 m) is expected (Figures 2, 3).

Nevertheless, it appears that "The 11+" recommends eccentric muscle strengthening exercises for hamstrings and as the strength is increased, the sprint or race becomes more efficient [24], with less energy being used and an increase in the time period before muscle fatigue occurs. It has been shown that eccentric muscle strengthening decreases the risk of tearing [6,16].

It can be seen that there was a favorable change, however, it is not statistically significant in relation to the variable studied after implementing "The 11+".

The structured warm-up program includes among its objectives the development of strength and muscle power in an indirect manner and this can be evaluated through the jump test (functional assessment) [5].

However, the average between the initial and final evaluation improves. The overall trend is towards

improving the jump and thus, the strength and power [5].

According to the literature, there is a correlation between jumping, strength, and power [5], and therefore, if there is an increase in the jump variable, this will bear tribute to the increase in strength and power. As mentioned previously, the improvement of these characteristics affects the stability of the knee, being that the more stable the joint, the lesser the risk of injury.

Moreover, studies conducted by Urabe et al [17,19,26] reported that an increased activation of the quadriceps on hamstrings is a factor that would have an impact on the increase on the risk of a knee injury given that during the post-jump buffer stage, the quadriceps tend to anteriorize the tibia generating an increase in ACL strain, stressing them beyond their capabilities and enhancing their risk of injury. From this, and considering the controversy that exists in the literature stating that the quadriceps is a protective factor against a knee injury [2] or that it can increase the risk of injury of the same [20], it is argued that it is not imperative to only increase the strength of quadriceps and hamstring, but to maintain proper synergy and intra and inter-muscular coordination at the thigh (quadriceps – hamstrings ratio) [2, 20, 21,27].

The modified SEBT corresponded to one of the functional assessments and included in these

assessments was the objective to evaluate balance ability and how the players controlled their knees and ankles.

According to Filipa [13] who analyzes the improvements in neuromuscular training performance in this test, there is a critical value when predicting the risk of injury and its relationship with the score obtained during a modified SEBT. It argues that a distance less than 94 % in relation to the length of the athlete's leg indicates that it is 6.5 times more likely that an injury makes occur in the lower extremity.

From this premise, and considering the previously analyzed results, it can be seen that most of the football players had scores higher than 94% with both extremities during the initial evaluation. Thus, if the players started off with a good performance of the modified SEBT (over 94% in relation to the length of the limb), it can be expected that once the program was applied, there would be no significant changes.

The changes are not attributed solely to the application of the warm-up program but to the combination of the program and the training carried out on a daily basis by the National Football Team.

Junior football players were used as the model in the study and it is unclear whether the results can be generalized to both sexes, other age groups, and other sports. However, similar prevention programs were effective in older athletes [4,1] for both sexes or in other sports [26,10].

Conclusions

The application of "The 11+" warm-up program for 3 months, along with proper training for junior female football players generated morpho-functional changes related with the increase in thigh circumference and improvement in speed.

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Conflict of Interest

We declare no conflicts of interest.

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