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# ORIGINAL

# EFECTO DE EJERCICIOS FIFA 11+ SOBRE EL BALANCE POSTURAL ESTÁTICO EN FUTBOLISTAS

# EFFECT OF FIFA 11+ EXERCISES ON STATIC POSTURAL BALANCE IN FOOTBALL PLAYERS

**Puerta-Mateus, K.[1]; Cortés-Reyes, E.[2]; Cárdenas-Sandoval, R.[3]**

[1] Magister en Fisioterapia del Deporte y la Actividad Física, Universidad de San Buenaventura. Cartagena. Facultad de Ciencias de la Salud. Grupo de investigación Movimiento Humano y Salud (Colombia) kpuerta@usbctg.edu.co

[2] Magister en Epidemiologia Clínica, Universidad Nacional de Colombia, Sede Bogotá. Facultad de Medicina. Departamento del Movimiento Corporal Humano. Instituto de Investigaciones Clínicas. Bogotá D.C. (Colombia) ecortesr@unal.edu.co

[3] Doctor en ingeniería. Ciencias y Tecnología de Materiales, Universidad del Rosario. Escuela de Medicina y Ciencias de la Salud. Bogotá D.C. (Colombia) rpcardenass@unal.edu.co

**Spanish-English translator:** Paola Hoyos, paohoyosm@gmail.com

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## ABSTRACT

The effect of the FIFA 11+ exercises on the static postural balance in young footballers was determined. Twenty young players were included and evaluated using the Romberg test with open and closed eyes on a force platform. The players were randomly divided into a control group (n = 10), who continued their soccer practice sessions and an intervention group (n = 10), who continued their soccer practice sessions and to whom the FIFA11 + exercises were carried out, supervised, during 22 sessions. In the results of the study, no statistically significant changes were found in the Plantar Pressure Center

(COP), the average p-value obtained in two axes was 0.7869 ($p < 0.05$), evidenced by Mann's statistical tests. Withney, Wilcoxon and Kolmogorov Smirnov. The application of the 11+ sports injury prevention program in 22 sessions does not develop significant improvements in the static postural balance.

**KEYWORDS:** Postural Balance, Soccer, Exercise, Athletic Performance, Disease Prevention.

## RESUMEN

Se determinó el efecto de los ejercicios FIFA 11+ sobre el balance postural estático en futbolistas juveniles. Se incluyeron 20 futbolistas juveniles que fueron evaluados usando el test de Romberg con ojos abiertos y cerrados sobre una plataforma de fuerza. Los jugadores fueron divididos aleatoriamente en un grupo control (n=10), quienes continuaron sus sesiones de práctica de fútbol y un grupo intervención (n=10), quienes continuaron sus sesiones de práctica de fútbol y a quienes se les realizaron los ejercicios FIFA11+, supervisado, durante de 22 sesiones. En los resultados del estudio no se encontraron cambios estadísticamente significativos en el Centro de Presión Plantar (COP), el p-valor promedio obtenido en dos ejes fue de 0,7869 ($p<0.05$), evidenciado a partir de las pruebas estadísticas Mann-Withney, Wilcoxon y Kolmogorov Smirnov. La aplicación del programa de prevención de lesiones deportivas 11+ en 22 sesiones no desarrolla mejoras importantes en el balance postural estático.

**PALABRAS CLAVE:** Balance Postural, Fútbol, Ejercicio, Rendimiento Atlético, Prevención de Enfermedades.

## INTRODUCTION

The literature reports on the incidence and prevalence of sports injuries in football are numerous (1), (2), (3), (4), (5). To treat and prevent ankle and knee injuries during sports practice, postural balance training has been used because a poor postural balance, increases the frequency of sports injuries (6), (7) , (8), (9) , (10).

For that reason, in sports injury prevention programs in football, postural balance exercises have been included as a neuromuscular warming strategy, easy to be incorporated into the athlete's regular activity (11). One of these programs is the 11+ exercises that are widely disseminated worldwide by the associations and medical committees attached to FIFA. These exercises seek primarily to maintain the postural alignment, with which a permanent feedback of the state of the posture occurs and a motor learning that allows the adequate postural adjustment is favored, as a component of preparation of a voluntary movement in stressful situations, which contributes to a lower energy expenditure when an exercise is carried out under conditions of great effort, as in the case of football (12).

Applying the Romberg test with open and closed eyes on a force platform by means of a stabilometry test, the static postural balance is quantified (13).The displacements occurred in two axes of movement according to the calibration parameters of the laboratory, X (anterior-posterior) and Z (mid-lateral) during the test can be recorded through a platform of plantar pressure sensors or reaction forces (14).The better postural control a subject has, the less dispersed is the movement of the plantar pressure center or the reaction force vector according to the platform used and the smaller the area that traverses the deviations (13).

The exercises of the FIFA 11+ program have important implications in the prevention of sports injuries, furthermore if by stabilometry it is found that there are greater anterior-posterior oscillations, work is being done to strengthen the plantarflexor and dorsiflexor muscles of the foot, and the extensors and hip flexors; and if there are greater mid-lateral oscillations, it is necessary to strengthen the abductor and hip adductor muscles and foot invertors and evertors (15), (16).

The aim of the present study was to determine the effect of the sports injury prevention program "FIFA 11+ exercises" on the static postural balance in young footballers, comparing a group that did the usual warm-up plus the FIFA 11+ exercises versus a group that performed only the usual warm-up.

## MATERIALS AND METHODS

Study with methodological design of blind clinical trial, randomized controlled. This study was approved by the Ethics Committee Nº113-14 on November 27, 2014 at the Faculty of Medicine of the National University of Colombia.

The sample size was made by means of a deviation analysis of the variable with the formula for differences of mean, it was concluded that 10 athletes were a sufficient size. This sample size allowed concluding on the difference observed between individuals with a level of significance of 5% and a power of the test of 80 % (17).

### Participants

The intervention was carried out by an expert Physiotherapist and by direct care at the facilities of the professional soccer fields in Mosquera, Cundinamarca - Colombia. The recruitment of the participants was between June and July 2015. The call for participation in the study was made through an initial informative conversation with the athletes about the general characteristics of the research. The subjects interested in participating signed up directly with the researcher or the sports coach; subsequently, those who met the following inclusion criteria were chosen: male soccer players belonging to the juvenile category of the Deportivo Expreso Rojo Club, aged between 17 and 20 years, apparently healthy, beneficiaries of the entrance to the training courts in Mosquera. Exclusion criteria were football players with a history of acute musculoskeletal injuries in the lower extremity or surgeries of less than 2 months and a history of

vestibular and visual impairment according to the medical history of each athlete, information provided by the coach to the researcher; inability to attend sessions or refusal to participate; and in the investigator's judgment, any illness or condition that could interfere with the completion of the trial.

25 athletes were contacted, 3 athletes did not meet the inclusion criteria, the subjects who signed the informed consent were randomly divided into an Intervention Group (GI) and a Control Group (GC) by means of sealed envelopes randomly distributed by an independent examiner to the study, assigned n = 11 for GI and n = 11 for the GI. During the process, the loss of the follow-up was systematized for the members of the GI and GC. Finally, the measure of effect was established in those athletes who stayed throughout the study, n = 10 for GI and n = 10 for GC.

**Intervention**

The intervention lasted two months, in order to guarantee the standardization of the procedures, the participants were summoned to the Digital Biomechanics Laboratory located in Bogotá to a session of familiarization with the different static balance tests prior to the initial evaluation process.In this session they were clearly explained the general objective of the tests, the correct way to perform these and the duration of each of them, so that participants had the opportunity to perform a trial with each of the tests and clarify the doubts that arose in this process.

On the day of the evaluation the participants were given the following instructions: arrive 30 minutes before the scheduled appointment, with sports clothes; that their last meal would have been two hours before the test; not having consumed exciting or stimulating beverages at least 48 hours before the tests; not having done intense physical activity, at least two days before the tests. All participants met these requirements.

In the evaluation data about size were taken, this was recorded with a digital height meter calibrated in centimeters (II and SB, range between 40-600 cm), the weight was measured with the Tanita® floor scale (model BC552, Continental Scale Corp., Bridgeview, III, USA) with a resolution of 0.100 kg., The Body Mass Index (BMI) was calculated by means of the formula: BMI = weight / height 2 (Kg / mt 2 ).The static postural balance was evaluated with stabilometry, which was carried out by two expert physiotherapists, independent of the study. It was executed on a BTS digital force platform, model P-6000. This has 4 more integrated platforms, which allowed placing 4 athletes on each of the platforms. Each athlete, before performing the Romberg test, was asked to stand barefoot on the strength platform only with the team uniform, in bipedal position, according to the anatomical position. To standardize the separation of both feet of 30 cm, the same for the entire study group. Then they were asked to keep their gaze fixed on the video camera for a total of 40 seconds: the test was performed 3 times, with a break in each test of one minute. Then the same procedure was performed with closed eyes.

The FIFA 11+ sports injury prevention program was applied to the GI during a competitive period, which took place in the morning (8:00 a.m.), 3 times a week, for a total of 22 sessions. While the program was applied, no adaptation was made to the 11+ exercises, which always kept the same number of series and repetitions; the suggestions proposed by the program for the changes of levels were respected: the totality of the players went to the next level of all the exercises after 3 or 4 weeks, maintaining the body alignment in the same way as it is officially proposed.

The usual warm-up always started at 8:00 in the morning, with a total duration between 20 and 30 minutes; was directed by the team's trainer, and composed of general exercises of joint mobility focused on lower limbs, active and specific or technical stretches. After finishing the 22 sessions, the groups were evaluated by the same blind evaluators using the same equipment and Romberg test.

### Statistical analysis

The data was stored in a database in Excel. Once typed, the processing and analysis of the information was carried out using the statistical program R-project. Non-parametric tests were used to determine the homogeneity of the data, for qualitative variables the Chi-Square test and quantitative the Levene test, with a P-Value <0.05. The effects of the intervention were evaluated with the Mann-Whitney test for comparison of two populations using independent samples, and with Wilcoxon for comparison of means for paired data. In addition, it was proved by means of the non-parametric test of Kolmogorov Smirnov if the POST measurements of the two groups could be considered to come from the same population; the methodology used in the calculation of confidence intervals was bootstrap or resampling.

## RESULTS

Table 1 shows the general data of the study population, which shows that the average athlete was 19 years old, average weight of 67 kg, average height of 1.76 m and an average BMI of 21,6 kg / m 2 cataloged in normal weight range .According to the characteristics of the study population, the hypothesis of homogeneity of groups is not rejected, from which it can be assumed that the GC and GI did not present significant differences to evaluate the effects of the intervention.

**Table 1.**Characteristics of the study population. The data of the variables are presented as mean ± standard deviation

| Variable | GC (n=10) | SD | GI (n=10) | SD | P-Value |
|---|---|---|---|---|---|
| **AGE (years old)** | 19 | 0,96 | 19 | 1,17 | 0,2654 |
| **WEIGHT (kg)** | 68,1 | 5,64 | 65,9 | 8,50 | 0,4526 |
| **SIZE (m)** | 1,75 | 0,06 | 1,76 | 0,06 | 0,9555 |
| **BMI (kg/m$^2$)** | 22,04 | 1,11 | 21,16 | 1,86 | 0,0674 |

SD = standard deviation.

The descriptive analysis of the main study variables: anterior-posterior and mid-lateral displacement.The variables are called X and Z respectively, see table 2. In the intervention group for the anterior-posterior and mid-lateral displacement, a better control of the static postural balance in the post-intervention is appreciated because the deviations of the vector of reaction force are lower compared with those of the pre-intervention displacement. That is, the dorsiflexor, twin, soleus, posterior tibial, peroneus lateral short and long muscles; gluteus maximus, psoas iliacus, gluteus medius and hip adductors, maintained a better control in the postural balance of the group of athletes who performed the 11+ exercises during the bipedal position.

**Table 2.** Average results of the anterior-posterior and mid-lateral displacement

| Measurement | PRE_X | POST_X | P- Value | PRE_Z | POST_Z | P- Value |
|---|---|---|---|---|---|---|
| **GC (mm)** | 8,80 | 8,25 | 0,8457 | 1,18 | 1,17 | 1 |
| **GI (mm)** | 7,40 | 0,48 | 0,2754 | 7,49 | 3,00 | 0,625 |

PRE = pre-intervention; POST = post intervention; X = anterior-posterior displacement; Z = medial-lateral displacement; mm = millimeters; p-value <0.05.

In relation to time, the anterior-posterior displacement presented a greater change in the static postural balance compared with the measurements of the mid-lateral displacement after intervention for both the GI and the GC, see figures 2 and 3.This is due to the fact that, when the measurement strategy is performed with a static and stable posture, in which the disturbances are small, the stabilization means is made through the ankle joint with the dorsiflexor, twin and soleus muscles, reflecting in the stabilometric measurement lower anterior-posterior oscillations. In addition, it is of clinical importance since it is recognized that the more the body is aligned, the less energy it requires to maintain its postural balance, and the lower the oscillations of the center of pressure the better the execution of postural control (14).

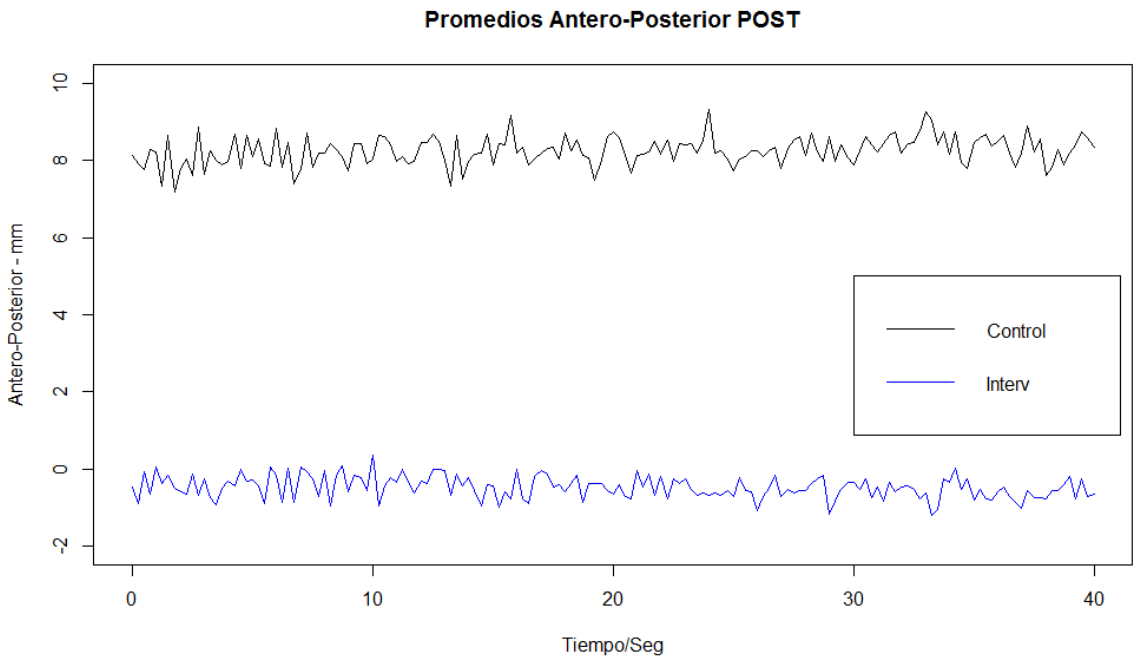



**Figure 2.** Relationship Time vs. POST Groups Anterior-Posterior Displacement

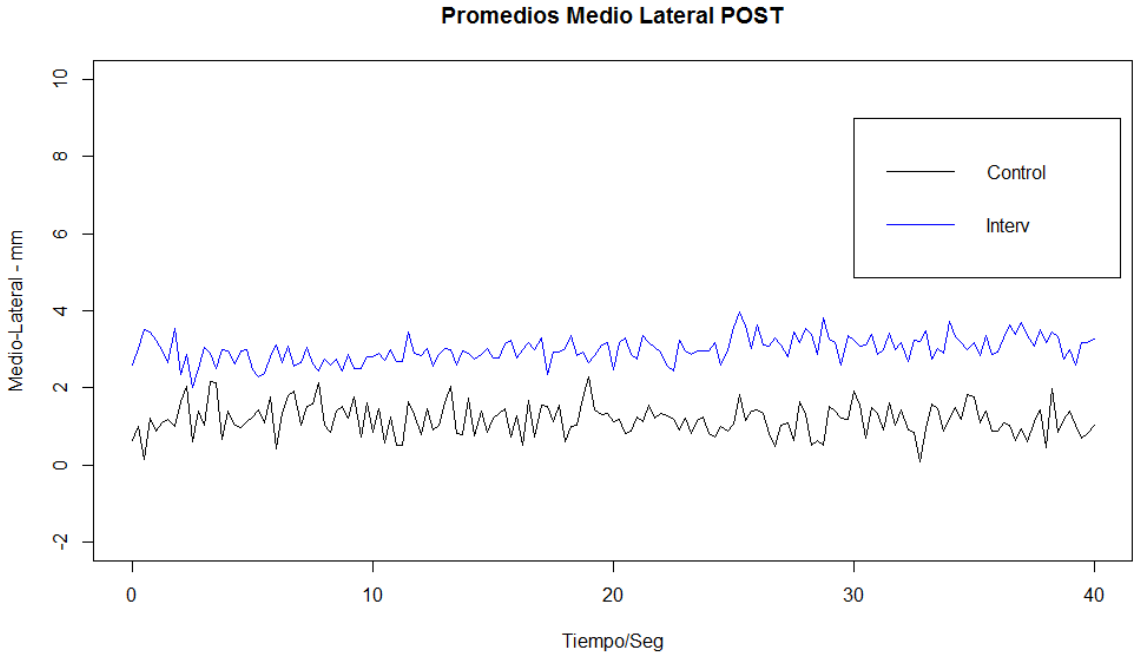
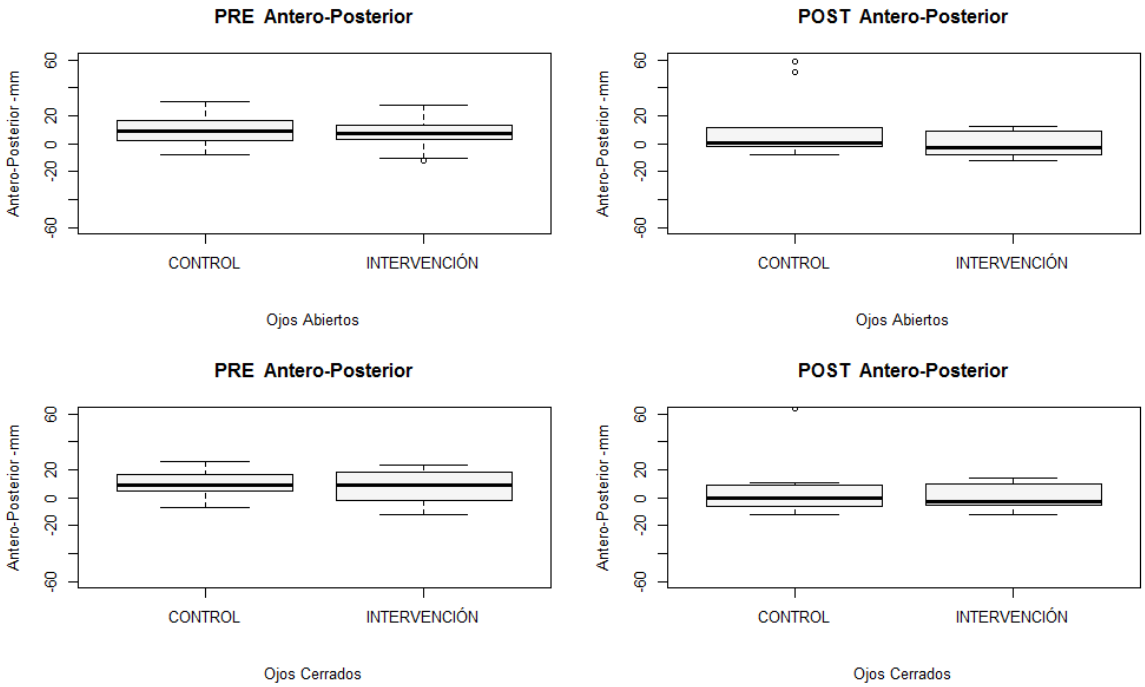



**Figure 3.** Relationship Time vs. POST Groups Lateral Displacement

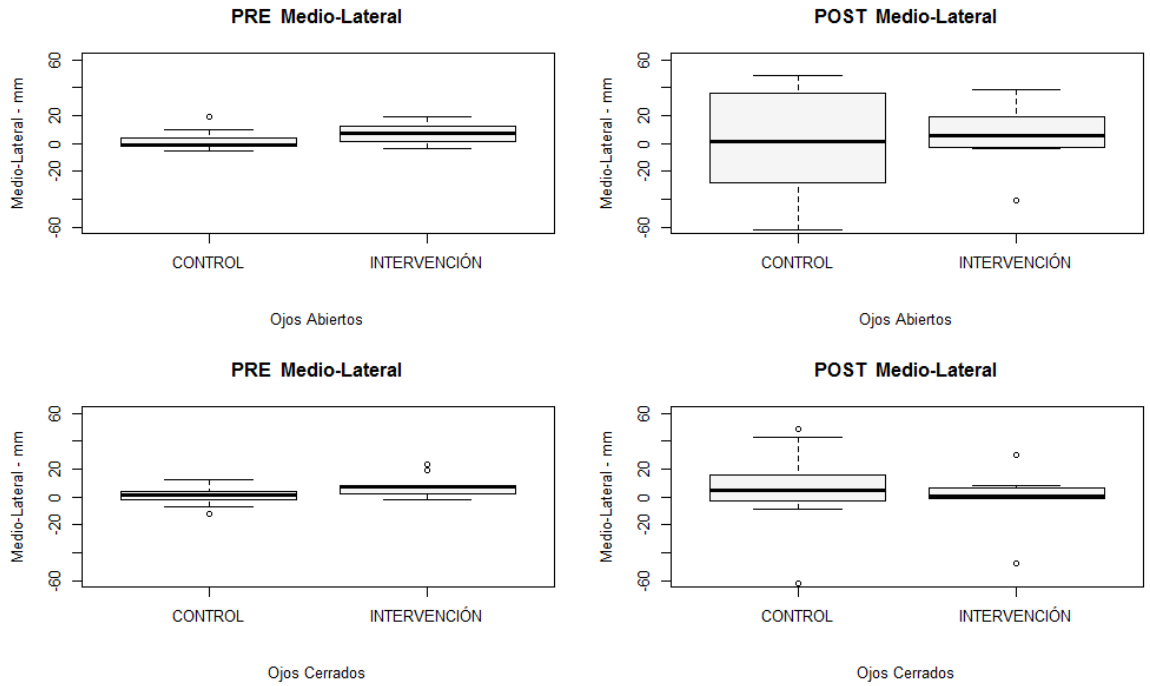
Despite the clinical importance in the static postural balance in the players who performed the 11+ exercises, it was evidenced from the results of the statistical test, that there are no significant differences in the values of the Anterior-Posterior and Mid-Lateral variables in the GC and the GI (table 2), that is, that the FIFA11 + exercises do not significantly improve the static postural balance in young footballers. In Figure 3, comparisons are observed in the anterior-posterior displacement with open eyes and with closed eyes, a better control of the static postural balance both for the control group and intervention when compared with the measurements made at the beginning of the study. In Figure 4, comparisons of the mid-lateral displacement are observed, in the post-measurement with open eyes the control group decreases its equilibrium; different is observed in the intervention group that improves it. In the control group with closed eyes, no changes were observed in the static postural balance when compared to the PRE measurement, but for the intervention group the static postural balance in the medial-lateral displacement with closed eyes does improve.

## Comparative graphs Anterior-Posterior displacement PRE vs POST




**Graphic No. 3.** Comparative Anterior-Posterior Displacement PRE vs. POST

## Comparative Graphs Mid-Lateral displacement PRE vs POST




**Graphic No. 4.** Comparative mid-lateral displacement PRE vs POST

However, although there are no statistically significant improvements, it can be observed that sports training improves the ability to use the somatosensory system and otolithic information, which improves postural abilities. In the present study, greater improvements were observed in the anterior-posterior

displacement with open eyes with greater predominance in the GI and with a greater proportion with closed eyes than in the GC, when compared with the medial-lateral displacement.

## DISCUSSION

To evaluate the effect of a program of prevention of sports injuries "exercises 11+" on the static postural balance in young players of the Club Deportivo Expreso Rojo, there were no statistically significant differences, however, there was a clinical importance due to the improvements in the static postural balance in the group of athletes who performed the 11+ exercises.These results are consistent with that reported by Bizid and Paillard (2006), who when measuring the static postural balance did not show any significant difference between the mid-lateral and anterior-posterior movements evaluated with open and closed eyes comparing the differences between players with offensive and defensive position in ages between 18 and 30 years old (18).

Similarly, the study by Pau et al (2015), reported that no significant differences were found between young and professional soccer players within the parameters of static and dynamic postural balance except for displacements of the plantar pressure center in the direction anterior-posterior (19).In our study, it was observed that the anterior-posterior displacement was the one that presented the greatest improvement of the static postural balance.

A possible explanation to the above may be due to the fact that the significant improvement in the quality of postural stability is associated with the decrease in the incidence of oscillation of low swing frequency, it is believed that this is probably due to somesthetic evaluations and less to a causal relationship (20 ).That is, the changes are reflected more if the plantar surface at the time of measurement is exposed to greater disturbances, for example, on an unstable surface, with unipodal support; in other words, the stance is stabilized more efficiently at higher swing rates (21), (22) and not so much the design of postural balance programs.

This was evidenced in the study by Gioftsidou et al (2012) .In which the measurements were performed with high swing frequencies, ie on a mobile force platform, with a unipodal support test, the results showed significant differences ($P < 0.05$) in the mid-lateral and anterior-posterior oscillations. It should be noted that in the Gioftsidou et al study, the training was specific in postural balance exercises using unstable surfaces for 20 minutes, 3 times a week for 6 weeks or 6 times a week for 3 weeks in professional players with an average age of 22 years old (23).

Two studies were found that measured the effect of the exercises of the 11+ program on the static postural balance through the use of stabilometric measurements, being a high-tech tool that yields accurate values of the anterior-posterior and mid-lateral oscillations of the plantar pressure center .One was performed in female soccer players (24) and another in male soccer players, but for unipodal static postural balance (25).

The limitations of this study should be highlighted, one of which is that most of the studies on postural balance in soccer players are analyzed only standing on static force platforms, software systems equipped with mobile force platforms would be needed to acquire information about the most dynamic conditions, similar to those found in real matches or training sessions (22). And the other is to increase the number of sessions performed.

## CONCLUSIONS

The application of 22 sessions of a sports injury prevention program "FIFA 11+ exercises" does not significantly improve the static postural balance with and without visual feedback with respect to the usual warm-up. When characterizing the impact of the static postural balance in the athletes evaluated from the analysis of the results obtained from the stabilometer, the displacement that presents greater improvements is the anterior-posterior.The greatest differential effects of the interventions between the study group and the control group are observed when the oscillations or anterior-posterior and mid-lateral displacements are analyzed in relation to time. This allows to reaffirm the importance of feedback in the sportsmen on the correct use of the posture and the good control of the body, keys to improve the conscience on the corporal alignment and the stability in the knees, the ankles when standing, running, jumping and landing.

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