



## THE VERTICAL JUMP HEIGHT OF SOCCER PLAYERS AFTER STATIC OVERSTRETCHING

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### ABSTRACT

**Purpose.** The purpose of this study was to assess the effect of static overstretching on performing a vertical jump. **Methods.** A methodological model was used, using descriptive and comparative methods on 45 randomly selected under-15-year-old male soccer players. Three jump test measurements were taken over a period of several days, where the first measurement included a pre-test in order to familiarize the athletes with using a contact mat, where maximum vertical jump height was recorded as a control. The second measurement had the athletes perform a vertical jump after static overstretching of the lower limbs. The third test had the athletes perform another vertical jump with no overstretching as another control. **Results.** The results found a significant difference in vertical jump heights ( $\Delta\% = 34.1\%$ ,  $p < 0.05$ ), with jumps performed after static overstretching to be much lower. **Conclusions.** The usage of such a static overstretching method negatively influences the vertical jump within the tested group of under-15 male soccer players.

**Key words:** soccer, overstretching, vertical jump

### Introduction

Soccer is a sport where performance is based on the proper development of a set of factors, among them flexibility. Flexibility depends on both muscular elasticity and joint mobility, and it is represented by the maximum amplitude of the necessary movements that are needed, in this case, to optimally perform in a soccer match [1]. Feland et al. [2], mention two distinct methods that can be used to promote flexibility, where both methods are directly influenced by the joint-amplitude ratio. When the movement amplitude is submaximal, there is a total use of the movement arch and this movement is known as stretching. When the movement amplitude is caused by an outside force, the expanded arch achieved by this movement is called overstretching.

Stretching, in itself, has become an increasingly controversial topic over the last few years regarding its practical application. However, the classical recommendation of stretching before and after physical exercise is still upheld as fact [3]. Nonetheless, many studies have shown conflicting and even opposing results regarding the use of stretching as a protective remedy against lesions [4–10], in reducing muscle soreness post-exercise [7, 11] and the benefits it has on increasing performance, particularly with producing maximum power and muscular strength [3, 10, 12–18].

In this regard, muscular power, strength and velocity are important physiological characteristics for soccer players, as they are required to perform numerous jumps, sprints and kicks [19]. In particular, the muscular power of the lower limbs is significantly connected to vertical jump height as well as sprint performance, in terms of velocity [19, 20].

Several studies on the effects of flexibility on muscular power have already been performed, finding a correlation between static overstretching and strength reduction, but whether this reduction in strength could have an impact on the performance of a vertical jump is unknown. Therefore, the purpose of this study is to assess the acute effect of static overstretching on vertical jump performance. It was decided to first question if there is in fact a reduction in vertical jump height after a period of static overstretching, and if so, if the reduction could be considered significant.

### Material and methods

A descriptive, comparative study was carried out on 45 male soccer player volunteers, with a mean age of 14 years ( $\pm 0.66$ ). The subjects were randomly selected among the nine clubs that participated in the under-15 Rio de Janeiro State Championships in 2009, in which took part a total of five hundred soccer players.

In compliance to Resolution 196/96 of the National Council of Health, the guardians of the participating soccer players in the study signed an Informed Con-

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sent Waiver and their clubs provided their consent in an Institution Information Form. The project was approved by the Ethics Committee of the Castelo Branco University under study number 0178/2008.

The vertical jump (VJ) was performed on a Jumptest contact mat (Hidrofit LTDA, Brazil) which had been previously validated by Ferreira et al. [21]. The contact mat determines the jumping height by an athlete's jump air time, using the equation:  $height = 1/8 gt^2$ , where  $g$  is the acceleration of gravity ( $9.81 \text{ m/s}^2$ ) and  $t$  is the flight time in the air (s). A photoelectric system of receptors that respond to light, found within the jump platform, counted the flight time from the moment the athlete left contact with the ground.

Three separate vertical jump measurements were taken over a period of 48 hours in order to not influence the results. All of the test volunteers received instructions about the procedure and participated before each jump with a 10 minute warm-up, which constituted of a run that included small sprints and jumps over obstacles. At the end of the warm-up, each volunteer performed three jumps, where free movement of the upper limbs was permitted, with a minimum interval of 45 seconds between each of the jumps. Only the highest recorded result was considered in the study

On the first day of the experiment a medical questionnaire was given and anthropometric measurements (height and body mass) were taken to check for sample homogeneity. In addition, the soccer players performed a pre-test jump on the contact mat in order to become familiarized with the procedure.

On the second day the first vertical jump test was performed without static overstretching (VJ PRE), with the procedure as stated above. On the third day the vertical jump height was assessed after performing static overstretching (VJ STATIC). The static overstretching method used in this test was as follows: The test subject slowly reached their flexion limit, noted by approaching their pain threshold, with one of the study's researchers then smoothly forcing the joint beyond this limit for six seconds, then increasing the tension again in order to reach the highest possible movement arch beyond the pain threshold. This position was then held for another 10 seconds. This overstretching method was performed another three times with a rest interval of five seconds between each stretch. Six different static overstretching exercises of the lower limbs were performed. The chosen exercises were, in a seated position: (1) hip and lumbar flexion; (2) flexion of the hip and lumbar spine with the hip abducted with knee flexion, once for each side; (3) hip abduction; then in lateral decubitus position: (4) knee flexion, once for each side; then in a standing position: (5) hip and lumbar flexion with open legs; and finally, in a crouching position (6) abduction of the hip and arms between the legs holding the ankle.

The third and final vertical jump height measurement (VJ POST) occurred 48 hours after the VJ STATIC test was performed with the purpose of assessing whether the vertical jump could be used as a re-test procedure. This was done in order to evaluate if there was a difference among the initial non-static overstretching jump height results.

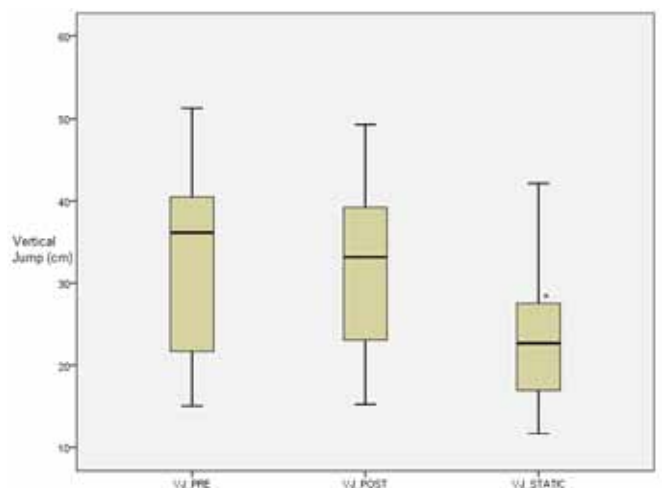
All statistical analysis was calculated using SPSS Statistics ver. 18.0 statistical software (IBM, USA). The Kolmogorov-Smirnov test found that the data could be represented by the Gaussian probability distribution function (at  $p > 0.05$ ). For analysis of the difference between the means of the data groups, ANOVA was used for repeated measures as well as the Post Hoc Bonferroni test. The confidence level for all tests was set at 0.05.

## Results

Figure 1 shows the values of the VJ STATIC measurements, which were found to be 34.1% lower than the jump height at VJ PRE, while VJ POST finds jump height to be 5.3% lower than at VJ PRE. In addition, when the means were compared by using inferential statistics (ANOVA for repeated measures), a significant difference was noted among the results ( $F_{1,205} = 70.258$

Table 1. Characteristics of the tested soccer players ( $n = 45$ )

	Weight (kg)	Height (cm)	BMI (kg/m <sup>2</sup> )
Mean	59.47	168.36	20.95
Standard deviation	± 6.47	± 7.39	± 1.42
Minimum	48.6	152	18.14
Maximum	78.1	188	25.5
Standard error	0.97	1.1	0.21
Coefficient of variability (%)	10.89	4.39	6.80



In this figure the mean and standard deviation of the sample is presented.

Figure 1. Average of the vertical jump heights after overstretching using the static method in young soccer players

and  $p < 10^{-5}$ ). In order to identify which groups were different, the Bonferroni Post Hoc Test was used and found a significant difference in the measured values ( $p > 0.05$ ) when comparing VJ PRE and VJ STATIC but did not find a significant difference ( $p > 0.05$ ) when comparing VJ PRE to VJ POST. These results found that static overstretching does in fact influence an athlete's vertical jump, especially in this case of under-15 male soccer players.

### Discussion

An explanation for the results could come from the duration and intensity of static overstretching, which could be long enough to stimulate the Golgi tendon organs, reducing agonist muscular action and could explain the difference in the vertical jump heights. This could be intense enough to produce a laxity of the plastic components which then generates a higher contraction time during the concentric phase of the jump [13]. The mostly soft muscle-tendon system would have a rapid period of decreasing length with an absence of overload, dislodging the contractile component to a less favorable position for power production [22]. Also, according to Cramer et al. [13], there is a possibility that static overstretching can act on the Golgi tendon organs and cause the release of an inhibitory neuromediator in the spinal marrow, reducing power.

Behm et al.'s [23] study on 12 physically active men found a decrease in strength after passive and static stretching of the quadriceps. Five sets of stretching were performed, each for 45 seconds. The tests consisted of three maximum isometric contractions of the quadriceps, performed before stretching and then six and ten minutes afterwards. It was found that the maximum contraction rate reduced by 12.2% after stretching. Behm et al. also concluded that, instead of making the muscle-tendinous unit more complacent, stretching reduced maximum contraction due in part to muscular inhibition. This conclusion also seems to be applicable in this study. Although the measurements of Behm et al.'s study were taken at larger time intervals than the ones used in this study, it can be determined that the results of this study are credibly representative due to the intensity of the static overstretching.

This study found, when compared to the previously mentioned one, a shorter muscle-tension time, but where a higher muscle-tension was imposed. It can suggest that the decrease in the vertical jump height is related to the imposed tension of the muscle during static overstretching. Altogether, several factors can influence strength after stretching, such as increasing muscular extension and reducing muscle-tendinous rigidity, which can influence contraction due to the necessity of a higher performance time of contraction strength based on the higher laxity of the muscle's elastic components [24].

However, one of the limitations of this study was that the phase of muscle tension was not performed more gradually and slower, which could therefore ensure that this tension would be significantly higher, as was in other studies.

### Conclusion

It can be concluded that static overstretching influences vertical jump performance, as based on the group of tested under-15 male soccer athletes, and the differences were found to be significant. Even though the control results (VJ PRE) presented different values than the post-control values (VJ POST), this difference was found to be not significant and can even be considered as a variance of the test itself. However, we recommend future studies take into consideration a different number of series as well as different durations and intensity of the measured performance benchmark, including a sample population different from the subjects used in this study.

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