Comparison of a Time Efficient to Standard Stretching Protocol for Short-Term Flexibility Improvements

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ABSTRACT

Marucci R, Heck A, Ferraro E, Kudrna R. Comparison of a Time Efficient to Standard Stretching Protocol for Short-Term Flexibility Improvements. JEPonline 2016;19(5):49-58. The purpose of this study was to compare the effectiveness of a short-term flexibility protocol to a standard stretching protocol. Twenty-three healthy college-aged volunteers (18 to 22 yrs of age) were randomly divided into three groups: Experimental (EXP), Standard (STD), and Control (CON). The 5-min EXP protocol involved three stretches targeting chronic adaptive shortening while the 10-min STD protocol consisted of six conventional stretches. Hip flexion measurements with a goniometer, functional double reach test, straddle groin flexibility test, and modified sit-and-reach were used to assess flexibility before and after completed 8 sessions over 2 wks. A Kruskal-Wallis analysis identified a significant difference between groups for overall ranked flexibility improvements (H(2)=7.159, P=0.028). The post hoc Mann-Whitney U Test identified significant flexibility improvements in the EXP and STD groups compared to the CON group, but no significant difference in flexibility between the EXP and STD groups. The EXP stretching protocol improved overall flexibility as much as the STD protocol in half the time. Future studies will need to examine if the time effective protocol yields greater adherence among clients.

Key Words: Adaptive Shortening, Flexibility, Adherence
INTRODUCTION

Not only can stretching be beneficial for athletes and recreational exercisers (6,8), but it can also improve or maintain the joint range of motion (ROM) necessary to perform activities of daily living (ADL) as one ages (13). Furthermore, stretching may enhance both postural and balance, which frequently decline with age (7). Even in young and middle age populations the plague of sedentary behaviors associated with work, transportation, and leisure in our modern lifestyle can have a dramatic and detrimental effect on flexibility and posture at any age (5,9,12). Long periods of inactivity, particularly sitting, increase the likelihood that adaptive shortening will occur, which is best described as an immobilization induced shortening of a muscle. In relation to changes associated with sedentary behavior, the muscles that control posture (9,10,16) are weaker and have less range of motion. Sedentary behavior induced adaptive shortening can contribute to movement dysfunctions that ultimately makes exercise and activities of daily living (ADLs) more difficult (10,16). Regular stretching has long been viewed as the remedy for such losses in range of motion (13).

People often fail to value the benefits of stretching exercises (and regular exercise in general) because of the time commitment. In fact, both are often perceived to be a low priority (15,17). Based upon these perceptions, it is important to determine the most time efficient method of stretching and focusing education on the benefits that are of greater priority to individuals. Previous such research has produced mixed results (3,5). For example, Borms et al. (5) found hip flexibility increased similarly with static stretch durations of 10, 20, and 30 sec for hamstring stretches. In contrast, however, Bandy and Irion (3) performed a similar study with a stretch duration of 15, 30, or 60 sec and found that at least 30 sec was required to improve flexibility. While these studies have contributed to our understanding of stretch, they have not contributed greatly to an understanding of a more time-efficient exercise protocol.

Although there has been a plethora of research regarding the shortest duration a person must hold a stretch to see improvements, little research has been done regarding the careful selection of stretches to minimize stretching time. Time efficiency in stretching could be improved by choosing stretches that only target joints that are likely to lose flexibility because of lifestyle induced adaptive shortening. Secondly, selecting stretches that are bilateral instead of unilateral would reduce overall stretching time by half. Finally, stretches that target multiple muscle groups and even multiple joints simultaneously could save time similar to multi-tasking. Therefore, the purpose of this pilot study is to compare the effectiveness of a brief time efficient flexibility protocol to a standard stretching protocol for effectiveness over a brief 2-wk period.

METHODS

Subjects
Twenty-three healthy college students (9 males, 14 females; age, 20.04 ± 0.824 yrs; weight, 66.61 ± 15.4 kg; height, 169.51 ± 10.1 cm), volunteered to participate in this study. Subjects of each gender were randomly divided into three stretching intervention groups. This study was approved by the Institutional Review Board of DeSales University, Center Valley, PA.
Procedures
This study utilized a Pre-Post Design to test the effectiveness of a time efficient stretching protocol (EXP) compared to both standard stretching recommendations (STD) and a control group (CON). Each volunteer completed a battery of four flexibility assessments before and after their assigned 2 wks of flexibility training. The flexibility assessments were chosen to assess areas of the upper and lower extremities in which college students are most likely to experience adaptive shortening. Specifically, flexibility was assessed using a passive hip flexion measurement, a functional double reach shoulder flexibility test, a straddle groin flexibility test, and a modified sit-and-reach test.

The CON group was instructed to continue without change their personal exercise. They did not report back to the laboratory until post-testing. Both the EXP and STD groups completed 4 sessions·wk⁻¹ for a total of 8 stretching sessions over the same 2-wk period. The stretching sessions were scheduled for convenience of the subjects. The subjects could perform sessions on consecutive days, but no more than 1 session·d⁻¹. Also, no more than 3 days were allowed between sessions. The duration for holding each stretch was 1 min, which was the same for both the EXP and STD groups. However, the total duration of the stretching protocols were dramatically different because the EXP protocol included far fewer stretching exercises.

The EXP protocol consisted of a total stretching time of 5 min·session⁻¹. The three stretches included in the EXP protocol consisted of the sit-straddle-reach stretch, the shoulder flexor stretch, and the hip flexor stretch as described by Boone (4). The sit-straddle-reach stretch and the hip flexor stretch were performed for each side of the body separately. However, the shoulder flexor stretch is a synchronous bilateral stretch. Figure 1 demonstrates the three stretches.

Figure 1. Experimental Protocol. (A) Sit-Straddle-Reach Stretch: Subject sat with legs spread and reached with both arms toward one foot and then the other. (B) Shoulder Flexor Stretch: Subject sat with the knees flexed and feet flat with their hands on ground behind them. With arms straight, subject sat as close to their feet as possible. (C) Hip Flexor Stretch: Subject stood in the lunge position with the upper body upright and the front knee bent forward.
The standard protocol (STD) group performed 6 stretches that lasted a total of 10 min. The stretches included in this protocol were the triceps stretch, calf stretch, quadriceps pull, butterfly groin stretch, the trunk and thigh stretch, and the seated forward reach (11). The trunk and thigh stretch, triceps stretch, and quadriceps pull stretch were performed unilaterally for each side, and the seated forward reach stretch and butterfly groin stretch were bilateral.

**Flexibility Measurement Procedures**

Passive hip flexion measurements were performed as previously described by Ahlback and Lindahl (1) and Heyward and Gibson (11). With the subject in a relaxed, supine position, a resting joint angle was measured by goniometer and recorded. One tester stabilized the extended knee and neutral ankle while passively elevating the leg until the subject reached maximal degree of flexion. The maximum flexion angle was recorded and the difference between the two measurements was computed to obtain the passive hip flexion ROM. An average of three trials was used for statistical analysis.

The functional double reach shoulder assessment is a measure of thoracic spinal extension, scapular retraction, and gleno-humeral range of motion in multiple planes (14). This test also has both unilateral and bilateral components. The functional double reach shoulder assessment was performed by holding a measuring stick from the functional movement screen (FMS) kit (Functional Movement Systems, Chatham, VA), behind the head and down the back with one hand while reaching behind and up the middle of the back with the opposing hand (see Figure 1). Subjects were asked to place their hands as close together as possible without undue strain. The distance between the hands was measured and the best attempt of three trials was chosen for statistical analysis.

For the straddle groin flexibility test, subjects sat straight and tall with their back against the wall. Then, they were instructed to abduct the legs as far as comfortable from which the location of the center of each heel was marked on the floor (Figure 1). After the subject stood up, a goniometer with an added straight edge extending all the way was used to measure the maximal abduction angle markings on the floor. The center of rotation for the measured angle was defined as the point on the floor representing the center of contact for the seated trunk. Subjects completed three trials and the highest attempt was kept for statistical analysis.

The modified sit-and-reach measured the subjects’ dorsal chain flexion. It was performed as described by Heyward et al. (11). Subjects were seated on the floor with the head, buttocks, and shoulders against the wall. With the knees extended and the soles of the feet placed vertically against the sit-and-reach box, the subject reached the arms forward from which the reach from the upright position was measured. Next the subject was instructed to reach forward (spinal flexion) and move the hands forward as far as was comfortable. This position was also recorded. The modified sit-and-reach score was the difference between the reach of the arms in the seated position and the reach of the arms while leaning forward in trunk flexion. Subjects attempted three trials of the assessment and the highest was retained for statistical analysis.
Statistical Analyses

Descriptive characteristics (mean and distribution) of the subjects were analyzed for age, height, and weight between groups (One-way ANOVA), non-parametric comparison between groups in each of the four outcome flexibility measures. To calculate an overall group comparison for all flexibility tests combined, the rank order for flexibility was calculated using the Kruskall-Wallis method and post hoc Mann-Whitney U comparisons were performed. All statistical procedures were performed using SPSS version 22 (IBM, Armonk NY). The a priori value for statistical significance in each analysis was P<0.05.

RESULTS

Separate One Way ANOVAs comparing change in flexibility between the three treatment groups for each flexibility test identified significant differences between groups for the sit and reach (F=6.942, P<0.01) and the straddle groin flexibility test (F=3.533, P<0.05). Tukey HSD post hoc analyses determined that the EXP and STD groups improved flexibility above the CON group, but there was no statistical difference between the EXP and STD groups. However, there was no significant group effect for double shoulder reach (F=1.00, P>0.05) or hip flexion (F=2.85, P>0.05) measurements (Figure 3).
In addition to comparing each flexibility measurement separately, a combined flexibility improvement score was calculated by summing the changes in each flexibility test. These combined scores were then ranked and a Kruskal-Wallis test was performed to test for significant overall differences in the data that was not normally distributed. The Kruskal-Wallis test identified a significant difference between groups for overall flexibility improvements ($H_{(2)} = 7.16$, $P = 0.028$). The post hoc Mann-Whitney U Test then identified significantly greater flexibility improvements in the STD and EXP groups compared to the CON group ($P = 0.014$ &
P=0.029 respectively), but no significant difference in flexibility change in the STD and EXP group (P=0.96) (Figure 4).

![Figure 4. Rank Overall Flexibility Improvements by Group](image)

*Indicates a significant difference from both other groups (P<0.05).

**DISCUSSION**

The purpose of this study was to determine if a well designed time efficient flexibility training program can be as effective as the standard joint by joint flexibility training recommendations for a battery of flexibility measures. The results of the modified sit and reach and the straddle groin flexibility tests indicate that both the STD and EXP groups had a significant increase in flexibility compared to the CON, but there was no difference between each other. Therefore, both the STD and EXP protocols can be used to increase trunk and groin flexibility.

The remaining flexibility assessments, the functional double reach shoulder flexibility test and the passive hip flexion measurement exhibited no significant change between any of the groups. There are at least three possible explanations for these observations. First, it is possible that these areas are slower to respond to flexibility training and, therefore, this short two week training program was unable to elicit a significant change. Second, this study utilized young healthy individuals, the majority of which already had average or better than average flexibility. These individuals may be nearer a flexibility 'ceiling'. Thus it may be unrealistic to expect large changes in these measures without significantly greater volume and intensity of flexibility training. Lastly, it is possible that the specific stretches within both the standard protocol and the experimental protocol fail to target the musculature crucial for proper performance of the flexibility tests. In other words neither the typical stretches nor the experimental stretches are specific to these tests of flexibility. This is most likely with regard to the functional double reach test, but seems unlikely in a simple hip flexion test.
This study only examined four measures of flexibility focusing on the major joints. Future studies will be necessary to determine if the time efficient protocol is as effective for other flexibility assessments and other joint mobility measures. Additional research will also be required to confirm that the shorter adaptive shortening focused flexibility program is as effective over longer periods of time (such as months or even years). It is possible that adherence to any stretching program is more important than the particulars of duration or stretch type. If that is true, a shorter protocol may prove to be more effective over long periods of time, and should be investigated further.

Stretching protocols targeting the muscles most likely to be affected by lifestyle associated adaptive shortening would not be universally adequate for addressing flexibility deficiency in all instances. First, some jobs and lifestyle activities produce atypical patterns of adaptive shortening. These sites would not be addressed by recommendations that only target ‘typical’ patterns. Also, decreases in flexibility due to injury or neuromuscular diseases can easily occur in muscles that are not typically affected in healthy ambulatory individuals. These concerns raise two important questions about flexibility guidelines given to the public. Is it better for the stretching recommendations given to the general public to be complete so as to address every possible flexibility concern, even if this means that individuals are likely to find it tedious and overwhelming? Or, is it better to create stretching guidelines that are simpler and shorter so that more individuals will benefit by doing them, while knowing that the recommendations will be inadequate for some segment of the population?

CONCLUSIONS

Young healthy individuals looking for a more time efficient way to stretch can expect similar flexibility changes by utilizing a shorter protocol focused on the muscles most prone to adaptive shortening compared to traditional joint by joint protocols that take twice as long. By reducing the time demand on clients and athletes, the shorter protocol may encourage individuals who don’t already incorporate regular stretching into their exercise program to do so.

However, more research is needed to confirm that the time efficient training remains as effective as the traditional recommendations over months and years. Adaptive shortening focused stretching protocols would not address decreases in flexibility caused by injury, disease, or individuals who have lost flexibility in joints typically unaffected in healthy ambulatory populations. Future research must examine whether recommendations to focus stretching on the muscles most likely to be adaptively shortened would be better than current recommendations that may be more universally adequate but have low compliance.

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