# Improving General Flexibility with a Mind-Body Approach: A Randomized, Controlled Trial Using Neuro Emotional Technique®

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## Abstract

Jensen, AM, Ramasamy, A, and Hall, MW. Improving general flexibility with a mind-body approach: A randomized, controlled trial using Neuro Emotional Technique®. *J Strength Cond Res* 26(8): 2103–2112, 2012—General flexibility is a key component of health, well-being, and general physical conditioning. Reduced flexibility has both physical and mental/emotional etiologies and can lead to musculoskeletal injuries and athletic underperformance. Few studies have tested the effectiveness of a mind-body therapy on general flexibility. The aim of this study was to investigate if Neuro Emotional Technique® (NET), a mind-body technique shown to be effective in reducing stress, can also improve general flexibility. The sit-and-reach test (SR) score was used as a measure of general flexibility. Forty-five healthy participants were recruited from the general population and assessed for their initial SR score before being randomly allocated to receive (a) two 20-minute sessions of NET (experimental group); (b) two 20-minute sessions of stretching instruction (active control group); or (c) no intervention or instruction (passive control group). After intervention, the participants were reassessed in a similar manner by the same blind assessor. The participants also answered questions about demographics, usual water and caffeine consumption, and activity level, and they completed an anxiety/mood psychometric preintervention and postintervention. The mean (*SD*) change in the SR score was +3.1 cm (2.5) in the NET group, +1.2 cm (2.3) in the active control group and +1.0 cm (2.6) in the passive control group. Although all the 3 groups showed some improvement, the improvement in the NET group was statistically significant when compared with that of either the passive controls ($p = 0.015$) or the active controls ($p = 0.021$). This study suggests that NET could provide an effective treatment in improving general flexibility. A larger study is required to confirm these findings and also to assess longer term effectiveness of this therapy on general flexibility.

**Key Words** biopsychosocial model, alternative therapies, mind-body therapies, stress, anxiety, psychology

## Introduction

General flexibility is a key component of health, well-being, and general physical conditioning (37). Moreover, poor flexibility has been associated with an increased risk of musculoskeletal injuries (37,66) and underperformance (17). There are many factors that contribute to flexibility, only some of which may be influenced by interventional procedures (16). For example, flexibility depends upon joint range of motion, which may be limited by skeletal muscle elasticity (63), which has been shown to improve with active stretching (36). However, the cause of reduced muscular flexibility, or a shortened muscle length, can be multifactorial.

Reduced muscular flexibility can be because of physical causes, such as an injury or recent strength training (7). Likewise, mental factors, such as anxiety or stress, can significantly contribute to muscle tension (18,19), which may greatly impact flexibility. In an examination of muscle activity, Hoehn-Saric et al. (19–21) found that anxious patients exhibited a global autonomic arousal and a general increase in muscle tension, a peripheral manifestation of central arousal. He found this not only during laboratory-induced psychological stress but also during baseline rest periods (19,21). This suggests that a reduction in anxiety may lessen autonomic arousal, which in turn may reduce muscle tension and improve muscular flexibility.

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Many physical interventions, such as static stretching (3,31,44), have been found to have some degree of acute success in improving flexibility. In addition, it has been previously shown that by treating the psychological symptoms of anxiety the somatic symptoms of anxiety can also be lessened (20). However, few studies have investigated the impact that reducing anxiety or stress may have on muscular flexibility.

Neuro Emotional Technique® (NET) is a unique mind-body approach that has been shown to be effective in reducing stress (22,23,41,48). The aim of NET is to remove neurological abnormalities that have a specified physiopathological pattern (62). Often, emotional trauma can cause a learned emotional response, and as a result, a related physiopathological pattern (29,47,62). Under normal conditions, the learned response becomes extinct, and the physiopathological pattern resolves. However, occasionally this does not happen, and both persist. The goal of NET is to normalize the aberrant patterns through a physical correction. How NET accomplishes the extinction of a conditioned response is currently unknown.

Because muscular flexibility may be limited by psychological factors, it was hypothesized that psychological, mind-body, or antianxiety interventions might prove to increase flexibility. Therefore, the aim of this study was to investigate if NET, a mind-body, stress-reduction intervention, has an impact on muscular flexibility. The randomized, controlled design will confirm or deny the effectiveness of NET in improving muscular flexibility. If our results support this hypothesis, then NET could be directly applied to athletes whose sports require flexibility for optimal performance.

## Methods

### Experimental Approach to the Problem

To test our hypothesis that NET may be used to improve muscular flexibility, a "black box" study design was used in which the participants were assessed, randomized to 1 of 3 treatment groups (1 experimental, 2 controls) and then reassessed. If our hypothesis were supported, those in the NET group would show a significant improvement in their flexibility compared with those in either control arm.

The specific study design was a single blinded randomized controlled clinical trial with 1 experimental arm and 2 control arms (active and passive). The randomized clinical trial format was chosen because it is the gold standard method to establish a cause-and-effect relationship (58). Single blinding (i.e., only the participants blinded) was used over double blinding (i.e., both participants and practitioners blinded) because of the unfeasibility of blinding practitioners during hand-on therapies (6). The independent variables are the interventions assigned to each of the 3 groups. The experimental arm, receiving the NET intervention, was chosen because NET is hypothesized to reduced psychological stress, which may impact flexibility. The control arms, receiving stretching instruction (SI) and no intervention, were chosen because they were believed to provide no therapeutic benefit. The 3-arm design of this study was used to distinguish a Hawthorne Effect from a therapeutic effect. General flexibility, the dependent variable, was measured using the sit-and-reach test (SR), which was chosen because of its widespread use, its familiarity within the field of sports science, and because of its accuracy and reliability (8).

### Subjects

Forty-five healthy participants (23 men and 22 women) were recruited from the general population in the local area. Volunteers were recruited via flyers placed in the public clinics of a teaching institution and were screened for eligibility by an impartial research assistant, who was also responsible for group allocation. To be eligible, volunteers must have been healthy adults, aged 18–45 years, without any physical or mental disorders, no pain on forward bending, no history of lumbopelvic spinal surgery, and not pregnant. Both athletes and nonathletes were included in this study. Because the participants were being compared only with themselves and not with other participants, training status was not included as a controlled variable.

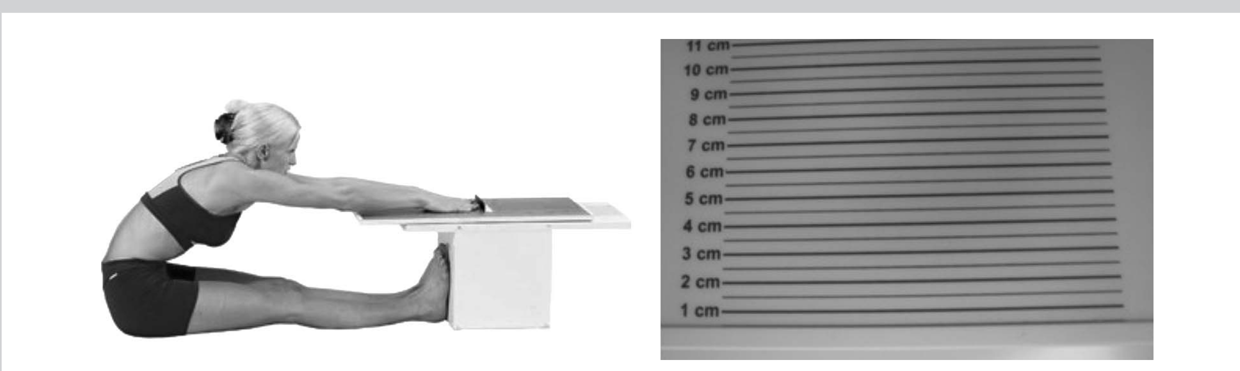
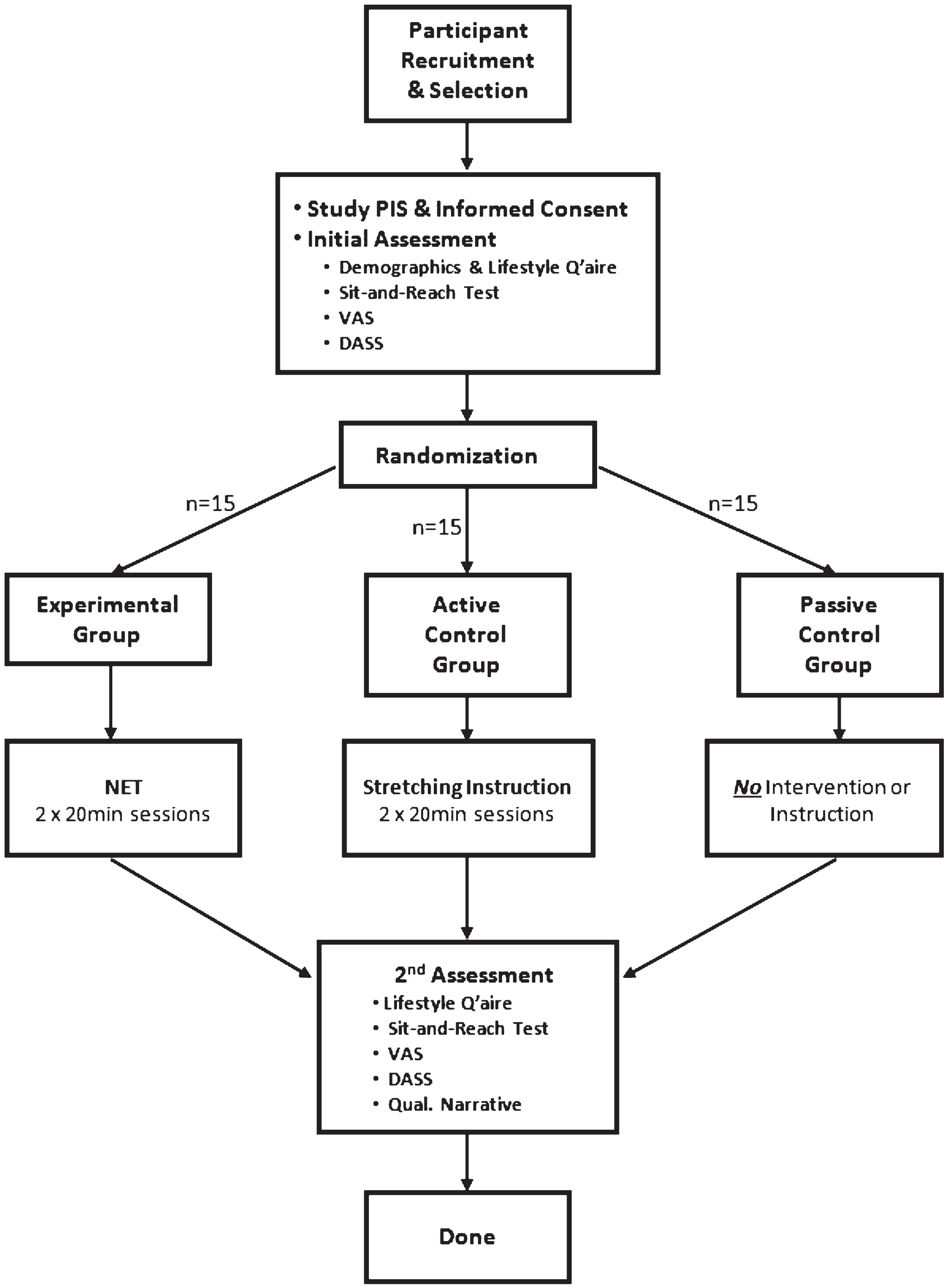



**Figure 1.** The sit-and-reach (SR) test: test position (left) and scale (right) in centimeters.




PIS, Participant Information Sheet; VAS, Visual Analog, Scale; DASS, Depression Anxiety Stress Scales; NET, Neuro Emotional Technique

**Figure 2.** Participant flowchart.

All data collection and interventions were conducted in private consultation rooms within a research department of a university. The temperature in the consultation rooms was monitored and kept at a constant 70° F (±2° F). The local institutional review board approved this study (Parker IRB Approval # R01_10). Also, this study was registered with a clinical trials registry, ClinicalTrials.gov. Written informed consent was obtained from all the participants, and all other tenets of the Declaration of Helsinki were upheld.

### Procedures

Before group allocation, the general flexibility of each participant was assessed by a blind assessor, who was not involved in the randomization process and remained unaware of treatment allocation. General flexibility was measured by the SR, a commonly used assessment of general flexibility (56), which has been shown to be a valid and reliable measure (8,30,46). The primary outcome used was the change in each participant's SR scores preintervention and postintervention.

For all the assessments, the participants were asked to wear comfortable clothes and to remove shoes. They were then asked to sit on the ground with their knees fully extended and the soles of their feet in contact with the SR box (Figure 1). Each participant was asked to stretch forward as far as possible with open palms resting on the SR box top (Figure 1) and to hold that position for at least 1 second. The measurement was taken from the farthest tip of the middle finger, and the distance was recorded to the nearest 0.5 cm. Each participant had 3 attempts with the best score being recorded.

The participants also completed questionnaires about demographics, usual water and caffeine consumption, recent activity level, current pain levels, anxiety, and mood, all of which could have an influence on general flexibility. In addition, the participants in the NET and SI groups were also asked to comment on their degree of satisfaction with their allocated intervention. Satisfaction with intervention was measured using a participant satisfaction scale, which ranged from 0 (not at all) to 10 (extremely).

All the assessments were performed at the initial session and again after the completion of both interventions sessions, 3–4 weeks later, by the same blind assessor.

### Interventions

After the initial assessments, the participants were randomly allocated to 1 of 3 groups: (a) *experimental group*, receiving two 20-minute sessions of NET, (b) *active control group*,

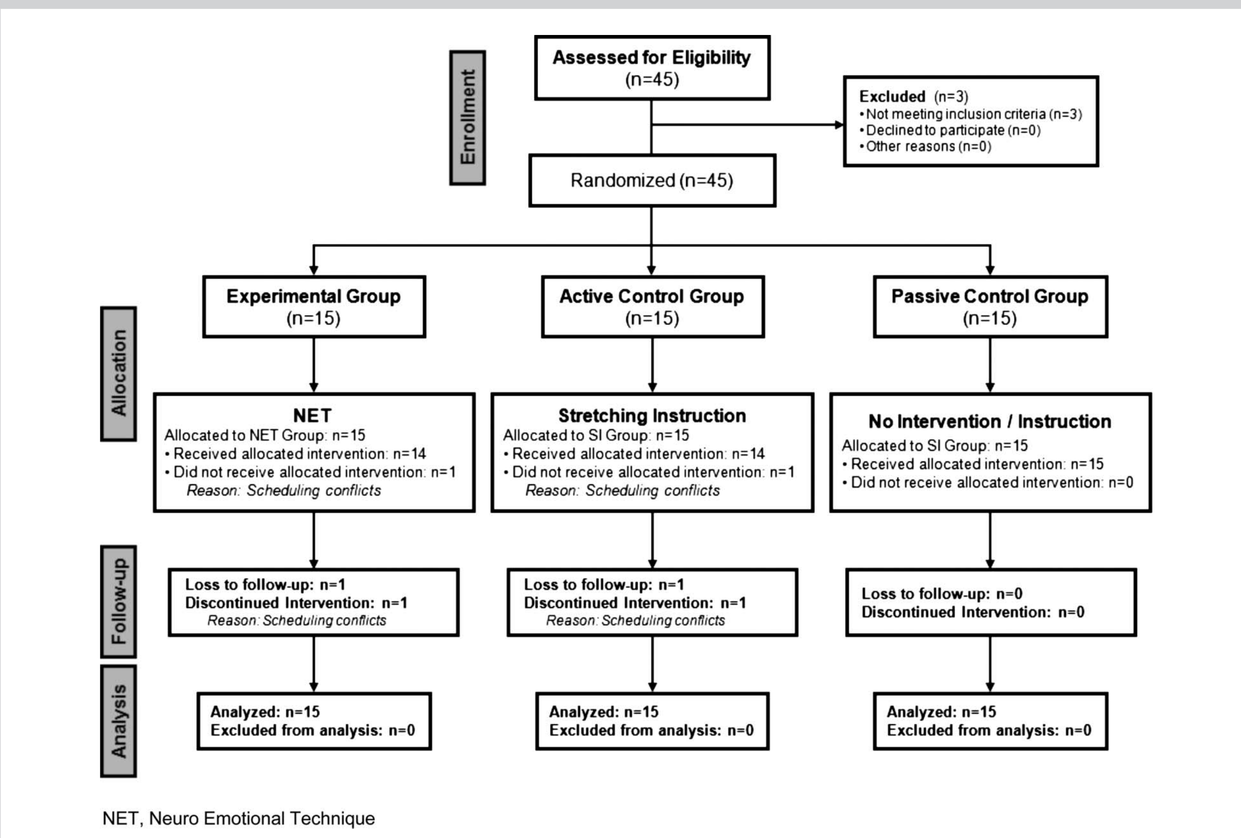



**Figure 3.** CONSORT diagram.

receiving two 20-minute sessions of SI, and (c) *passive control group*, receiving no intervention or instruction (NI). Figure 2 outlines participant flow.

*Experimental Group—Neuro Emotional Technique.* The participants in the experimental group received two 20-minute sessions of NET, by 1 of 3 qualified NET practitioners. Once a practitioner was assigned to a participant, he or she administered both NET sessions. Each NET practitioner had a minimum of 5 years' NET experience and performed the standard 15-step NET procedure as described by Walker (62). The practitioners received training to ensure that a standardized treatment was given, which included a review of the standard NET procedure and instructions to begin the process by using the participants' subjective feeling of bodily muscular tension while seated and bent forward (the SR position). No treatment other than the NET was given to participants.

The NET procedure involves a series of well-defined steps (see Supplement 1), which addresses a number of psychological components: (a) cognitions, (b) emotions, and (c) behaviors (41). These components are explored for a physiological stress response in the participant. The manual muscle test is used throughout the NET procedure as an assessment of a participant's physiological reactivity, which has previously been shown to be correlated (40). Once a stress response is found, the practitioner helps the participant explore possible reasons for this reaction. The procedure is concluded when the patient no longer feels discomfort associated with the experience and as a result can resist the downward pressure of the muscle test (41). After an NET session, the patients frequently report feeling subjective relief (41).

*Active Control Group—Stretching Instruction.* The participants in the group of active controls received two 20-minute sessions of SI, by 1 of 3 licensed chiropractors, who each had at least 5 years' clinical experience. Once a practitioner was assigned to a participant, he or she administered both SI sessions. These practitioners also received training to ensure a standardized treatment, which included explicit instructions to read the stretching handout to the participant, to then demonstrate each stretch, and end the session after 20 minutes. No other instruction or interventions were given to the participants.

The 20 minutes of SI consisted of verbal and pictorial descriptions of how to perform 5 different stretches for the low back, hips, and hamstrings. The specific stretches were chosen because the muscles involved may impact the ability to perform the SR. After the verbal instructions, the practitioner demonstrated each of the stretches, and then the participants were asked to perform them. The participants were directed to hold stretches for 5 seconds each for 5 repetitions each, an interval that was unlikely to have any therapeutic benefit (50,51). The SI is described in detail in

**Table 1.** Baseline demographics and clinical characteristics of trial groups.*

| Characteristics | Passive controls | Active controls (stretching) | NET | *p* Value |
|---|---|---|---|---|
| Number of participants | 15 | 15 | 15 | |
| % Male (male:female) | 66.70 (10:5) | 26.70 (4:11) | 53.30 (8:7) | 0.08† |
| Mean age, y (*SD*) | 29.2 (5.1) | 27.6 (4.8) | 28.5 (6.9) | 0.7 |
| Mean age of men, y (*SD*) | 28.9 (5.3) | 31.0 (6.1) | 29.1 (7.1) | 0.8 |
| Mean age of women, y (*SD*) | 29.8 (5.2) | 26.4 (3.9) | 27.9 (7.3) | 0.5 |
| Recent weight training (% participated) | 33.30 | 46.70 | 53.30 | 0.53† |
| Recent other exercise (% participated) | 80 | 80 | 80 | 1.00† |
| Recent water Intake (%) | | | | |
| $\leq$2 x 8 oz. glasses$\cdot d^{-1}$ | 20.00 | 26.70 | 6.70 | 0.57† |
| 3–7 x 8 oz. glasses$\cdot d^{-1}$ | 53.30 | 40.00 | 46.70 | |
| $\geq$ 8 x 8 oz glasses$\cdot d^{-1}$ | 26.70 | 33.30 | 46.70 | |
| Recent caffeine intake (%) | | | | |
| None | 13.30 | 13.30 | 33.30 | 0.40† |
| Low (<200 mg$\cdot d^{-1}$ average) | 80.00 | 66.70 | 60.00 | |
| High (>200 mg$\cdot d^{-1}$ average) | 6.70 | 20.00 | 6.70 | |
| DASS depression score, mean (*SD*) | 2.53 (2.53) | 2.00 (4.66) | 3.33 (3.27) | 0.6 |
| DASS anxiety score, mean (*SD*) | 3.87 (4.44) | 3.47 (6.48) | 2.40 (3.22) | 0.7 |
| DASS stress score, mean (*SD*) | 7.87 (5.32) | 5.60 (6.94) | 8.67 (7.58) | 0.43 |
| VAS score before SR, mean (*SD*) | 0.91 (1.22) | 0.75 (1.21) | 1.01 (1.11) | 0.82 |
| VAS score during SR, mean (*SD*) | 2.13 (1.91) | 2.16 (1.48) | 1.73 (1.24) | 0.7 |
| SR score, mean (*SD*) | 23.2 (9.2) | 22.7 (8.6) | 21.3 (8.1) | 0.82 |

*NET = neuroemotional technique; DASS = depression anxiety stress scales; VAS = visual analog scale; SR = sit-and-reach test; ANOVA = analysis of variance.
†*p* Value is based on Pearson's chi-square test (otherwise from ANOVA *F* test).

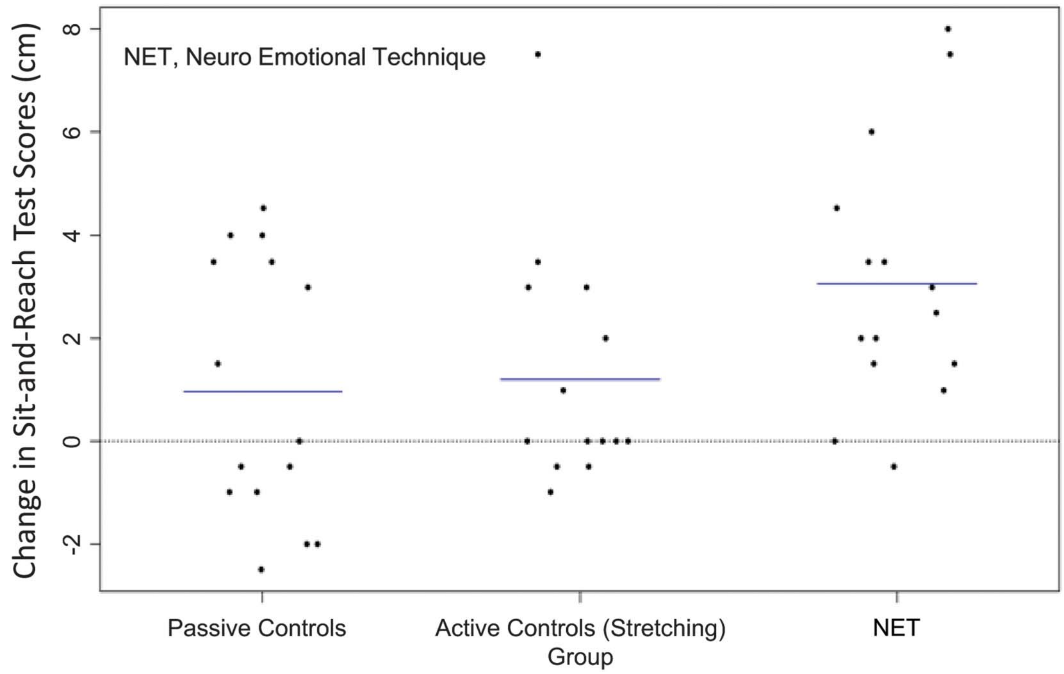



**Figure 4.** Change in sit-and-reach test scores (centimeters) for each group. Values above zero represent improvement. The horizontal blue line represents the average values for each group.

Supplement 2. The participants were not given any explicit instructions to perform these stretches at home.

*Passive Control Group—No Intervention/No Instruction.* The participants in the group of passive controls received no interventions, no instructions, and no overt attention. They were merely assessed twice, 3–4 weeks apart.

**Table 2.** SR score changes.*

| Group | Group mean (cm) | *SD* (cm) | 95% CI (cm) | Mean/*SD* |
|---|---|---|---|---|
| Panel A: By group | | | | |
| NET | 3.06 | 2.52 | 1.67 to 4.45 | 1.24 |
| Passive controls (SI) | 1.20 | 2.26 | −0.05 to 2.45 | 0.52 |
| Active controls | 0.96 | 2.54 | −0.44 to 2.37 | 0.38 |

| Group comparisons | Difference in group means (cm) | One-sided *p*-Value | Hedges' adjusted *g* |
|---|---|---|---|
| Panel B: Comparison between groups: superiority hypothesis testing | | | |
| NET vs. passive controls (SI) | 2.10 | 0.015 | 0.70‡ |
| NET vs. active controls | 1.86 | 0.021 | 0.65‡ |
| Active vs. passive controls | 0.24 | 0.390 | 0.08 |

*SR = sit-and-reach test; NET = neuroemotional technique (experimental group); SI = stretching instruction; CI = confidence interval.
‡Medium-large effect size.

**Sample Size**

Sample size estimation was performed based on the primary outcome, the change in the SR score (in centimeters). A minimum change in the SR score of 4.0 cm between any 2 of the intervention groups was anticipated. Using the results from similar effectiveness studies (25,53), an error variance of 3.38 was estimated, resulting in an effect size of 1.18. Based on this effect size, the study required a total of 45 subjects (15 per group) to achieve 81% statistical power with 5% type 1 error rate (confidence interval). No loss-to-follow-up was anticipated, and no adjustments for attrition were made.

**Blinding**

The study participants were masked to group allocation. Because of the hands-on nature of the interventions, the practitioners required knowledge of allocation. The assessor was also blind to group allocation and was kept naive to the hypothesis and objectives of the study. The participants were instructed not to reveal their group allocation to the assessor at follow-up appointments or to other participants or potential participants for the duration of the study. The intervention appointments for the NET and SI groups were kept identical in duration and frequency, with only the content varying, minimizing the influence of attention bias.

### Statistical Analyses

The Welch 2 sample *t*-test was used to analyze the difference in the SR score improvements (preintervention and postintervention) between (a) the NET group and passive controls, (b) between the NET group and active controls, and (c) between the active controls and passive controls. The *t*-test was conducted using 1-sided testing because we wish to test the superiority of the NET treatment or either control groups (and the superiority of SI group to passive control group). A difference in SR score improvements was considered statistically significant if the $p$ value was $\leq 0.05$. To explore the influence of other covariates, a backward elimination procedure was performed (i.e., start with a model that includes all covariates of interest and recursively eliminate any covariate that does not worsen the model fit statistics when eliminated until the most parsimonious model is found). The data were analyzed using SPSS 17.0.

## Results

Of the 48 volunteers recruited, 45 were found to be eligible for inclusion, randomized, and included in the intention-to-treat analysis (see Consort Diagram [10], Figure 3). The 3 excluded volunteers failed to meet the maximum age criteria (<45 years). One person in the NET group and 1 person in the SI group dropped out after 1 intervention session because of scheduling conflicts, leaving 43 participants completing the study. All the 45 participants were included in the final analysis, with the last observation carried forward methodology used for missing data. The participants were recruited between March and July 2010, and all data collection was completed by August 2010. The recruitment for the trial ended when the initial 45 participants were enrolled.

At baseline, the 3 groups were similar in demographics, usual water and caffeine consumption, and activity level (Table 1) and in responses to when they last received a chiropractic adjustment or massage (data not shown).

The mean (*SD*) change in the SR score was +3.1 cm (2.5) in the NET group, +1.2 cm (2.3) in the active control group and +1.0 cm (2.6) in the passive control group (Figure 4 and Table 2). Although all 3 groups showed some improvement, the improvement in the NET group was statistically significant when compared with either the passive controls ($p = 0.015$) or the active controls ($p = 0.021$). The difference between active controls and passive controls was not statistically significant ($p = 0.39$). Usual water or caffeine consumption, activity level, current pain level, or psychometric scores did not predict or influence the change in the SR score.

The mean (*SD*) satisfaction score in the NET group was higher than that in the active control group, 7.1 (2.9) vs. 5.3 (3.8), but the difference was not statistically significant ($p = 0.078$). No satisfaction scores were collected for the NI (passive control) group. No adverse events were reported, and no participant withdrew from the study because of any side effects of the interventions.

## Discussion

Muscle flexibility is a sport-specific integral part of physical conditioning, and under some conditions, it may be used to gain a competitive advantage. Certain sports, such as gymnastics, dance, springboard diving, and wrestling, require a high degree of general flexibility for optimal performance. Other sports require joint specific flexibility. For example, swimming and throwing sports require shoulder flexibility. If flexibility is compromised, underperformance could result (15,17). Our results suggest that a mind-body approach such as the NET may prove beneficial to athletes who would like to improve their muscular flexibility.

Interventions for improving flexibility can be grouped into 2 categories: Those that are therapist applied and those that are self-applied. Self-applied therapies that have been shown to be effective at improving flexibility include static (3,31,44), active (36), and functional stretching exercises, aerobic exercise (38), aquatic exercise (65), Tai Chi (59,64), yoga (2,28,60), Pilates (53), and strength training (13). Empirically supported therapist-applied interventions for improving flexibility include proprioceptive neuromuscular facilitation (5,26,49,52) and other muscle energy techniques (55,57), massage therapy (1,35), continuous ultrasound (54), vibration therapy (9,12,14), and Bowen Therapy (33). Despite acute improvements in flexibility evoked by these various interventions, because of the lack of long-term follow-up, durability of effect is questionable (11,32). Furthermore, these interventions are aimed at making changes in the muscular or musculoskeletal systems, without regard for psychosocial factors, which may be impeding flexibility. The intervention under investigation in this study (NET) is unique in that it takes a mind-body approach toward improving flexibility.

In this single-blinded randomized, controlled trial, the participants who received NET improved significantly more compared with those participants in either control group. These results support our study hypothesis that NET may be used to improve muscular flexibility. Improvements in the active control group (SI) were comparable with those in the passive control group (NI), and both were insignificant.

Arabaci (1) reported a mean change in the SR scores of 0.9, 1.9, and −0.3 cm for groups that were assigned to massage, stretching exercises, and rest, respectively. These values are comparable with both of our control groups (1.20 and

0.96 cm). In addition, Leardphadungchai and Poonsawat (28) reported a finding similar to ours (3.1 cm) after a yoga exercise program with a 5.7-cm improvement in the SR score in the experimental group. A noteworthy distinction is that the intervention time for the NET participants in our study was 40 minutes in total, compared with 3 $d \cdot wk^{-1}$ for 2 months in the yoga study. Therefore, NET might be able to help athletes improve flexibility within a relatively short amount of time. Of course, further studies with sufficient follow-up periods, which compare NET with other interventions, are now indicated to confirm this.

It is hypothesized that the therapeutic effect of NET is mediated through a calming of the autonomic nervous system. Hoehn-Saric (20,21) found that because of a cerebral overresponse to perceived stimuli, anxious individuals exhibit heightened muscular tension and global autonomic arousal. Therefore, it is theorized that the positive effect of NET might be mediated through a diminishing of the autonomic arousal. Because NET addresses psychosocial stressors that may impact flexibility, patients who were resistant to other interventions might benefit from this new intervention. Also, the noninvasive nature of NET might make this technique attractive to patients who prefer a holistic approach.

One primary strength of this study is the randomized study design, and the 2 control conditions, which controls for the Hawthorne effect (34), a phenomenon inherent to hands-on therapies. Another strength is the multipractitioner approach, which may have served to replicate a more realistic clinical setting. However, despite the fact that all the practitioners were highly qualified and explicitly trained in the study protocol, this approach may also have introduced a proficiency bias. In fact, it was noted during some intervention sessions that despite the explicit training, some practitioners failed to adhere exactly to the specified 20-minute session time.

Another limitation of this study was the absence of group allocation concealment from practitioners, which is not possible with hand-on therapies such as NET. In addition, the participants may have speculated about group assignment, particularly those in the passive control arm. This may have resulted in resentful demoralization (4,45), introducing participant bias.

This study could have been strengthened by collecting supplementary data on other factors that may impact flexibility, such as height, weight, and Body mass index (39,42,61), time of day, hydration and training status (27), medications and sleep amount or quality, and other participant background information.

A larger study is needed to confirm these findings. However, these encouraging results suggest that future research is warranted, such as investigating the effects of NET on other specific joint ranges of motion. Also, because the benefits of static stretching are generally short lived (11,32), future research should also focus on the durability of effect, which would require a longer term follow-up. In addition, the acute effect of NET on general flexibility might be of interest, as would the use of other measures of flexibility besides the SR. Basic science research analyzing how and why NET works is also needed. A suggestion for basic science research includes investigating if NET effects a viscoelastic stretch relaxation response at the level of the myofibril or if the response is mediated by supraspinal modulation. Another suggestion is exploring if central nervous system arousal (53) is diminished via an NET session.

Although NET may require multiple sessions for more deep-rooted issues, the results of this study demonstrate that two 20-minute sessions are sufficient to effect an improvement in the SR scores. The efficient implementation of these results into clinical practice may be achieved by increasing the number of qualified NET practitioners available to the general public, as there are currently just 8,000 trained practitioners worldwide (43), and primarily only in developed countries.

As suggested by the results of this study, NET, a proven stress-reduction technique (22–24,41), could provide an effective treatment for improving general flexibility. A larger study is required to confirm these findings and also to assess longer term effectiveness of this therapy on general flexibility.

## Practical Applications

Flexibility is essential for many types of athletes. Because reduced flexibility may have both physical and psychosocial etiologies, a multipronged approach may be indicated. The NET could provide a means to improve the flexibility of athletes where other interventions have failed. The NET should be considered in parallel to a routine stretching program.

All interventions may not be suitable for every individual. Sport scientists must tailor their approaches to suit the needs of their specific athletes. In addition, an athlete's particular preferences must also be taken into account when choosing an intervention.

Coaches, trainers, sports psychologists, and other healthcare professionals should consider becoming trained in NET or other mind-body interventions. Once doing so, they could determine which of their athletes would best suit this approach. Alternatively, a multidisciplinary approach may best serve the athlete population. Therefore, sport scientists may want to consider referring to a healthcare provider specifically trained in NET.

Because appropriate flexibility is an integral part of conditioning, those working with athletes must consider psychological factors impacting flexibility. The NET may help some athletes improve performance through improving muscular flexibility.

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