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Research Article

Comparison of the Effects of Two Types of Stretching Warm Ups for Rehabilitation

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Abstract

This pilot study compares the effects of static therapeutic trunk stretching using an unstable flex chair, a stretching bench and a stretching stick on physical fitness with those of a general Japanese style of static stretching. The participants underwent physical fitness tests. Before and after warming up using a general Japanese style of stretching and trunk treatment stretching. Twenty-three healthy college students (age, 20.7 ± 1.2 years; height, 165.3 ± 7.6 cm; weight, 59.0 ± 9.7 kg; BMI 21.4 ± 2.3) were enrolled in this study. The physical fitness test assesses grip strength, sit-ups, eyes-closed single-leg stance, sit-and-reach flexibility, six-minute walk, and ten-meter obstacle course. The participants performed vertical jump, forward standing flexion measured using the analog flexion meter, thoracolumbar extension, horizontal flexure, deep forward bow. These results suggest that trunk stretching improves flexibility, walking ability, endurance and explosive power more effectively than the general Japanese style of stretching. Three static trunk stretches can improve flexibility, walking ability, endurance and explosive power. Trunk treatment stretching before physical activity might reduce the incidence of injury and improve the physical performance of individuals who participate in exercise, athletes and injured persons undergoing rehabilitation.

Keywords: Stability; Flexibility; Stretching; Trunk Treatment.

Introduction

Warming up before engaging in physical activity is widely practiced for many athletes to improve their performance and reduce risk of injury [1, 2]. Warm-ups that increase core temperature and blood flow and prepare the body for exercise have been shown to improve performance [3, 4, 5]. Stretching during a warm-up usually follows cardiorespiratory activity [6] that can help with the ability to stretch [7]. Stretching during warm-ups has become a standard practice in preparing for an exercise or athletic performance [8]. Various stretching techniques are commonly included in warm-ups to reduce musculotendinous stiffness and increase the range of motion of the joints [9].

Static stretching is recommended to increase flexibility and reduce the incidence of musculoskeletal injury [10]. However, static stretching decreases muscular strength and endurance [11, 12, 13] and might impair performance by reducing power output [14, 15]. Moreover, passive stretching causes musculotendinous units to become more compliant, and the generation of force is reduced by decreasing musculotendinous unit stiffness, neural drive to muscles and power output [16]. Smith et al. reported that ballistic stretching might improve flexibility more effectively than static stretching [17]. Others have found that ballistic or dynamic stretching may or may not improve performance [11, 18, 19]. Abitbol and Mcneill reported that the neuromusculoskeletal cooperation in the body is that the most suitable waist, a pelvic girdle, and the pelvis joint area are stable, and the flexibility of these lower limbs part is important [20, 21]. In addition, the trunk muscles are important in maintaining vertical posture during physical activity.

The functional goals of warm upsare to reduce the risk of injury and enhance performance. This pilot study compares the effects of trunk treatment stretching; stretching using an unstable flex chair, a stretching bench and a stretching stick on physical fitness with those of a general Japanese style of static stretching. We postulated that physical performance would be improved more by trunk treatment stretching than by the general style of Japanese stretching.

Methods

Participants

Twenty-three healthy college students (age, 20.7 ± 1.2 years; height, 165.3 ± 7.6 cm; weight, 59.0 ± 9.7 kg; BMI 21.4 ± 2.3) were enrolled in this study, which proceeded in accordance with the latest guide linesin the Helsinki Declaration adopted by the Institutional Ethics Committee at Shinshu University. Table 1 shows the physical characteristics of participants.

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Table1. Physical characteristics of participants

	All (N = 20)
Age (years)	20.7 ± 1.2
Height (cm)	165.3 ± 7.6
Weight (kg)	59.0 ± 9.7
BMI	21.5 ± 2.3

Values are shown as means ± SD.

Design

The participants underwent physical fitness tests before and after warming up using a general Japanese style of stretching and trunk treatment stretching. The general Japanese-style stretching consists of knee flexion and extension (20 seconds twice), leg extensor stretches (20 seconds twice), deep leg extensor stretches (20 seconds twice), side stretching (20 seconds twice), forward and backward body flexion (20 seconds twice), upper body rotation (20 seconds twice), wrist and ankle rotation (40 seconds), Achilles tendon extension (20 seconds twice) and deep breathing (20 seconds twice). All stretches were completed within six minutes.

Two weeks later, the same participants underwent physical fitness tests before and after warming up using three trunk treatment stretches that were designed to relieve pain in the low back and hip joints and regain the original mobility of muscles or joints. This type of stretching proceeded using the following equipment: the unstable flex chair (HU-800, Minato Medical Science Co. Ltd., Tokyo, Japan), the stretching bench (K2590SB, Minato Medical Science Co. Ltd., Tokyo, Japan) and the stretching stick (SS-1, Minato Medical Science Co. Ltd., Tokyo, Japan). All stretches were completed within six minutes.

The pelvis can move in the unstable flex chair, and the seat can move in all directions (Figure 1). The participants sat in the chair and consecutively contracted the posterior and anterior hip flexors and extensors (40 seconds), right and left (40 seconds) and rotated their hips (40 seconds).

Figure1. HU-800 Flex chair.

The stretching bench can be anteverted to improve the forward tilting movement of the pelvis to relieve hamstring strain (Figure 2). The participants executed this exercise with both legs for 40 seconds and then with each leg individually for 40 seconds each.

Figure 2. K2590SB stretching bench

The stretching stick is used to loosen muscles in the back (Figure 3). The participants layalong the stick and breathed deeply for 40 seconds. They then placed their hands at the top of the rib cage and continued to breathe deeply for 40 seconds. Finally, the participants slowly moved their hands up and down the sides of the body while breathing deeply for another 40 seconds. The same participants executed the two types of stretches.

Figure 3. SS-1 stretching stick.

Physical fitness tests

We applied the physical fitness test for 65- to 79-year-olds, which was introduced by the Ministry of Education, Culture, Sports, Science and Technology of Japan. Thistestassesses grip strength, sit-ups, eyes-open single-leg stance, sit-and-reach flexibility, six-minute walk, and ten-meter obstacle course. Most of our participants achieved the maximum time of 120 seconds in the eyes-open single-leg stance test, so this test proceeded performed with the eyes closed. The participants performed vertical jump, forward standing flexion measured using the analog flexion meter (5003FLEXION-A, Takei Scientific Instruments Co. Ltd., Tokyo, Japan), thoracolumbar extension and horizontal flexure. The participants stood on a platform with the tips of their feet about 5 cm apart, held their arms out in front of the body, bent forwards and pushed a cursor with the middle fingers of both hands. The thoracolumbar extension angle test comprised placing the hands on the waist while standing and bending the body forward without moving the pelvis. The basic axis was set as the rear surface of the sacrum, and the crossing angle was measured between the basic axis and the movement axis that connects the first thoracic and fifth lumbar vertebrae. For the horizontal flexure angle test, the arms were raised anteriorly to 90°relative to the flexed shoulder joint.

The basic axis was taken as the line perpendicular to the sagittal plane, which passes along the acromion, and the humerus was regarded as the movement axis. Vertical jumps were assessed using the jump meter (LC020267, Senoh Corporation, Matsudo, Japan).

Statistical Analysis

Two-way repeated measured ANOVA was used to assess differences between the general style of Japanese stretching and the trunk treatment stretching. Moreover, data of scores of pre- and post two type stretching were analyzed using paired t-tests and SPSSVer.14 statistical software. The level of statistical significance was set at $P < 0.05$.

Results

General Japanese-style stretching

Scores for grip strength and sit-ups decreased after Japanese style stretching. However scores in the physical fitness tests did not significantly differ between before and after the stretch. Scores for the eyes-closed single-leg stance test, sit-and-reach flexibility, six-minute walk, ten-meter obstacle course, vertical jumps, forward standing flexion, thoracolumbar extension and horizontal flexure increased, but the differences did not reach statistical significance. Table 2 shows the results of physical fitness test.

Trunk treatment stretching

Scores significantly increased for sit-and-reach flexibility by 4.5 cm (before vs. after: 47.7 ± 17.2 vs. 52.2 ± 12.7 cm, $P < 0.001$) and significantly decreased by 0.4 seconds for the ten-meter obstacle course (4.2 ± 1.0 vs. 3.8 ± 1.0sec, $P < 0.001$). Scores significantly improved by 52.9 m for the six-minute walk (788.5 ± 95.0 m vs. 841.4 ± 94.0 m, $P < 0.001$) and by 4 cm for vertical jumps(52.0 ± 12.3 vs. 56.0 ± 13.3cm, $P < 0.001$). Scores for forward standing flexion (-12.3 ± 11.0 vs. -14.2± 10.6cm, $P < 0.001$) , thoracolumbar extension (52.4° ±11.0° vs. 61.3° ± 11.8°, $P < 0.001$) and horizontal flexure (133.9° vs. 144.2°,$P < 0.001$) significantly improved after stretching. Scores for grip strength decreased from 39.8 to 39.7 kg and those for the single-leg-stance increased from 90.0 to 95.2 seconds. However, neither of these differences reached statistical significance. On the other hand, the number of sit ups decreased from 30.9 to 28.2. Mean changes were not significantly different for grip strength, the single-leg-stance and sit ups. Mean changes for sit-and-reach flexibility, ten-meter obstacle course, six-minute walk, vertical jumps, forward standing flexion, thoracolumbar extension and horizontal flexure were all positive. Result from analyzing differences between the general stretching and the trunk treatment stretching by two-way ANOVA showed a significant difference inhorizontal flexure.

Discussion

This study comprised warming up using the general Japanese style of stretching and the trunk treatment stretching. Scores after the Japanese style of stretching decreased for grip strength and the number of sit-ups, and increased for the eyes-closed single-leg stance, sit-and-reach flexibility, six-minute walk, ten-meter obstacle course,

Table2. Effects of streatching on physical fitness

	General stretching			Trunk treatment stretching			2 Way ANOVA
Physical fitness test	Pre	Post	P	Pre	Post	P	
Grip strength (kg)	38.7 ± 9.6	38.3 ± 9.7	NS	39.8 ± 10.2	39.7 ± 10.3	NS	NS
Single-leg stance (sec)	96.0 ± 26.7	90.7 ± 35.5	NS	90.0 ± 36.1	95.2 ± 31.8	NS	NS
Sit up (n)	30.1 ± 7.9	29.3 ± 8.3	NS	30.9 ± 8.3	28.2 ± 9.6	NS	NS
Sit-and-reach flexibility (cm)	48.3 ± 13.1	49.3 ± 11.7	NS	47.7 ± 12.2	52.2 ± 12.7	***	NS
Ten-meter obstacle course (sec)	4.1 ± 1.1	4.1 ± 1.1	NS	4.2 ± 1.0	3.8 ± 1.0	***	NS
Six-minute walk (m)	825.6 ± 92.2	830.8 ± 90.4	NS	788.5 ± 95.0	841.4 ± 94.0	***	NS
Vertical jump (cm)	52.0 ± 10.9	52.0 ± 11.4	NS	52.0 ± 12.3	56.0 ± 13.3	***	NS
Forward standing flexion (cm)	-12.5 ± 10.3	-12.7 ± 10.3	NS	-12.3 ± 11.0	-14.2 ± 10.6	***	NS
Thoracolumbar extension (°)	54.1 ± 12.1	56.1 ± 14.9	NS	52.4 ± 11.5	61.3 ± 11.8	***	NS
Horizontal flexure (°)	138.2 ± 13.3	132.9 ± 28.8	NS	133.9 ± 11.7	144.2 ± 11.2	***	*

means ± SD; NS, not significant; *p<0.05; ***p<0.001.

vertical jumps, forward standing flexion, thoracolumbar extension and horizontal flexure. However, the changes did not significantly differ between before and after the warm-up.

After the trunk treatment stretching, mean changes for grip strength, single-leg-stance and sit ups did not significantly differ, whereas mean changes were significantly positive for sit-and-reach flexibility, ten-meter obstacle course, six-minute walk, vertical jumps, forward standing flexion, thoracolumbar extension and horizontal flexure.

These results suggested that trunk treatment stretching improves flexibility, walking ability, endurance and explosive power more effectively than the general Japanese style of stretching.

The three trunk treatment stretches comprise a rehabilitation exercise to relieve lower back and hip joint pain, and help regain original muscle function and joint mobility.

Mälkiäand Ljunggren reported that individuals with back pain have impaired muscular and connective tissues, functionally limited muscle strength, endurance, speed and neuromuscular functions, as well as physical, social and psychological disabilities [22]. Physical exercises for rehabilitation address the ability of the neuromuscular system to perform dynamic concentric, eccentric and isometric stabilization contractions. The objective of physical exercises for rehabilitation is usually to stress both damaged tissue and healthy supporting tissues to foster tissue repair while avoiding further excessive loading [7]. Lumbar stability, core stability and low back stability exercises are believed to be an important factor in the physical training and maintenance of a healthy back [23].

Early adaptation by means of short-term core exercise programs using a physioball or a Swiss ball enhances gains in torso balance and EMG neuronal activity [23]. Sitting on unstable Swiss balls is often advocated to promote proper seated posture to prevent lower back pain by stretching consecutively contracted hip flexors and extensors to posteriorly and anteriorly rotate thehips [14]. Similarly, sitting on a flex chairs and stretching benches used for spine rehabilitation and hamstring stretches can reduce back pain [24]. The foam roller used for spine rehabilitation is an excellent tool for mobilizing the mid-back that can be used in various ways with an emphasis on increasing dorsal extension [24].

Static stretching during warm-ups has become established practice in preparing for exercise. Stretching is generally accepted as being effective in improving performance [18]. However, recent studies have demonstrated that static stretching before physical activity decreases performance [14, 15]. The mechanism of this decrease in performance might be due to short-term decreases in activation, muscle stiffness and reflex sensitivity [16]. The present study examined the influence of a warm-up comprising three static stretches performed using an unstable flex chair, a stretching bench and a stretching stick. Flexibility, walking ability, endurance and explosive power improved. As a result of comparison between the general Japanese style of stretching and the trunk treatment stretchingby two-way ANOVA, there was a significant differencein horizontal flexure, and it suggests that the trunk treatment stretching improved flexibility.

These results show that different static stretches can influence the performance of physical activity.

Conclusions

This pilot study compares the effects of static therapeutic trunk stretching using an unstable flex chair, a stretching bench and a stretching stick on physical fitness with those of a general Japanese style of static stretching. The participants underwent physical fitness tests before and after warming up using a general Japanese style of stretching and trunk treatment stretching. Twenty-three healthy college students were enrolled in this study. These results suggest that trunk stretching improves flexibility, walking ability, endurance and explosive power more effectively than the general Japanese style of stretching.

Three static trunk stretches can improve flexibility, walking ability, endurance and explosive power. Trunk treatment stretching before physical activity might reduce the incidence of injury and improve the physical performance of individuals who participate in recreational exercise, high-performance athletes and injured persons undergoing rehabilitation.

Interests Competing

The authors declare that they have no competing interests.

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