THE EFFECTS OF CORE STABILITY TRAINING ON DYNAMIC BALANCE IN HEALTHY YOUNG STUDENTS

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The purpose of this study was to evaluate the effects of core stability training (CST) on dynamic balance in healthy young students. 24 healthy collegiate female students volunteered and underwent a series of CST exercise. Dynamic balance was evaluated by the 8-direction limits of stability (LOS) test. The CST combined the Pilates mat and Swiss ball exercise, ninety minutes, twice per week, for six weeks. The LOS performance in right and backward-right directions at level 3 was significant improved in post-training than pre-training. Furthermore, The LOS performance in overall, forward, right, forward-left, backward-right, and backward-left directions at level 6 were significant improved in post-training than pre-training. It is concluded that regular CST can improve the dynamic postural stability in healthy young students.

KEY WORDS: balance control, limits of stability, core training.

INTRODUCTION: Postural stability has an important role in injury prevention and in athletic activities. Stability is preserved through the dynamic integration of internal and external forces and environmental factors. Greater core stability may benefit sports performance by providing a foundation for greater force production in the upper and lower extremities (Omkar, Vishwas, & Tech, 2009).

Core strengthening has become a major trend in rehabilitation. Core stability training targets the muscles deep within the abdomen which connect to the spine, pelvis and shoulders, to assist in the maintenance of good posture and provide the foundation for all arm and leg movements (Akuthota, Ferreiro, Moore, & Fredericson, 2008). On a more significant note, muscle power is derived from the trunk region of the body and a properly conditioned core helps control that power, allowing for smoother, more efficient and better coordinated movement in the limbs.

METHODS: Twenty-four healthy collegiate female students (height: 162.3 ±6.0 cm, weight: 54.1 ± 16.3kg, age: 20.1 ± 1.4 yrs) from National Hsinchu University of Education, Taiwan, participated in this study. All participants completed a self-report health history questionnaire and signed a written informed consent before testing. All participants were screened for lower-extremity (ankle, knee, hips) bone and joint injuries and abnormalities as well as for conditions (i.e., concussion, inner-ear disorders, upper-respiratory infection, etc.) that may influence balance. Any participant self-reporting the presence of any injury or condition within the last 6 months was excluded from the study.

The CST program used in this study was a synthesis of findings derived from published research studies and prevention techniques. The CST was combined the Pilates mat (Teaser, Swimming, Leg Pull Front, The Hundred, The Roll Over, and Shoulder Bridge One Leg Lift Exercise, etc.) and Swiss ball exercise altogether (bridge, plank, V-up, and crunch, etc.) in ninety minutes, twice per week, for six weeks. Guidelines from the United States aerobic fitness association was followed, including warm-up exercise, the main movement along with

three phases in order promote a progressive manner, and impose different intensity at different stages of the training protocol as well as strengthen the abdominal muscle strength and lower limb muscle strength.

Limits of stability (LOS) was evaluated by the Biodex Balance System (BBS). Subjects were tested bilaterally at two levels of difficulty: 3 and 6. To control for the learning effect and fatigue, the order of the tests was randomly assigned. Prior to performing the experiment measurements, subjects were familiarized with proper practice. During the test session, subjects warmed up for 5 to 10 minutes on running and performed dynamic stretching lasting approximately 12 seconds for each lower muscle group. The performance is based on their ability to accurately move the display cursor to a target 10 degrees from a level platform position and back to level again.

The subject was instructed to start moving the cursor which accurately moves the display toward the flashing target at eight different directions. The LOS score was calculated for each direction according to the percentage between the straight line distance to target and the number of samples. Therefore, more direct the path to the target and back to center, the higher score will be achieved.

Repeated-measures t test were used to examine the differences in each parameter before and after training. For all analyses, the level of statistic significance was set at $P < .05$.

RESULTS: The LOS performance in right (26.6 ± 14.4 vs. 32.1 ± 14.2) and backward-right (29.8 ± 14.7 vs. 37.5 ± 17.0) directions at level 3 was significant improved in post-training than pre-training. Furthermore, The LOS performance in overall (27.7 ± 9.2 vs. 38.9 ± 11.3), right (30.9 ± 12.3 vs. 40.9 ± 13.3), forward-left (32.3 ± 12.4 vs. 43.9 ± 14.3), backward-right (32.9 ± 9.6 vs. 40.2 ± 14.5), and backward-left (32.5 ± 12.7 vs. 43.4 ± 17.3) directions at level 6 was significant improved in post-training than pre-training (Figure 1).

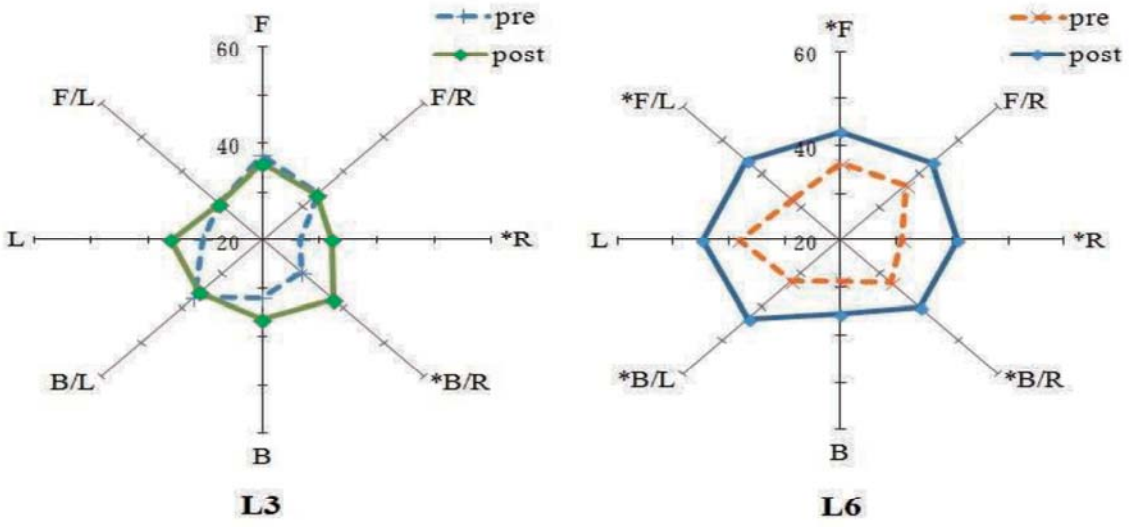

Figure 1: Comparisons of the LOS scores in each direction between groups before and after training.

DISCUSSION: Core muscles are located in the vertebral column and around the abdominal cavity. Depending on the role and properties of the core muscles it can be divided into deep and shallow core muscles, the former covering the transversus abdominis (TrA) and the multifidus muscle, while the latter contains the rectus abdominis, abdominal oblique muscle, external oblique, and lumbar paraspinal muscles. This study also indicated that core training not only improve the core muscles strength, but also can improve the stability of the body movement during the LOS test which requires the well coordination of the upper and lower extremity limb, because a recent studies also indicated that Pilates training can enhances the control of trunk movement, and improves the neuromuscular coordination of movements (Lugo-Larcheveque, Pescatello, Dugdale, Veltri, & Roberts, 2006).

Previous studies investigating the measurement properties of the BBS tested the dynamic postural stability (Costa, Graves, Whitehurst, & Jacobs, 2008). Testing in the dynamic LOS mode seems to be more demanding than testing in the static balance mode (Perron, Hebert, McFadyen, Belzile, & Regniere, 2007), since subjects have to maintain balance while actively controlling joint movements in the functional limits of their range of motion. Furthermore, the LOS test was designed to measure the ability of subjects to actively control the ankle and proximal joints to the limits of their functional range of motion while keeping balance on a multi-directionally unstable surface.

Moreover, significant improvements in the LOS test were found in the overall (level 6), right (level 3 & 6), forward-left (level 6), back-right (level 3 & 6), and back-left (level 6) directions, which supports the hypothesis that CST can improve lower extremity coronal and sagittal plane control (Myer, Ford, Brent, & Hewett, 2006). This direction-specific benefits might strongly related to the movement of training exercises which utilized in this study, might improve lower extremity coronal and plane dynamic control during the LOS test in unstable condition.

The finding of this study showed significant improvement in the overall performance on the stable, level 6 LOS test indicates that a 6-week period of unstable exercise training can improve dynamic postural stability. This study provided support for this hypothesis, since it showed that core training could facilitate voluntary active postural and lower extremity corrections during the unstable LOS test.

CONCLUSION: This study demonstrated that six weeks core training can improve flexibility, dynamic balance in healthy young students.

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