THE EFFECTS OF UNSTABLE EXERCISE TRAINING ON DYNAMIC BALANCE AND ABDOMINAL MUSCLE STRENGTH IN YOUNG FEMALE INDIVIDUALS

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The purpose of this study was to evaluate the effects of unstable exercise training (UET) on dynamic balance (DB) and abdominal muscle strength in young female individuals. 22 healthy collegiate female students underwent a series of UET sessions. DB was evaluated by the 8-direction limits of stability (LOS) test. Abdominal strength was measured using 60s sit-up test. The UET combined the Both Sides Utilized (BOSU) and Swiss ball exercises, undertaken for 90mins, twice per week, for 6 weeks. The LOS performance in overall, forward, right, forward-left, backward-right, and backward-left at level 6 also significantly improved post-training. Further, significant improvements were observed in the 60s sit-up test. It is concluded that regular UET can improve DB and abdominal muscle strength in young female individuals.

KEY WORDS: balance, core training, postural stability.

INTRODUCTION: Unstable exercise training (UET) is relatively new training paradigm which emphasizing dynamic manoeuvres and unstable situations to improve sensorimotor control and neuromuscular function. Core stability is the ability to control the position and movement of the central portion of the body. 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 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-two healthy collegiate female students (height: 162.8 ±5.9 cm, weight: 54.5 ± 6.2kg, age: 20.1 ± 1.5 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.

The UET was combined the BOSU 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 were followed, including warm-up exercise, three phases progressive manner in each traing movements, and impose different training intensity at different stages of the protocol as well as strengthen the abdominal muscle strength and lower limb muscle strength.

The dynamic balance was evaluated by the 8-direction limits of stability (LOS) test. 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. 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, the more direct the centre of mass path takes to the target and back to center, the higher the score achieved.

Abdominal strength was evaluated by a 60 second sit-up test. Subjects were prepared by lying supine on the mat, arms across the chest, hands placed gently on the shoulders, knees at 90 degrees and feet flat on the ground. The subjects were instructed not to arch their back during the exercise and to keep their arms flat against their chest. The subject's ankles were firmly held by a partner for support. The partner maintained count of how many sit-ups were performed. For a complete repetition, sit-up was performed to raise upper-body approximately a 30 degree angle, to touch the knee, and then the subject returned to the starting position. The subjects were instructed to not arch their back during the exercise and to keep their arms flat against their chest. The duration of this test lasted one minute. The subjects were instructed to do as many repetitions as possible. Repetitions were recorded by its partner in the middle and at the end of the test.

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 a=.05.

RESULTS: The LOS performance in backward-right (29.8 ± 14.8 vs. 38.3 ± 17.1) directions at level 3 was significant improved in post-training than pre-training. Furthermore, The LOS performance in overall (28.0 ± 9.4 vs. 39.2 ± 11.3), forward (35.7 ± 16.3 vs. 42.7 ± 16.5), right (30.5 ± 11.2 vs. 40.5 ± 13.8), forward-right (31.3 ± 12.5 vs. 43.9 ± 14.5), backward-right (33.1 ± 9.9 vs. 40.3 ± 15.1), and backward-left (33.2 ± 13.0 vs. 44.5 ± 17.2) directions at level 6 was significant improved in post-training than pre-training (Figure 1).

After six weeks of unstable exercise training, the average 60 seconds sit-ups were 45.5 ± 9.7 times in pre-training, and changed to 49.1 ± 10.5 times after the six weeks period (t=-3.69, $p < .05$).

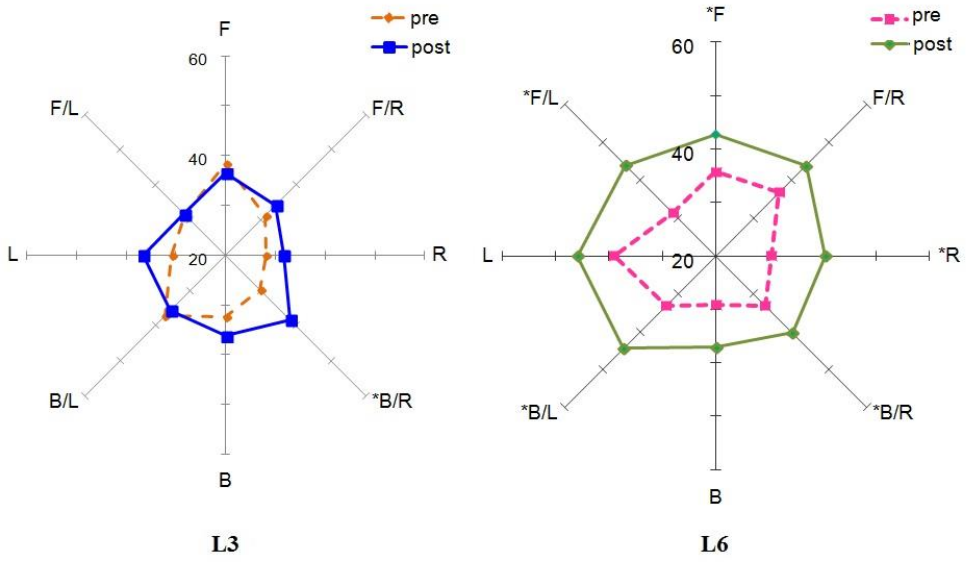

Figure 1: Comparisons of the LOS scores in each direction between groups before and after training.

DISCUSSION: Results from this study indicated that the young healthy collegiate female students who participated in unstable exercise training, improved their dynamic balance performance and increased their abdominal strength and endurance. These findings were consistent with previous research investigating middle aged female subjects who trained three times a week for 5 weeks. These participants significantly increased their 1-minute sit-up performance (14.0 vs. 29.2) confirming that Pilates mat exercises increase muscular endurance (Sekendiz, B et al, 2007). However, the very large standard deviations which

demonstrated in this study might also indicated that the variability of this testing, therefore, should be more cautions and strongly recommended utilize the isokinetic equipments to evaluate the strength of the abdominal for better reliability and validity. Furthermore, Herrington & Davies (2005) study verified this and also indicated that the transversus abdominis is mainly, which helps maintain better lumbo-pelvic control, hereupon, improve the performance of the 60 seconds sit-up test.

Previous studies investigating the measurement properties of the BBS tested the dynamic postural stability (Costa, Graves, Whitehurst, & Jacobs, 2008). To our knowledge, our study was the first to investigate the effects of Pilates training on dynamic postural stability in the LOS mode. 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.

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 unstable exercise training could facilitate voluntary active postural and lower extremity corrections during the unstable LOS test.

CONCLUSION: This study demonstrated that six weeks unstable exercise training can improve flexibility, dynamic balance and abdominal muscle strength in young female individuals. .

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