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Original Research Article

Comparative Study of Core Stability Exercise with Swiss Ball in Improving Trunk Endurance

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ABSTRACT

The purpose of this study was to compare the effects of 5 weeks of Swiss ball core stability exercises with conventional floor exercises in men. The experimental group (n=10) performed curl-ups and back extensions on the Swiss ball while the control group (n=10) performed the same exercises on the floor. Data analysis shows significant improvement in trunk endurance of experimental group (t= 2.25; p = 0.03) and control group (t= 2.25; p = 0.03) after five weeks of exercise training. The present study shows that core stabilization exercises with Swiss ball and without Swiss ball are equally effective in improving trunk endurance.
Key Words: Core Stability, Swiss Ball, Endurance.

INTRODUCTION

The "core" has been used to refer to the lumbopelvic-hip complex, which involves deeper muscles, such as the internal oblique, transversus abdominis, transversospinalis (multifidus, rotatores, semispinalis), quadratus lumborum, and psoas major and minor, and superficial muscles, such as the rectus abdominis, external oblique, erector spinae (iliocostalis, spinalis, longissimus), latissimus dorsi, gluteus maximus and medius, hamstrings, and rectus femoris. [1, 2, 3]

The use of Swiss ball training for core muscle development has been popular for several years.4 Multiple studies have examined core muscle recruitment during varying types of Swiss ball abdominal exercises [4, 5, 6] and during traditional abdominal exercises like the crunch (abdominal curl-up) and bent-knee sit-up. [6, 7, 8]

Muscular endurance is the ability of an isolated muscle group to perform repeated contraction over a period of time, with intensity of the activity being moderate. [9] It is one of basic elements of muscular performance that has great relevance to activities of daily living lifting and bending in which the ability of trunk extensor to resist fatigue being important in industrial setting. [10] Poor endurance of trunk muscle may induce strain on passive structure of lumbar spine and hence result in low back pain. [11] Muscle been identified as a potential source of low back pain [12, 13] as failure to protect passive structure from excessive loads may result in damage to pain sensitive structure and produce pain. [14]

Endurance of lumbar stabilizer is most important key for preventing lumbar pain. [10, 15] Trunk muscle endurance training has been recommended as means of increasing fatigue threshold and improving performance and reducing disability. [16] Improving endurance of trunk extensor therefore appears to be sound and promising approach for preventing low back pain and hence justification for conducting this study among individual without low back pain.

The trunk extensor training protocols used in studies focused extensively on erector spinae composed of longissimus, spinalis, i.e. mobilizers of trunk at expense of stabilizers such as transverse abdominus and multifidus that are affected majorly in individuals with back pain. So trunk extensor training protocol may need to be used in conjugation with specific stabilizing exercise for multifidus and transverse abdominals.

Core stabilization exercise links to the most effective abdominal training and increases ones strength and stamina. Core strengthening exercise program aims to improve stabilization and support to the spine providing the muscles of arms and legs. The muscles mainly involved in maintaining the trunk extensor stability are multifidus and transverse abdominus. This therefore helps in improving the endurance of trunk extensors and preventing future backache hence the study between the core stabilization exercises and the trunk extensors is carried out among individuals.

Core Stability- Core stability is the ability of body to control the whole range of motion of a joint thereby not creating deformity, neurological deficits, or incapacitating pain. Core stability is the strengthening of the corset of muscle surrounding the back and abdomen

Core musculature- It consists of 29 pairs of muscle that support the lumbopelvic hip complex in order to stabile the spine, pelvis and kinetic chain during functional movement. Transversus Abdominus, Multifidus, Diaphragm and pelvic floor muscle are the main muscle. These muscles are also known as the ‘core’ or ‘power house’ muscles and provide a solid base upon which all other muscle can work upon to initiate movement. Comprehensive strengthening program of this core muscle can be used for injury prevention, rehabilitation and sport performance enhancement. Strengthening the core is essential to prevent all forms of injury around the lower back areas.

When all these muscles contract together, they keep the spine in its most stable position (the neutral zone) & aid in preventing injury. They are known to contract prior to any limb movement & so they function in keeping the centre, or core of the body rigid during all movement. Recent evidence has found that in people with low back pain these muscles fails to contract before limb movement & so the spine is vulnerable to injury. Thus retraining these muscles to contract at the right time is the fundamental theory of core stability.

This study therefore aimed to investigate effects of core stabilization

exercise on a trunk extensor endurance exercise protocol in apparently healthy subjects.

METHODOLOGY

20 normal male participants within the age group of 18-30 years were recruited for the study after signing an informed consent and fulfillment of inclusion criteria. The participants were randomly assigned to either the experimental group or the control group. The control group performed the modified curl-up by Robertson [17] and back extension exercises on the floor. The experimental group performed the same sit-up and back extension exercises using the Swiss Ball. The study procedure and rationale were explained to all the participants before the start of the study.

Procedure:

The 5-week program for the experimental and control groups are shown in Table 1 (Ludmila M. Cosio-Lima et al). [18] The program consisted of training 5 days per week, with each session lasting 15 minutes. During the first week, all the participants performed 3 sets of 15 repetitions of each exercise, alternating the sit-up with the back extension exercises. During the second week, the training routine consisted of 4 sets of 15 repetitions of each exercise. During the third and fourth weeks, the training routine included 4 sets of 20 repetitions of each exercise. During the fifth week, participants performed 4 sets of 25 repetitions of each exercise. No rest periods were taken between all sets of repetitions.

After the five weeks of exercise the endurance of trunk extensor muscles was measured with the modified Sorensen test.

Exercises given to experimental group: Back extension and curl-up exercise on Swiss ball.
Exercises given to control group: Back extension and curl-up exercise on floor.

Table 1. Training Log*

	Monday Set/reps	Tuesday Set/reps	Thursday Set/reps	Friday Set/reps	Saturday Set/reps
Week 1					
Curl-up	3/15	3/15	3/15	3/15	3/15
Back extension	3/15	3/15	3/15	3/15	3/15
Week 2					
Curl-up	4/15	4/15	4/15	4/15	4/15
Back extension	4/15	4/15	4/15	4/15	4/15
Week 3					
Curl-up	4/20	4/20	4/20	4/20	4/20
Back extension	4/20	4/20	4/20	4/20	4/20
Week 4					
Curl-up	4/20	4/20	4/20	4/20	4/20
Back extension	4/20	4/20	4/20	4/20	4/20
Week 5					
Curl-up	4/25	4/25	4/25	4/25	4/25
Back extension	4/25	4/25	4/25	4/25	4/25

* Experimental group performed the exercises on the Swiss Ball and the control group did them on the floor.

Sorenson Test: Procedure in which subject is made to lie prone on a rectangular box keeping upper half body (from ASIS) out of the box. i.e. upper half body is kept

unsupported. Subject is then asked to maintain the upper body in a horizontal alignment while firmly strapped to the table over the pelvis, thigh & lower leg. The time for which subjects could maintain the position is evaluated.

Inclusion criteria:

1. Age: 18-30 years
2. Sex: Male
3. BMI: 18-24

Exclusion criteria:

- Acute inflammatory conditions of back
- Spinal fractures
- Systemic conditions affecting muscular performance
- Spinal instability
- Obesity

Tools and Materials

- Weighing Scale
- Height meter
- Rectangular Wooden Box(80x50x20.3cm)
- Stop Watch
- Velcro Straps

Statistical Analysis:

All statistical analyses were performed using SPSS Version 16.0. Data were analyzed with descriptive statistics, and results were summarized as mean± standard deviation. t-test was used to detect any significant differences in muscle endurance between the groups. The level of significance for all data was set at $p \leq 0.05$.

RESULTS

Table 1 shows comparison of scores of hold time (seconds) in experimental group prior to exercise and after exercise for five weeks. There is significant difference in experimental group at 0 and 5 weeks of exercise programme ($t = -6.44$; $p = 0.00$). This suggests that improvement in trunk endurance after performing core stabilization exercise on Swiss ball for 5 weeks in experimental group.

Table 1: Comparison between 0th and 5th week result of experimental group (N=10).

Week	Mean	SD	t-value	p
0 week	80.80	29.43	-6.44	0.00 (HS)
5 week	116.60	33.86		

HS = Highly Significant

Table 2 shows comparison of scores of hold time (seconds) in control group prior to exercise and after exercise for five weeks. There is significant difference in experimental group at 0 and 5 weeks of exercise programme ($t = -5.74$; $p = 0.00$). This suggests that improvement in trunk endurance after performing core stabilization exercise on floor for 5 weeks in control group.

Table 2: Comparison between 0th and 5th week result of control group (N=10).

Week	Mean	SD	t- value	p
0 week	54.80	29.30	-5.74	0.00 (HS)
6 week	86.20	26.05		

HS = Highly Significant

Table 3 shows comparison between experimental (116.6±33.86) and control (86.2±26.05) group after 5 weeks of exercise programme on Swiss ball and floor respectively. There is significant difference in trunk endurance measured in terms of trunk hold time (in seconds) in experimental ($t = 2.25$; $p = 0.03$) and control ($t = 2.25$; $p = 0.03$) group. This suggests trunk endurance improvement in experimental group as well as in control group.

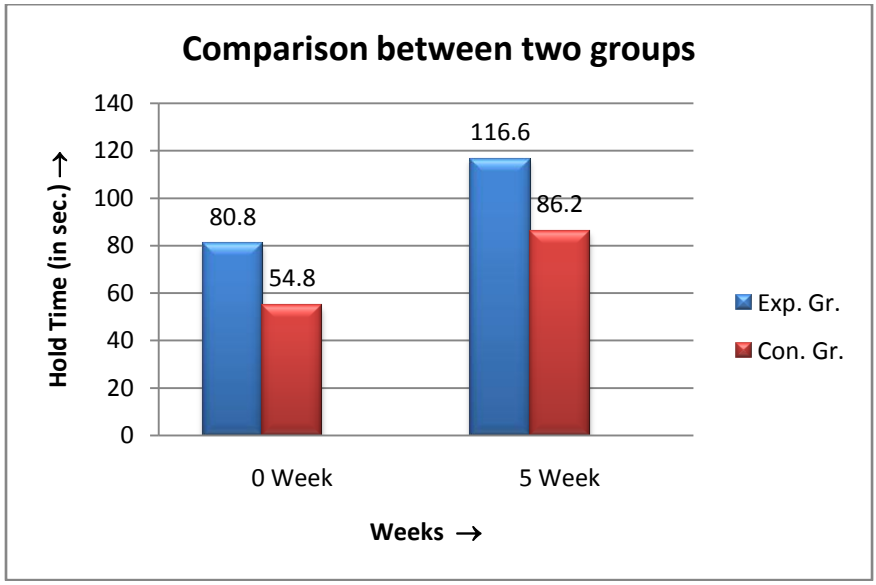
Table 3: Comparison between experimental and control group at 5th week (N=10).

Group	Mean	SD	t-value	p
Experimental	116.6	33.86	2.25	0.03*
Control	86.2	26.05	2.25	0.03*

*Significant as $p<0.05$

Graph 1 shows comparison between mean values of pre and post test scores of experimental and control group which clearly indicates improvement in trunk endurance in both the group.

Graph 1: Comparison between mean values of pre and post test scores of experimental and control group.



DISCUSSION

The purpose of the study was to determine the effect of core stabilization exercise on active trunk extensor endurance exercise protocol in healthy subjects. Here in this study we made 2 groups, which were given different exercises. Before starting exercise protocol trunk endurance of each subject of both groups was measured using Sorenson test. Similarly the test was carried out after five weeks and score was recorded.

The 5-week training program on Swiss ball in this study resulted in significant increase in endurance of trunk extensors when compared to floor exercises. Therefore, it is evident that performing abdominal and back exercises on unstable surfaces stressed the musculature and activated the neuroadaptative mechanisms that led to the early phase gains in stability and proprioceptor activity in this study. [19, 20, 21, 22]

Individuals beginning a regular exercise program or athletes performing early season conditioning could incorporate this short phase physioball training program that enhances trunk stability and may help the individual to progress to the next phase of their training program. [23, 24, 25] Wolfson et al. [25] demonstrated that short-term exposure to alter sensory input resulted in significant improvement in sway control and inhibition of inappropriate motor responses and improved core stability.

The score was analyzed using student t-test. From the analysis it was seen that there was significant difference between pre test and post test scores of both groups. This suggests that there is improvement in trunk endurance in both experimental and control group after performing exercises for 5 weeks. The current finding which shows significant improvement in trunk endurance after 5 weeks of exercise programme in experimental and control group is not consistent with the findings of previous study of Shankar G. et. al. [26] which shows insignificant differences in post test scores between the control group and experimental group after 6 weeks of exercise training. The reason for insignificance would be that core stabilization exercises might not be so much effective in improving trunk extensors endurance of normal population either because of the inability of normal subjects in proper activation of core stabilizers or the duration of the study might not be so much effective in getting results in normal healthy population.

Professor Eyal Lederman in his article "Myths of core stabilization" concluded that core stability exercises are no more effective and will not prevent injury more than any other forms of exercise. Thus core stability exercises are no better than other forms of exercise for back care.

Cairns et. al [27] concluded that there was no effect of core stabilization exercises on recurrent low back pain. They took 2 groups: conventional physiotherapy consisting of general active exercise and manual therapy, and conventional physiotherapy plus specific spinal stabilization exercises. Both group showed improved physical functioning. No statistically significant differences between the 2 groups were seen for any of the outcomes measured and there was no additional benefit of adding specific spinal stabilization exercises to a conventional physiotherapy package for patients with recurrent LBP, similarly when studies were conducted on healthy subjects it was concluded that there was no effect of core stabilization on trunk extensors.

The mode of action of core stabilization training still remains unclear, because it has not been shown to be capable of mechanically containing an unstable segment, even upon improvement of muscle activation. Other than this no direct long term effect of stabilization exercises on the status of the local stabilizing muscles has been demonstrated. Stabilization exercises do not appear to provide additional benefit to patients with sub acute or chronic low back pain who have no clinical signs suggesting the presence of spinal instability.

CONCLUSION

Our study shows that core stabilization exercises with Swiss ball and without Swiss ball are equally effective in improving trunk endurance.

Keypoints

Findings: Swiss ball exercises provided improved trunk extensor endurance of the core musculature.

Implication: Our findings can be used to help guide core stability training and rehabilitation, using a variety of Swiss ball and traditional abdominal exercises.

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