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Original Article

Physiotherapy Section

Swiss Ball Versus Mat Exercises For Core Activation of Transverse Abdominis in Recreational Athletes

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ABSTRACT

Introduction: Core stability is an essential component for improving athletic performance and injury prevention. Exercises on a Swiss ball and on the mat are two different ways of improving core stability. Comparison of these methods can help physiotherapists incorporate the better method for athletic training and rehabilitation.

Aim: To compare swiss ball and mat exercises for core stability of transverse abdominis in recreational athletes.

Materials and Methods: This pilot randomized control trial was performed on a total of 25 recreational athletes. Subjects were alternatively allocated into three different groups: group A performed swiss ball exercises; group B performed mat exercises; and group C was the control group.

Statistical analysis: Paired t-test for pre and post values within the group and one-way ANOVA for between the groups comparison was used.

Results: There was significant improvement in the core stability in Group A (Pre values: 3.6±2.06; Post values: 8.3±3.02; p-value: <0.05) and Group B (Pre values: 2.1±2.4; Post values: 4.3±2.5; p-value<0.05), however, improvement was more in group A compared to group B.

Conclusion: There was significant improvement seen in the recreational athletes performing exercises on Swiss ball as compared to athletes performing exercises on mat. Therefore, Swiss ball exercises can be included in the prehabilitation and rehabilitation stages of athletic training to prevent injury and enhanced recovery post injury, thereby, improving performance of the athletes.

Keywords: Athletic performance, Muscle strength, Physical endurance, Physical fitness

INTRODUCTION

Core muscles have been of considerable importance in the sports medicine [1]. Adequate core strength helps to maintain sufficient core stabilization [2]. Athletes, during dynamic and highly loaded movement require maintaining stability [3]. Core stability in sporting environment is defined as ability to maintain the position of trunk over the pelvis to efficiently produce, transfer and control the force and motion to the terminal segments during an athletic activity [4]. The role of core stability is different in athletes than the general population [5]. Athletes place more demand on their body with regard to force generation and transmission, therefore, more complex core exercises are used than the rehabilitation of the general population [6].

Core stability helps in improving athletic performance by helping in force generation during the complex athletic movements [7]. There is development of force and motion from proximal to distal segment by the "summation of force" principle [8]. In sports activities, there is a force transmission from the ground, transferred through the core muscles to the distal segments [8]. If there is adequate core strength this force transmission becomes efficient as large, bulky core muscles help in creating a rigid cylinder at the center and create a large amount of inertia against the body perturbation and provide the stable base for the distal segment mobility [9].

While analysing core strength and endurance there are certain muscles which need to be monitored. Transverse abdominis is one of the core muscles. It helps in bracing the spine during high loading activities [10]. Therefore, developing its endurance is very important in athletes [11]. There are various ways of developing core stability like contraction exercises, proprioceptive exercises, plyometric exercises, joint stability exercises [12]. Out of these proprioceptive exercises like spine loading on a wobble board, Swiss ball is believed to be important in physiotherapy [13]. Mat exercises are also a traditional way of developing core stability [14].

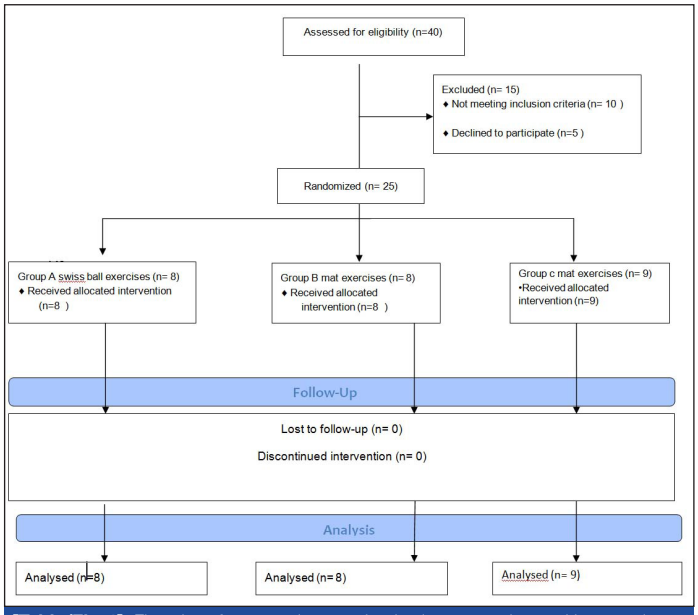
Studies have shown that mat exercises and Swiss ball exercises can help in development of core stability and core activation but there is a dearth of literature comparing these two techniques for improving core stability in athletic population. Hence, there is a need to compare the effect of mat exercises and Swiss ball exercises on the core stability for efficient conditioning and rehabilitation of the athletes, so that better technique can be incorporated in the rehabilitation and prehabilitation phases of athletic training.

MATERIALS AND METHODS

The study was quasi randomized control trial carried out for six months. Institutional ethical committee approval was obtained for the study. Recreational athletes of either gender, age 18-30 year, playing sports like football, basketball, tennis, badminton for at least two times in a week from last three months, with no abdominal surgeries were included in the study. Subjects with low back pain, any current or previous core strengthening experience, currently on any fitness program, any past history of fracture (spine, rib) or injury, any systemic illness, disc or spinal pathology were excluded. Subject information sheet was given and informed consent was obtained.

Subjects were alternatively allocated into three groups randomly: Group A was asked to performed core stability exercises on a Swiss ball, group B performed core stability exercises on mat and group C were asked to continue with their regular activities. Methodology has been explained in [Table/Fig-1].

In each group, baseline core stability for transverse abdominis muscle was assessed using the Stabilizer Pressure Biofeedback Unit, Chattanooga Group Inc., Hixson, TN 37343, USA. Pressure biofeedback was kept under the lower border of anterior superior iliac spine. The cuff was inflated to 70 mmHg and the subjects were asked to tuck in their stomach until the pressure dropped till 60 mmHg. Then the subjects were asked to hold the contraction for ten seconds for a maximum of ten repetitions [15]. Group A performed swiss ball leg lift and stomach vacuum exercise on a swiss ball, group B performed reverse crunch and stomach vacuum



[Table/Fig-1]: Flowchart for screening, randomization, screening and intervention.

on the mat, group C performed regular daily activities. Subjects were asked to do the exercises for three days in a week. After one month post intervention core stability readings using stabilizer pressure biofeedback were taken again with the same procedure. This was a pilot study, 25 recreational athletes were included in the study.

STATISTICAL ANALYSIS

Data was analysed using Statistical Package for Social Sciences (SPSS) version 15.0. Descriptive statistics were used for demographic variables. Paired t-test was used for comparison of pre and post values within the group and one-way ANOVA was used for between the group comparisons. Level of significance was fixed at 5% ($p<0.05$).

RESULTS

A total of 25 subjects were assessed as planned. The characteristics demographics have been shown in [Table/Fig-2]. There was a change in the core stability score in group A and group B after the intervention but there was no statistically significant changes seen in group C, presented in [Table/Fig-3].

Group	Mean age	Mean Height (cm)	Mean Weight (Kgs)	Mean BMI (Kg/m^2)	Gender F= Female, Male=M
A	23.22±1.397	171.79±8.63	65.58±11.16	26.16±2.22	F=4, M=4
B	22.22±1.394	170.60±7.76	63.11±12.21	25.32±1.13	F=7, M=1
C	21.22±1.567	169.1±1.11	70.22±13.22	26.72±2.14	F= 4, M=5

[Table/Fig-2]: Participant's characteristics.

Group	Pre values	Post values	p-value
A	3.6±2.06	8.3±3.02	<0.05
B	2.1±2.4	4.3±2.5	<0.05
C	3.2±3.4	3.8±3.8	0.36

[Table/Fig-3]: comparison Within the group.
Abbreviations: Group A: Swiss ball exercises, Group B: Mat exercises, Group C: Control group, p-value: p<0.05, Pre and post core stability score in mm Hg, Paired t-test was used for comparison

Post values	p-value
Group A and Group B	0.60
Group B and Group C	1.000
Group A and Group C	0.03

[Table/Fig-4]: comparison Between the group.
Abbreviations: Group A: Swiss ball exercises, Group B: Mat exercises, Group C: Control group, p-value: p<0.05, one-way ANOVA was used for within the group comparison

Comparison of core stability between the groups showed significant improvement in group A as compared to group B and group C, represented in [Table/Fig-4].

DISCUSSION

This study aimed at comparing the effect of Swiss ball and mat exercises on the core stability of transverse abdominis in the recreational athletes. The group A performed core exercises on Swiss ball, group B performed core exercises on mat and group C were asked to continue with their daily activities. Before the intervention, baseline core stability scores of transverse abdominis muscle was recorded and after one month of core stability exercise program, values were taken again for all the three groups using pressure biofeedback unit. The pressure biofeedback unit is a safe and non-invasive method of measuring core stability while loading the body [16]. It can be inflated to mold to the irregularly shaped surface of the back, is highly sensitive to movement and positional change and can provide indices of displacement [16]. The mean value for core stability of Swiss ball group (group A) before intervention was 3.6±2.0, which was higher post intervention 8.3±3.02. The p-value was <0.05. The mean value for core stability of mat exercises group (group B) was 2.1±2.4, which increased to 4.3±2.5, p-value was <0.05. The mean value for core stability for control group (group C) was 3.2±3.4, and post intervention was 3.8±3.8 with p-value 0.36, so there was no significant change in this group post intervention. There was significant change in group A as compared to group B and group C. This can be because performing core exercise on an unstable surface like swiss ball increases the muscular activity of transverse abdominis muscle more and it results in increasing the recruitment pattern of the muscle more [12]. It can also be due to increase in the perturbations on Swiss ball, more control of centre of gravity with a limited base of support, due to reduced contact area, performing activity on swiss ball is more in vertical position than on mat, thus more muscle recruitment is required to produce spinal stabilization, may be subjects were highly motivated and found swiss ball activities to be fun [17,18].

Our results also show that there was more core stability in subjects who performed exercise on the mat than the control group. This can be because the exercises like abdominal vacuum and reverse crunch increase the magnitude of muscle activation and recruitment of motor units in the core muscles. This helps in the development of core stability [19]. Our study also has similar findings to Vera-Garcia et al., they studied the effect of curl up exercise on stable and unstable surface. They found that performing curl-ups on unstable surfaces changes both the level of muscle activity and the way that the muscle coactivates to stabilize the spine and the whole body. This finding suggests a much higher demand on the motor control system, which may be desirable different sporting activities [20]. Our study shows similar results to study done by Marshall et al., they compared the core muscles activity on swiss ball and on floor. Participants were made to perform set of exercises on the swiss ball and on floor and their activation was observed using electromyography. They found that for the transversus abdominus, the activation on the unstable surface was greater as compared to the stable surface [21].

LIMITATION

The limitations of our study are that males and females groups were not separated. Core muscle activity was not recorded using electromyography biofeedback, to quantify the amount of muscle activity. Core stability was measured only for transverse abdominis muscle, other global and local core muscles were not considered during evaluation of core stability. Confounding factors like speed, agility, balance training, motor control was not considered. Compressive forces or shear loading on the spine during the task

were not considered. It is optimal kinematics when safety and tissue loading properties of various movements is considered.

CONCLUSION

From the result of study it can be concluded that within short time period core stability can be improved in the athletes using swiss ball. It doesnot require any sophisticated tools. It is not a time-consuming program, athletes can take out the time conveniently even in their busy schedules. It is easy to learn and perform these exercises, once learned assistance is not required. Thus, core exercises when performed on swiss ball can improve core stability can help improve athletic performance and can be helpful in injury prevention.

REFERENCES

[1] Hibbs AE, Thompson KG, French D, Wrigley A, Spears I. Optimizing performance by improving core stability and core strength. *Sports Med*. 2008;38(12):995-1008.

[2] Stanton R, Reaburn PR, Humphries B. The effect of short-term Swiss ball training on core stability and running economy. *J Strength Cond Res*. 2004;18(3):522-28.

[3] McGill SM. Low back stability: from formal description to issues for performance and rehabilitation. *Exerc Sport Sci Rev*. 2001;29(1):26-31.

[4] Axler CT, McGill SM. Low back loads over a variety of abdominal exercises: searching for the safest abdominal challenge. *Med Sci Sports Exerc*. 1997;29(6):804-11.

[5] Huxel Bliven KC, Anderson BE. *Core stability training for injury prevention*. (1941-7381 (Print)).

[6] Myer GD, Ford KR, Palumbo JP, Hewett TE. Neuromuscular training improves performance and lower-extremity biomechanics in female athletes. *J Strength Cond Res*. 2005;19(1):51-60.

[7] Wirth K, Hartmann H, Mickel C, Szilvas E, Keiner M, Sander A. Core Stability in Athletes: A Critical Analysis of Current Guidelines. (1179-2035 (Electronic)).

[8] Tinto A, Campanella M, Fasano M. Core strengthening and synchronised swimming: TRX(R) suspension training in young female athletes. *J Sports Med Phys Fitness*. 2016.

[9] Leetun DT, Ireland ML, Willson JD, Ballantyne BT, Davis IM. Core stability measures as risk factors for lower extremity injury in athletes. *Med Sci Sports Exerc*. 2004;36(6):926-34.

[10] Sharrock C Fau - Cropper J, Cropper J Fau - Mostad J, Mostad J Fau - Johnson M, Johnson M Fau - Malone T, Malone T. A pilot study of core stability and athletic performance: is there a relationship? (2159-2896 (Electronic)).

[11] Kibler WB, Press J, Sciascia A. The role of core stability in athletic function. *Sports Med*. 2006;36(3):189-98.

[12] Silfies SP, Ebaugh D, Pontillo M, Butowicz CM. *Critical review of the impact of core stability on upper extremity athletic injury and performance*. (1809-9246 (Electronic)).

[13] Rajan Balakrishnan, Eman Yazid, Mahat MFB. Effectiveness of the core stabilisation exercise on floor and Swiss ball on individual with non-Specific low back pain. *International Journal of Physical Education Sports and Health*. 2016;3(1):347-56.

[14] Hides JA, Jull GA, Richardson CA. Long-term effects of specific stabilizing exercises for first-episode low back pain. *Spine (Phila Pa 1976).* 2001;26(11):E243-48.

[15] Richardson, Carolyn. In: Hodges PW, Hides J, editors. Therapeutic Exercise for Lumbopelvic Stabilization (Second Edition). Edinburgh: Churchill Livingstone; 2004. Pp. 247-63.

[16] Jull G, Richardson C, Toppenberg R, Comerford M, Bui B. Towards a measurement of active muscle control for lumbar stabilisation. *The Australian Journal of Physiotherapy*. 1993;39(3):187-93.

[17] Lehman GJ, Hoda W, Oliver S. Trunk muscle activity during bridging exercises on and off a Swiss ball.*Chiropr Osteopat*. 2005;13:14.

[18] Hodges PW. Is there a role for transversus abdominis in lumbo-pelvic stability? *Man Ther*. 1999;4(2):74-86.

[19] Vezina MJ, Hubley-Kozey CL. Muscle activation in therapeutic exercises to improve trunk stability. *Arch Phys Med Rehabil*. 2000;81(10):1370-79.

[20] Vera-Garcia FJ, Grenier SG, McGill SM. Abdominal muscle response during curl-ups on both stable and labile surfaces. *Phys Ther*. 2000;80(6):564-69

[21] Marshall PW, Murphy BA. Core stability exercises on and off a Swiss ball.*Arch Phys Med Rehabil.* 2005;86(2):242-49.

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