

# Effect of Swiss Ball and Thera Band Exercises on Muscle Endurance in Healthy Individuals in the Age Group of 18-25 Years

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## ABSTRACT

### AIM:

Aim of the study is to find the effect of Swiss ball and Thera Band exercises on muscle endurance in healthy individuals in age group of 18-25 years.

### OBJECTIVES:

To study the effect of Swiss ball exercises on muscle endurance in healthy individuals in age group of 18-25. To study the effect of Thera band exercises on muscle endurance in healthy individuals in age group of 18-25 years. To compare the effect of Swiss ball and Thera band Exercises on muscle endurance in healthy individuals in age group of 18-25 years.

### METHODOLOGY:

In this comparative study 50 subjects in the age group of 18-25 years who fulfilled the inclusion criteria were recruited from MVP'S College of Physiotherapy. Subjects were then were divided into two groups- Group A- Swiss ball exercises and Group B – Thera band exercises. Then the treatment was given once a day for 4 times per week for 4 weeks with 10 repetitions and a 10-second hold. Outcome measures of Curl up test and Modified Sorensen Test were evaluated before and after treatment session.

**RESULT:** ANOVA was found extremely significant when the data was compared within the group. And unpaired t test was found significant when data was compared between the groups.

### CONCLUSION:

The study concluded that Thera band exercises are more effective than Swiss ball exercises in terms of improving muscle endurance in the age group of 18-25 years.

**Keywords:** Swiss ball, Thera band, Metronome, Masking tape, Muscle endurance, Core stabilization, Balance.

## INTRODUCTION

Increased resistance and endurance training for core muscles allows for more successful incorporation of arm and leg movements into sporting performance. In order for the arms and legs to produce the desired level of strength and to maintain the movement in the same direction, the core muscles must keep the spine in balance.<sup>1</sup>

Exercises on unstable surfaces increase the level of muscle activity. For this reason,

higher core muscle activities are seen in exercises with the Swiss Ball. In exercises with the Swiss Ball, the motor control system is needed more for the stabilization of muscles surrounding the spine. As for the resistance produced by the Thera band, it increases with stretching of the band while allowing work on multiple joints at the same time. In addition, as the exercise range of motion increases, the resistance provided by the Thera band increases, which increases the

muscle fiber count. Increased number of muscle fibers leads to increased adaptation to the exercise-acquired muscle strength.<sup>1</sup> Swiss-ball core training programs are among the most popular trends in physiotherapy and strength and conditioning programs. Benefits of Swiss-ball core training exercises that facilitate spinal stability and balance have often been emphasized by researchers to develop strength, endurance, flexibility, and neuromuscular control as a cost effective and enjoyable way to prevent lower back injury.<sup>1</sup> Core training emphasizes strength and conditioning of the local and global muscles that work together to stabilize the spine. The global (outer) muscles include rectus abdominus, obliques, latissimus, and erector spinae. They are the torque producing muscles mostly composed of type 2 (fast twitch) muscle fibers, and they control extension and flexion of the trunk. The local (deeper) muscle groups include transverse abdominus, multifidus, and pelvic floor. They are mostly composed of type 1 (slow-twitch) muscle fibers that allows them to improve trunk endurance.<sup>2</sup> Endurance is mechanically defined as either the point of isometric fatigue, where the contraction can no longer be maintained at a certain level or as the point of dynamic fatigue, when repetitive work can no longer be sustained at a certain force level.<sup>1</sup> The main point in endurance training is to increase muscle endurance and reduce the risk of injury of intervertebral discs, facet joints and surrounding structures to minimum, by continuing the Musculo ligamentous control.<sup>3</sup> We need to understand the benefits a good core conditioning programme will decrease the likelihood of back and neck pain, incontinence, rupture discs, muscle and ligamentous strains. Anatomically speaking, the core is an integrated functional unit consisting of lumbo-pelvic-hip complex and the thoracic and cervical spine. It is a muscular corset that lends integrity and support to the body.<sup>1</sup> Core muscles are referred as spinal stabilizers. The normal function of the stabilizing system is to provide sufficient

stability to the spine to match the instantaneously varying stability demands due to changes in spinal posture, static and dynamic loads.<sup>1</sup>

Core stability allows the simultaneous improvement of arm and leg strength. The presence of a strong and stable lumbopelvic region plays a role in the energy transfer required to create strength in the extremities. Core stabilization is an exercise program involving the activation of multifidus, transverse abdominis, and pelvic floor muscles stabilizing the lumbar region.<sup>1</sup> Therefore, trunk muscle endurance training has been

recommended to elevate fatigue threshold and improve performance. Core training are used for fitness purposes in healthy individuals, and to improve performance and reduce injuries.<sup>1</sup>

## **METHOD AND MATERIAL**

### **Methodology:**

#### **Selection and Description of Participants**

In this comparative study 50 subjects in the age group of 18-25 years who fulfilled the inclusion criteria were recruited from MVP'S College of Physiotherapy. Subjects were then divided into two groups- Group A- Swiss ball exercises and Group B – Thera band exercises. Then the treatment was given once a day for 4 times per week for 4 weeks with 10 repetitions and a 10-second hold. Outcome measures of Curl up test and Modified Sorensen Test were evaluated before and after treatment session of post 2 and 4 weeks.

In Group A (Swiss ball): Abdominal curl exercise, Back extension exercise, Pelvic bridge exercise, Swiss ball leg raise exercise. In Group B (Thera band): Thera band loop abdominal crunch exercise, Thera band loop abdominal oblique crunch exercise, Thera band long-sitting back extension, Thera band loop trunk side bending.

**INCLUSION CRITERIA** for the subject (1) Age group 18 – 25 years. (2) Both males and females. (3) BMI (Body Mass Index): 18.5 – 24.9.

**EXCLUSION CRITERIA** (1) Any previous or current experience in core strengthening. (2) Low back ache. (3) Low back pain radiating to lower limb. (4) History of trauma. (5) Associated neurological symptoms. (Numbness, tingling, weakness). (6) Injuries to lower limb. (7) Pregnancy. (8) Any contraindication for exercises. (Recent fracture). (9) History of recent abdominal, back, lower limb surgeries.

**Materials Used:** Pen, Paper, Consent form, Swiss ball, Thera band, Metronome, Masking tape.

**Procedure:**

**OUTCOME MEASURES**

1. Modified Sorensen Test
2. Curl up Test

- **Trunk Extensor (Lower Back) Endurance:** The trunk extensor (lower back) muscular endurance

e)

will be assessed by the number of back extensions completed without rest using **Modified Sorensen test**.

- a) The trunk of the subjects will be positioned horizontally unsupported from the upper border of the iliac crest while prone on an examination table.
- b) During the test, the buttocks and legs will fixed to the table by 3 wide straps, and the hands will be placed at the side of head.
- c) The subjects will be instructed to perform back extensions within a range of 45° while maintaining the natural lordic curve. The examiner will give instructional and verbal cues during the test.
- d) The number of repetitions will be recorded when subjects could no longer remain horizontal.

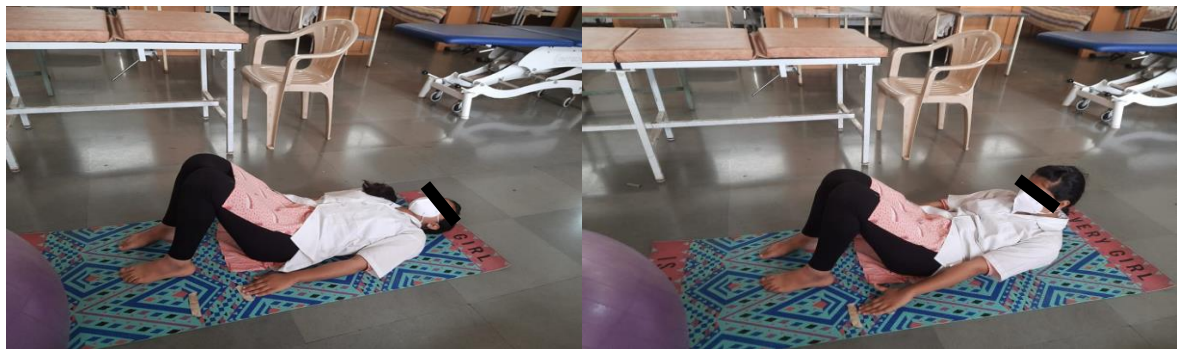


**Fig: Modified Sorensen test**

- **Trunk Flexor (Abdominal) Endurance:** Trunk flexor (abdominal) muscular endurance will be assessed by the **curl-up test**.
- a) The position is supine and arms will be placed at the sides, palms facing down with the middle fingers touching a piece of masking tape.
  - b) A second piece of masking tape will be placed 12 cm apart. Feet will be flat on the ground with knees bent at 90 degrees.
  - c) A metronome will be set to 50 b, and the subjects will do slow, controlled curl-ups to lift the shoulder blades off the mat in time with the metronome.



- d) The subjects will perform as many curl-ups as possible without pausing by touching their finger tips to both pieces of the masking tape.



**Fig: Curl-up test**

**GROUP A [Swiss ball exercises]**

**(1) Abdominal curl exercise :**

Lower back will be placed on top of the ball with feet flat on the floor and thighs parallel to the floor. Keep the arms behind the head. Keep both the feet firmly on the floor as you curl up making sure to keep the ball stable.

**(2) Bridging exercise:**

Lie supine on the ground with your lower legs on the ball. Keeping your arms on the side. Lift your hips off the ground until there is a straight line from your heels to your upper back. Hold the position for 10 second and then return to starting position.

**(3) Back extension exercise:**

Lie face down on a Swiss ball with your feet against a bench or wall. Place your hands behind your head. Lift your torso upward by flexing your glutes, hamstrings, and lower back until your back forms a straight line. Hold for 10 sec and, then return to the starting position.

**(4) Swiss ball leg raise:**

Lie supine on the floor with your knees slightly bent and hold the ball between your lower legs. Lift your legs up until the upper thigh touches the lower abdominals while maintaining the same knee angle. Keep your feet off the ground through the exercise.



**Fig: Abdominal curl exercise**



**Fig: Bridging exercise**



**Fig: Back extension exercise**



**Fig: Swiss ball leg raise**

### **GROUP B [THERABAND EXERCISES]**

#### **(1) Thera Band loop abdominal crunch:**

Securely attach the ends of the band to a stationary object near the floor. Lay on your back with your knees bent 90. Extend arms in front and grasp the middle of the loop with hands close together. Keep elbows straight in front and curl trunk upward, lifting shoulder blades from floor. Hold and slowly return.

#### **(2) Long sitting back extension:**

Secure the tubing to your feet by wrapping the tubing around each foot. Grasp the handles, keeping your elbows bent at your side. Keeping your lower back and knees straight, lean backwards, stretching the tubing. Hold and slowly return. Don't arch your back.

#### **(3) Thera Band loop abdominal oblique crunch:**

Securely attach the ends of the band to a stationary object near the floor. Lay on your back with your knees bent. Extend 1 arm in front and grasp the middle of the loop. Keep elbow straight in front and curl trunk upward toward opposite knee, lifting shoulder blade from floor. Hold and slowly return. Keep your elbows straight and be sure to lift shoulder blade off floor.

#### **(4) Trunk side bending:**

Begin with the middle of the tubing secure under both feet. Grasp each handle. Lean toward the side you are strengthening. Hold and slowly return.



**Fig: Thera band loop abdominal crunch**



**Fig: Long sitting back extension**



**Fig: Thera band loop abdominal oblique crunch      Fig: Trunk side bending**

### **Statistical Analysis**

The study comprised of 50 subjects out of which group A consisted of 25 subjects who were given Swiss Ball exercises and group B consisted of 25 subjects who were given Thera Band exercises.

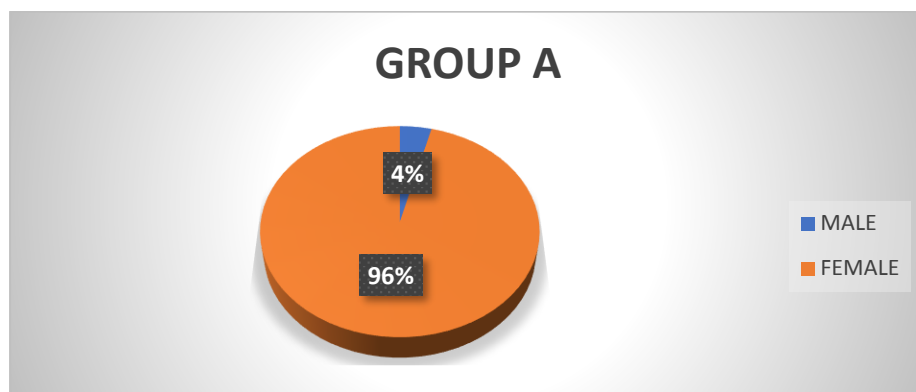
After the intervention pre and post treatment values within the groups was compared using One-way ANOVA and the difference between two groups was compared using unpaired t – test.

### **DATA PRESENTATION AND**

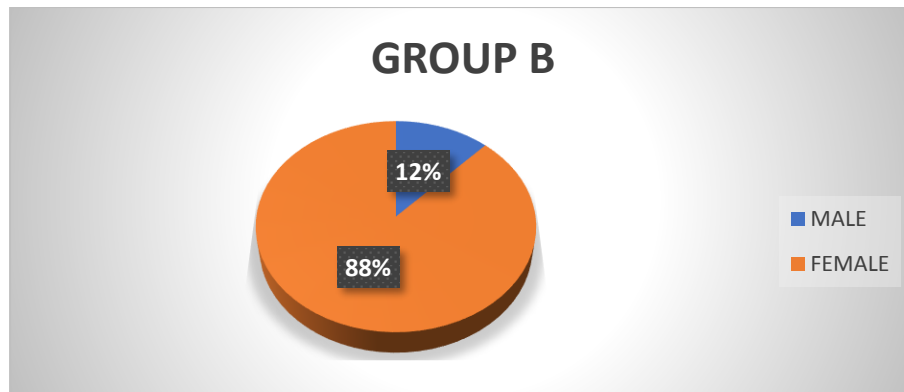
### **INTERPRETATION**

**TABLE NO.1:** GENDER DISTRIBUTION FOR GROUP A & B

	MALE	FEMALE
GROUP A	1	24
GROUP B	3	22



**GRAPH 1:** PIE DIAGRAM DENOTING GENDER DISTRIBUTION OF GROUP A



**GRAPH 2:** PIE DIAGRAM DENOTING GENDER DISTRIBUTION OF GROUP B

**TABLE NO. 1 [ GROUP A (SWISS BALL EXERCISES)]**

Comparison of pre and post mean treatment scores of Curl-Up Test and Modified Sorensen test in group A using One-way ANOVA.

One way ANOVA	Curl-Up Test			Modified Sorensen Test		
	Pre Rx	Post Rx		Pre Rx	Post Rx	
		2 weeks	4 weeks		2 weeks	4 weeks
Mean	5.44	9.4	14.24	2.92	7.16	10.92
S.D.	2.063169	3.135815	3.821867	0.702377	1.7	2.215852
F value	50.77			144.9		
p-value	<0.0001			<0.0001		
significance	Extremely Significant			Extremely Significant		

**TABLE NO.2 [ GROUP B {THERA BAND EXERCISE}]**

Comparison of pre- and post-mean treatment scores of Curl-up test and Modified Sorensen Test in group B using One Way ANOVA test.

One way ANOVA	Curl-Up Test			Modified Sorensen Test		
	Pre Rx	Post Rx		Pre Rx	Post Rx	
		2 weeks	4 weeks		2 weeks	4 weeks
Mean	7.04	11.04	17.12	3.52	8.6	12.84
S.D.	3.576311	5.078386	5.746883	1.50333	2.94392	3.223352
F value	26.98			76.61		
p-value	<0.0001			<0.0001		
significance	Extremely Significant			Extremely Significant		

**TABLE NO.3 & 4 [CURL-UP & MODIFIED SORENSEN TEST]**

Comparison of mean difference scores in group A and group B using unpaired t- test.

Unpaired t-test	Curl-up Test					
	Pre Rx		Post 2 weeks		Post 4 weeks	
	A	B	A	B	A	B
Mean	5.44	7.08	9.4	11.04	14.24	17.12
p-value	0.0586		0.0217		0.0423	
t-value	1.938		1.375		2.086	
Significance	Not significant		Significant		Significant	

**TABLE NO. 4:**

Unpaired t-test	Modified Sorensen Test					
	Pre Rx		Post 2 weeks		Post 4 weeks	
	A	B	A	B	A	B
Mean	2.92	3.52	7.16	8.6	10.92	12.84
p-value	0.0769		0.0394		0.0178	
t-value	1.808		2.118		2.454	
Significance	Not Significant		Significant		Significant	



## RESULT

- In group A, after comparing the results of pre- and post-intervention within the group using One way ANOVA test, the P value is <0.0001 that is extremely statistically significant in improving Curl-up test score.
- In group A, after comparing the results of pre- and post-intervention within the group using One way ANOVA test, the P value is <0.0001 that is extremely statistically significant in improving Modified Sorensen test score.
- In group B, after comparing the results of pre- and post-intervention within the group using One way ANOVA test, the P value is <0.0001 that is extremely statistically significant in improving Curl-up test score.
- In group B, after comparing the results of pre and post intervention within the group using One way ANOVA test, the P value is <0.0001 that is extremely statistically significant in improving Modified Sorensen test score.
- After comparing the results between two groups by using unpaired t-test for Swiss ball and Thera band exercises that is group A and group B –
- The P value for Curl-up test after post 2 weeks is 0.0217 that is statistically significant and after post 4 weeks is 0.0423 that is statistically significant.
- The P value for Modified Sorensen test after post 2 weeks is 0.0394 that is statistically significant and after post 4 weeks is 0.0178 that is statistically significant. So, thera band exercises are more effective in improving muscle endurance in healthy individual in the age group of 18-25 years.

## DISCUSSION

The purpose of this study was to compare the effectiveness of Swiss ball and Theraband Exercise on muscle endurance in the age group of 18- 25 years.

In this study, 50 subjects were assigned, 25 subjects were in group A who received swiss ball exercises for once a day for 4 times per

week for 4 weeks with 10 repetitions and a 10-second hold. Group B consisted of 25 subjects who received Thera band exercises for once a day for 4 times per week for 4 weeks with 10 repetitions and a 10-second hold.

**In group A**, the P value, for ANOVA test of Curl up test was <0.0001 (extremely statistically significant), the P value for Modified Sorensen Test was < 0.0001 (extremely statistically significant). Thus, the study showed that Swiss ball exercises was effective in improving the muscle endurance.

**Varun Naik (Jul - Sep – 2020):** found that the Swiss ball has become an acknowledged therapeutic apparatus in physiotherapy centers as well as among sports medicine personals and those trying to advance a healthy lifestyle<sup>7</sup>.

Swiss ball has been consolidated into strength training and promoted as the way to all the more adequately trains the musculoskeletal system. Performing strength exercises on Swiss ball has been pushed on the conviction that a labile surface will give a greater challenge to trunk musculature, increment the dynamic balance and potentially trains to balance out their spine to prevent and treat injury<sup>7</sup>.

Kamatchi K (2020) suggested that the majority of the research work done on abdominal muscle exercise were comparing them with traditional mat exercises, and the benefits of Swiss ball exercise appear to have been applied to whole body exercise equally<sup>15</sup>.

Swiss ball is a type of therapeutic tool, which is used to improve the muscle tone, balance, control, structure and coordination of the movement achieving a greater activation of musculature<sup>15</sup>.

A. Sathish Kumar ( January, 2012) stated that the Swiss ball permits a range of exercises that are based on the ability of the user to move with the motion of the ball while performing the exercise, using the ball to both support the body during the movement as well as to provide a measure of resistance to the muscles employed in the movement<sup>14</sup>.



Rafael F. Escamilla (May 2010) found that the use of Swiss ball training for core muscle development has been popular for several years. 8 multiple studies have examined core muscle recruitment during varying types of Swiss ball abdominal exercises and during traditional abdominal exercises like the crunch (abdominal curl-up) and bent-knee sit up<sup>16</sup>.

Most researchers who studied the use of Swiss ball exercises quantified abdominal muscle activity during the crunch, push-up, and bench press exercises, and typically investigated the recruitment patterns of only 1 or 2 muscles. Numerous other Swiss ball exercises are used in training and rehabilitation to enhance core development and stability<sup>16</sup>.

Swiss ball exercises employed in a prone position were as effective or more effective in generating core muscle activity compared to the traditional crunch and bent-knee sit-up<sup>16</sup>.

In group B, the P value, for ANOVA test of Curl up test was  $<0.0001$  (extremely statistically significant), the P value for Modified Sorensen Test was  $< 0.0001$  (extremely statistically significant). Thus, the study showed that Theraband exercises was effective in improving the muscle endurance. For unpaired t-test the p value for Curl up test between the Group A and B was 0.0423 (statistically significant) and the unpaired t test for Modified Sorensen Test the p value was 0.0178 (statistically significant). Varun Naik (Jul - Sep - 2020), along with American Physical Therapy Association (APTA), proposed that Thera band elastic resistance has been demonstrated to increase strength, mobility, and function. Evidence Based exercise programs using Theraband and tubing rehabilitating injuries, improve the functional capacity and improve overall performance. The utilization of elastic resistance products in therapeutic exercise programs has widespread in rehabilitation and has been demonstrated to be effective strategies for giving resistance and improving muscle strength<sup>7</sup>.

A study done by Dr. Jaynesh Vandra : (December 2020), proposed that when resistance is applied it generates strength curve by the tube is equal to the human strength curve. This is because of the angle generated by the lever arm and elastic resistance. This cause increase in ROM during exercise, also may increase in resistance provided by tube to body. Which helps to use more muscle fibers and further to improve / gain muscle strength. And the present study is also focusing on the same, by using resistance band during exercise helps to gain more muscle strength<sup>17</sup>.

Pelin Aksen-Cengizhan (2018) found that the resistance produced by the Theraband, it increases with stretching of the band while allowing work on multiple joints at the same time<sup>1</sup>.

In addition, as the exercise range of motion increases, the resistance provided by the Theraband increases, which increases the muscle fiber count. Increased number of used muscle fibers leads to increased adaptation to the exercise-acquired muscle strength<sup>1</sup>.

Peeyoosha V Nitsure (2014) stated that Thera band resistance is a unique type of resistance training compared to other traditional forms, such as isotonic or isokinetic resistances. When applied as an exercise, Thera band resistance offers a strength curve (torque) similar to human strength curves and isotonic resistance exercises (a bell-shaped curve). This is because of the angle created between the elastic resistance and the lever-arm, the "Force Angle"<sup>5</sup>.

The benefit provided by the fact that elastic resistance does not rely on gravity and that it provides continuous tension to the muscles being trained. Another unique benefit of elastic resistance is that it offers linear variable resistance. This means that, as the range of motion of the exercise increases, the resistance provided by the elastic equipment increases that is the number of muscle fibers that are being used in the exercising muscle increase. More the muscle fibers used, the greater the adaptations in muscle strength that can be achieved with the training program<sup>5</sup>.

It was also found that as the Thera band group had benefit of an added resistance to the muscles, it showed a significant improvement in terms of core strength measured post-session when compared to pre-session whereas yoga group showed significant increase in flexibility<sup>5</sup>.

When the findings are evaluated in general, the effects of Swiss Ball and Thera band core exercises on core stabilization in normal healthy individuals showed improvement in balance and stabilization. Swiss Ball and Thera band applications increase overall body stability.

Despite improvements in the practice of Swiss Ball for balance improvement, Theraband applications showed a better improvement, which is among the most important findings of the study. In this respect, it may be beneficial to increase the number of core exercises made with Thera band in training programs that are primarily aimed at improvement of muscle endurance. Thera band exercises included in the present study was based on providing the resistance and force elongation which has proven to be effective in increasing core strength. Also, Thera band does not rely on gravity and provides continuous tension to the muscles being trained improving the strength of the muscle group.

Whereas, Swiss ball exercises included in the present study focused more on improving the dynamic balance and stabilization of the muscle surrounding the spine.

Thus, Thera band exercises are more effective than Swiss ball exercises in terms of improving muscle endurance.

## CONCLUSION

The study concluded that Thera band exercises are more effective than Swiss ball exercises in terms of improving muscle endurance in the age group of 18-25 years.

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**Conflict of Interest:** None

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**Ethical Approval:** Approved

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