

Effect of Proprioceptive Training Versus Swiss Ball Exercise on Dynamic Balance in Sedentary Overweight and Obese Individuals

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Abstract

Background: Sedentary lifestyle and obesity are associated with impaired balance, reduced postural control, and an increased risk of musculoskeletal disorders. Dynamic balance deficits in overweight and obese individuals are mainly related to altered body mechanics, increased abdominal fat, and displacement of the centre of gravity.

Objective: To compare the effects of proprioceptive training and Swiss ball exercise on dynamic balance among sedentary overweight and obese individuals.

Methods: A comparative study with a single-blinded parallel-group design was conducted among 40 sedentary overweight and obese individuals aged 18–26 years. Participants were randomly allocated into two groups: Experimental Group 1 (proprioceptive training, $n = 20$) and Experimental Group 2 (Swiss ball exercise, $n = 20$). Both groups underwent intervention for 4 weeks, 3 sessions per week, with each session lasting 30 minutes. Dynamic balance was assessed using the Modified Star Excursion Balance Test (SEBT/Y-Balance Test). Statistical analysis included paired t-test and independent t-test with significance level set at $p < 0.05$.

Results: Both groups demonstrated statistically significant improvement in dynamic balance following 4 weeks of intervention ($p < 0.05$). However, the proprioceptive training group showed greater improvement in SEBT composite scores compared to the Swiss ball exercise group.

Conclusion: Both proprioceptive training and Swiss ball exercise were effective in improving dynamic balance in sedentary overweight and obese individuals. However, proprioceptive training demonstrated superior improvement in postural stability and balance performance.

Keywords: Proprioceptive training, Swiss ball exercise, Dynamic balance, Sedentary lifestyle, Obesity, Y-Balance Test

INTRODUCTION

Sedentary lifestyle is characterized by low levels of physical activity and prolonged sitting behaviour with minimal energy expenditure [1]. Sedentary behaviour is generally defined as activities performed at 1.0–1.5 metabolic equivalent units (METs), which may contribute significantly to obesity and related health complications [2]. Obesity has become a major global public health concern and is associated with increased risk of cardiovascular disease, diabetes mellitus, musculoskeletal disorders, and postural instability [3].

Body Mass Index (BMI) is commonly used to classify overweight and obesity based on body weight and height [4]. Increased body mass in overweight and obese individuals alters body geometry and contributes to postural imbalance due to anterior displacement of the centre of gravity caused by increased abdominal fat accumulation [5–7]. These biomechanical changes may reduce postural control and increase the risk of falls.

Balance is defined as the ability to maintain the centre of gravity within the base of support through coordinated neuromuscular activity [8]. Dynamic balance refers to maintaining postural stability while performing movements or transitioning between positions [9]. Obesity negatively affects balance because excessive body weight places additional stress on joints and alters sensory feedback mechanisms [10].

The Star Excursion Balance Test (SEBT) and Modified Star Excursion Balance Test are widely used tools for assessing dynamic balance and postural control [11,12]. These tests evaluate neuromuscular coordination, proprioception, and lower limb stability.

Core strengthening exercises using Swiss balls have gained popularity due to their effectiveness in improving trunk stability, balance, and neuromuscular control [13]. Swiss ball exercises activate both local and global stabilizing muscles, thereby enhancing spinal stability and postural alignment.

Proprioception refers to the body's ability to detect joint position and movement through sensory receptors located in muscles, tendons, ligaments, and joints [14]. Proprioceptive training improves neuromuscular coordination, postural reflexes, and joint stability, thereby enhancing balance control [15]. Previous studies have reported significant improvement in dynamic balance following proprioceptive exercises in overweight and obese individuals [16,17].

Although both Swiss ball exercises and proprioceptive training have shown positive effects on balance, limited studies have compared their effectiveness among sedentary overweight and obese individuals. Therefore, the present study aimed to compare the effects of proprioceptive training and Swiss ball exercise on dynamic balance in sedentary overweight and obese individuals.

METHODOLOGY

Study Design

A comparative study with a single-blinded parallel-group design was conducted.

Participants

Forty sedentary overweight and obese individuals aged between 18 and 26 years were recruited through outpatient services. Participants were randomly allocated into two groups using the lottery method.

- Experimental Group 1 (EG1): Proprioceptive Training (n = 20)
- Experimental Group 2 (EG2): Swiss Ball Exercise (n = 20)

Inclusion Criteria

- Age between 18–26 years
- BMI between 24.9–29.9 kg/m² according to Asian BMI classification
- Global Physical Activity Questionnaire (GPAQ) score less than 75 minutes/week
- Both genders

Exclusion Criteria

Participants with neurological disorders, vestibular dysfunction, diabetic neuropathy, musculoskeletal disorders, visual impairment, systemic disease, previous orthopaedic surgery, or endocrine disorders were excluded.

Outcome Measure

Y-Balance Test / Modified SEBT

Dynamic balance was assessed using the Modified Star Excursion Balance Test involving anterior, posteromedial, and posterolateral reach directions. Three trials were performed for each direction, and the average score was normalized to limb length.

Intervention Protocol

Swiss Ball Exercise Group

- Frequency: 3 sessions/week
- Duration: 30 minutes/session
- Total Duration: 4 weeks
- Intensity: Based on Rate of Perceived Exertion (RPE)

Exercises included:

- Swiss ball straight arm crunch
- Swiss ball alternate arm and leg extension
- Swiss ball squat
- Swiss ball back extension
- Swiss ball leg raise

Proprioceptive Training Group

- Frequency: 3 sessions/week
- Duration: 30 minutes/session
- Total Duration: 4 weeks
- Intensity: Based on Rate of Perceived Exertion (RPE)

Proprioceptive Training Protocol

Category	Exercise Description	Repetitions / Duration
No Material	Stand on one leg with the knee slightly bent and maintain balance for 5 seconds.	10 repetitions for both limbs
No Material	Stand on one leg with the hip and knee bent while maintaining balance for 5 seconds.	10 repetitions for both limbs
Ball (Pairs)	Maintain single-leg balance while throwing and catching a ball with a partner positioned 5 meters away.	5 throws/catches × 10 repetitions
Balance Board	Stand on one leg on a balance board for 30 seconds and then switch legs.	Repeat twice for both limbs
Balance Board	Perform knee flexion exercise while maintaining balance on the balance board.	10 repetitions
Ball + Balance Board	Maintain balance on the balance board while performing ball throwing and catching task.	10 repetitions × 2 sets

RESULTS

A total of 40 participants completed the study. Baseline demographic characteristics including age, BMI, and GPAQ scores showed no statistically significant difference between groups ($p > 0.05$), indicating homogeneity between the groups.

Both groups demonstrated statistically significant improvement in dynamic balance following intervention ($p < 0.05$). However, the proprioceptive training group showed greater improvement in Y-Balance Test composite scores compared to the Swiss ball exercise group.

Table 1. Baseline Demographic Characteristics of Participants

Variable	Proprioceptive Training (n=20)	Swiss Ball Exercise (n=20)	p-value
Age (years)	26.0	25.0	0.590
BMI (kg/m ²)	27.0	27.4	0.860
GPAQ Score	58	57	0.940
Baseline SEBT Score	81	80	0.630

DISCUSSION

The present study compared the effects of proprioceptive training and Swiss ball exercise on dynamic balance among sedentary overweight and obese individuals. Both interventions significantly improved balance performance; however, proprioceptive training demonstrated greater effectiveness.

Obesity negatively influences postural stability due to altered body alignment, anterior displacement of the centre of gravity, and reduced neuromuscular control [5,6]. Proprioceptive training enhances sensory input from mechanoreceptors and improves neuromuscular coordination, thereby contributing to better postural stability [14,15].

The findings of the present study are consistent with previous studies that reported significant improvement in dynamic balance following proprioceptive exercises [16–18]. Proprioceptive training improves joint position sense, activates stabilizing musculature, and enhances vestibular adaptation, leading to improved balance control.

Swiss ball exercises also demonstrated significant improvement in dynamic balance. The unstable surface of the Swiss ball activates deep core musculature, including the transverse abdominis and multifidus muscles, thereby enhancing spinal stability and postural control [13,19]. Previous studies have reported that Swiss ball training improves neuromuscular coordination, trunk stability, and functional balance [20,21].

The greater improvement observed in the proprioceptive training group may be attributed to increased stimulation of sensory receptors and enhanced neuromuscular adaptation associated with balance-specific exercises.

LIMITATIONS

- Small sample size
- Short intervention duration
- No control group included

CONCLUSION

Both proprioceptive training and Swiss ball exercise significantly improved dynamic balance in sedentary overweight and obese individuals. However, proprioceptive training demonstrated superior effectiveness in improving postural control and balance performance. These findings suggest that proprioceptive exercises may be beneficial for improving stability and reducing fall risk among sedentary overweight and obese individuals.

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