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Effectiveness Of Balance Exercise On Improving Postural Balance: An Experimental Study

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ABSTRACT

Postural balance is the body's ability to maintain a stable position while still or moving. Balance disorders increase the risk of falls, especially in adults and the elderly. Exercise is a non-pharmacological intervention aimed at improving postural control through proprioceptive training and muscle strengthening. This study aims to analyze the effectiveness of balance exercises. The effect of exercise on improving postural balance. The study used a quasi-experimental design with a pretest - posttest approach. with control group. The sample consisted of 40 respondents divided into intervention (n=20) and control (n=20) groups. The exercises were carried out for 4 weeks (3 times/week). Balance was measured using the Berg Balance Scale (BBS). The results showed a significant increase in BBS scores in the intervention group compared to the control ($p < 0.001$). It was concluded that balance Effective exercise significantly improves postural balance.

Keywords: Balance Exercise, Postural Balance, Fall Risk, Proprioceptive Training





1. Introduction

Postural balance is the result of the integration of the sensory systems (visual, vestibular, and proprioceptive) with the motor system to maintain body stability. Decreased balance can be caused by aging, muscle weakness, neurological disorders, or lack of physical activity.

Balance disorders increase the risk of falls, which can lead to serious injuries such as fractures and head trauma. Therefore, effective preventive interventions are needed to improve postural control.

Balance Exercises are designed to train neuromuscular coordination, improve proprioception, and strengthen the body's stabilizing muscles. These exercises involve activities such as single-leg standing, tandem stance, heel - to -toe walking, and the use of unstable surface.

This study aims to analyze the effectiveness of balance exercise on improving postural balance through experimental design.

2. Research Methods

a. Research Design

Quasi-experimental with pretest – posttest approach with control group.

b. Population and Sample

The population consisted of adult individuals at risk for mild balance disorders. The sample of 40 respondents was divided into:

- Intervention group (n=20)
- Control group (n=20)

c. Inclusion Criteria

- 1) Age 40–65 years
- 2) Have no severe neurological disorders
- 3) Willing to follow an exercise program

d. Intervention

Balance exercises performed:

- Duration: 30 minutes
- Frequency: 3 times/week
- Program duration: 4 weeks

Exercises include:

- Single leg stance
- Tandem walking
- Heel - to -toe walk
- Exercise on unstable surfaces



**e. Instrument**

Berg Balance Scale (BBS) with a score of 0–56.

f. Data analysis

- Paired t- test (within groups)
- Independent t- test (between groups)
- Significance $\alpha = 0.05$

3. Research Results And Discussion**a. Research Result**

The study involved 40 respondents divided into intervention (n=20) and control (n=20) groups. The baseline characteristics of both groups were relatively homogeneous.

1) Initial Characteristics of Respondents

| Variables | Intervention (Mean \pm SD) | Control (Mean \pm SD) | p- value |
|-------------------|-------------------------------|--------------------------|----------|
| Age (years) | 54.2 \pm 6.1 | 53.7 \pm 5.8 | 0.78 |
| Initial BBS score | 42.3 \pm 3.5 | 43.1 \pm 3.2 | 0.49 |

There was no significant difference in initial scores ($p > 0.05$), so both groups were considered equivalent before the intervention.

2) Berg Score Change Balance Scale (BBS)

Intervention Group

| Measurement | Mean \pm SD | Difference |
|-------------|----------------|------------|
| Pretest | 42.3 \pm 3.5 | |
| Posttest | 50.1 \pm 2.8 | +7.8 |

Paired t- test: $p < 0.001$

Control Group

| Measurement | Mean \pm SD | Difference |
|-------------|----------------|------------|
| Pretest | 43.1 \pm 3.2 | |
| Posttest | 44.0 \pm 3.4 | +0.9 |

Paired t- test: $p = 0.08$ (not significant)

3) Inter-Group Comparison (Posttest)

The independent t- test shows:

- $p < 0.001$
- Final average difference: 6.1 points

This shows a significantly higher improvement in balance in the intervention group.





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- 4) Effect Size and Magnitude of Influence
Cohen's $d = 1.9$
→ Category: large effect size
Partial Eta Squared (estimate) ≈ 0.48
→ The intervention explained almost 48% of the variation in balance improvement.
- 5) Analysis Based on Fall Risk
BBS Categories:
 - <45 = high risk of falling
 - ≥ 45 = low risk of falling

Category Intervention Pretest Intervention Posttest

| | | |
|-----------|----------|----------|
| High risk | 14 (70%) | 3 (15%) |
| Low risk | 6 (30%) | 17 (85%) |

There was a significant reduction in the risk of falls after exercise.

b. Discussion

1) Balance Clinical Effectiveness Exercise

An average improvement of 7.8 points on the BBS represents a clinically significant change. In the literature, an improvement of ≥ 5 points on the BBS is considered functionally significant. Thus, the study results demonstrate tangible benefits in the respondents' daily lives.

2) Physiological Mechanisms of Balance Improvement

Balance Exercise improves balance through several mechanisms:

a) Neuromuscular Adaptation

Exercise stimulates coordination between the central nervous system and muscles, improving motor control and postural stability.

b) Enhanced Proprioception

Exercising on unstable surfaces stimulates joint and muscle receptors, improving the body's ability to detect changes in position.

c) Core and Lower Extremity Strengthening

Gluteal muscles, quadriceps, and core Muscles play an important role in maintaining the center of gravity.

d) Sensory Integration

Exercise improves integration between the visual, vestibular, and somatosensory systems.





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3) Epidemiological Significance

The reduction in the proportion of falls at risk from 70% to 15% in the intervention group demonstrates a strong preventive effect. Fall risk is a major factor in morbidity in older adults, so this intervention has broad public health implications.

4) Comparison with Control Group

The control group experienced only minimal improvement (0.9 points), possibly due to normal daily activities or a learning effect from the first measurement.

The highly significant differences between groups confirm that the changes were not due to time alone, but were a direct effect of structured training.

5) Critical Analysis

Although the results show high effectiveness, several limitations need to be noted:

- The duration of the intervention was relatively short (4 weeks)
- No long-term follow-up was performed
- Do not use objective tools such as force plate

Further research with randomized design controlled Long-term trials and evaluations will strengthen the scientific evidence.

➤ Practical Implications

- Balance Exercise can be included in rehabilitation and fall prevention programs.
- A minimum 4-week exercise program is effective in improving postural stability.
- Can be applied in communities, clinics, and nursing homes.

4. Conclusion And Suggestions

a. Conclusion

Based on the research results, it can be concluded that balance Exercise was significantly effective in improving postural balance. The intervention group experienced an average increase in Berg scores. Balance Scale (BBS) of 7.8 points after following the exercise program for 4 weeks, with a statistically significant difference ($p < 0.001$) compared to the control group.

In addition to being statistically significant, this increase is also clinically meaningful because it substantially reduces the proportion of respondents at high risk of falling. large size indicates that the balance exercise has a strong impact on improving postural control.

Balance training works by improving neuromuscular coordination, strengthening stabilizer muscles, and enhancing proprioception and sensory integration. Thus, balance Exercise is an effective, safe, and applicable non-pharmacological intervention in preventing balance disorders and the risk of falls.





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b. Suggestion

- 1) For Healthcare Workers and Physiotherapists
 - Integrating balance exercise in rehabilitation and fall prevention programs.
 - Conduct regular balance evaluations using standardized instruments such as BBS.
 - Adjust the intensity of the exercise to individual conditions.
- 2) For Health Service Facilities
 - Developing a community-based balance training program.
 - Providing supporting facilities and infrastructure for balance training.
 - Conducting preventive education regarding the risk of falls in the adult and elderly population.
- 3) For the Community
 - Do balance exercises regularly at least 3 times per week.
 - Combining balance exercise with strength and flexibility training.
- 4) For Further Researchers
 - Using a randomized design controlled trial (RCT).
 - Conduct long-term follow-up to assess the sustainability of exercise effects.
 - Using objective measuring tools such as posturography or force plate.
 - Analyze the influence of age, gender, and physical activity levels on exercise effectiveness.

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