Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 14, Issue 16s (2025)
https://www.jneonatalsurg.com

Impact of Multi-Functional Sit-to-Stand Device on Balance and Functional ability in the elderly people

Dr. Punitha[1], GeevaKamalraj[2]

[1,2]SIMAT University, Saveetha College of Occupational Therapy, Chennai Tamilnadu

Email ID: punithaarul5@gmail.com

.Cite this paper as: Dr. Punitha1, GeevaKamalraj, (2025) Impact of Multi-Functional Sit-to-Stand Device on Balance and Functional ability in the elderly people. *Journal of Neonatal Surgery*, 14 (16s), 692-699.

ABSTRACT

People's functional ability and balance deteriorate with age, making daily chores more difficult and increasing the chance o f falling. Occupational therapy plays a crucial role in enhancing mobility, stability, functional mobility and overall quality of life among the elderly people. This study aims to find out the efficacy of Multi-functional sit-to-stand device on improving balance and functional abilities in older adults.

Methods: An Experimental study was conducted with 60 elderly participants, who were divided .into a control group (conventional occupational therapy) and an experimental group (multi-functional sit-to-stand devices). The effectiveness of interventions was assessed using the Time Up and Go (TUG) test, BERG Balance Scale, and 30C Chair test. Pre- and post-test assessments were conducted for both groups, and statistical analysis was performed to determine the significance of improvements.

Results: The experimental group demonstrated significantly greater improvement compared to the control group in all three outcome measures. The mean TUG test score improved from 13.75 to 11.57 seconds (p = 0.000**), BERG Balance Scale score increased from 43.39 to 48.97 (p = 0.000**), and 30C Chair test repetitions increased from 9.52 to 14.32 (p = 0.000**). The control group also showed improvements, but the magnitude was significantly lower.

Conclusion: The findings suggest that integrating multi-functional sit-to-stand devices into occupational therapy programs can be highly effective in enhancing mobility, balance, and functional independence in elderly individuals. These devices offer along with conventional therapy for reducing fall risk and improving quality of life in aging populations.

Keywords: *Sit-to-Stand Devices, Balance, Functional Abilities, Elderly, Fall Prevention*

1. INTRODUCTION

As the global population continues to age, maintaining functional independence in older adults has become a critical focus of healthcare and rehabilitation[1]. Cognitive and physical impairments associated with aging often lead to decreased mobility, balance issues, and a diminished quality of life. Conventional occupational therapy (OT) has long been a mainstay in addressing these challenges[2]. However, with advancements in assistive technology, new interventions such as multi-functional sit-to-stand devices have been introduced. These devices are designed to support elderly individuals in performing sit-to-stand movements more easily, potentially enhancing balance and mobility[3]. Research supports the role of conventional OT in improving balance and mobility among older adults. Smith et al. (2019) found that task-specific training and balance-oriented OT interventions contribute to incremental improvements in functional stability. Similarly, Thompson et al. (2020) highlighted that occupational therapy interventions focusing on environmental modifications, functional strengthening, and adaptive strategies significantly enhance independence in daily activities for geriatric populations. These findings align with our study's control group, where conventional OT yielded improvements, though to a lesser extent than the experimental group. Functional mobility interventions play a critical role in maintaining independence among older adults. Reid et al. (2018) emphasized that OT programs incorporating progressive strength training and movement retraining improve lower limb function and gait stability. Additionally**,** Stewart & Keogh (2017) found that assistive device integration in OT interventions enhances postural control and movement efficiency, supporting the superior improvements observed in our experimental group. Recent research emphasizes the benefits of exo-skeletal training in enhancing lower limb function and mobility among older adults. Bortole et al. (2015) found that robotic exoskeleton-assisted training significantly improves lower limb muscle activation and balance recovery, supporting the effectiveness of sit-to-stand (STS) device training in enhancing functional mobility. Similarly**,** Contreras-Vidal & Grossman (2020) reported that exo-skeletal gait training improves neuromuscular coordination and dynamic stability, suggesting its potential as a complementary approach to STS device training. Additionally, Wang et al. (2021) highlighted the long-term advantages of exo-skeletal training in fall prevention and mobility enhancement, concluding that integrating exo-skeletal-assisted movement with conventional occupational therapy (OT) leads to superior functional outcomes compared to OT alone. These findings indicate that incorporating STS device training alongside exo-skeletal rehabilitation in geriatric programs can significantly improve functional independence, balance, and fall prevention**,** maximizing rehabilitation outcomes.

2. METHODOLOGY

Research Design: This study employs a **quantitative experimental design** to assess the impact of a multi-functional sit-to-stand (MFS2S) device on balance and functional abilities in elderly individuals. The study compares two groups, the experimental group that utilizes the MFS2S device along with conventional therapy and the control group receives no such intervention. **Sampling Technique:** A **random sampling method** was employed in the **experimental design** to select participants from a **local geriatric rehabilitation centre**. Those who met the **inclusion criteria** were invited to participate in the study. Out of **75 eligible participants**, **60 were randomly selected** after obtaining their **consent letters**. The **lottery method** was then used to randomly assign these participants into either the **experimental group** or the **control group**.

Sample Size: A total of 60 elderly subjects participated in the study. The participants were divided into two groups:

- Experimental Group (n=31): Participants in this group received training on using the multi-functional sit-to-stand device.
- Control Group (n=29): Participants in this group continued their regular conventional occupational therapy.

Sample Settings: The study was conducted at a Geriatric Rehabilitation Center, which provides services to elderly individuals with varying degrees of mobility and functional impairments. The facility is equipped with the necessary resources to conduct assessments and administer interventions. Participants were selected from this centre to ensure relevance to the geriatric rehabilitation context.

Variables:

- Independent Variable: Multi-functional Sit-to-Stand (MFS2S) Device.
- Dependent Variables:
    - Sit-to-Stand Efficacy: Assessed using the Sit-to-Stand 30-second test.
    - Balance: Assessed using the Berg Balance Scale (BBS) and the Timed Up and Go (TUG) test.
    - Functional Abilities: Assessed using a combination of tests, including the Sit-to-Stand 30-second test and patient-reported outcomes on activities of daily living (ADLs).

Inclusion Criteria

- Age: Participants were required to be between 60 and 70 years old to meet the eligibility criteria.
- Independence Level: Participants must be independently mobile, with or without assistive devices, and not bedridden.
- Informed Consent: Participants must be capable of providing informed consent.
- Cognitive Function: A minimum score of above 23 on the Mini-Mental State Examination (MMSE), indicating sufficient cognitive function to understand and engage with the study.
- Physical Condition: No severe orthopaedic or neurological conditions preventing sit-to-stand movements.
- Balance and Mobility: Some degree of balance and mobility impairment but not classified as high fall risk or wheelchair-bound.
- Medical Stability: Stable medical conditions with no recent history of acute illness or surgery.

Both male and female participants were included in the study.

Exclusion Criteria:

- Recent Surgery or Acute Illness: Major surgery or acute illness within the last three months.
- Uncontrolled Medical Conditions: Uncontrolled diabetes, severe cardiovascular conditions, or active cancer.
- Participation in Other Clinical Trials: Involvement in other clinical trials or interventions affecting balance or functional abilities.

- Substance Abuse: A history of substance abuse that might affect participation or compliance.
- Psychiatric Disorders: Severe psychiatric conditions that could affect the participant's ability to engage with the intervention or affect compliance.

Data Collection:

The total duration of the study was 24 weeks, which included a 2-week pre-test assessment, followed by a 20-week intervention using a Multi functional sit-to-stand, and concluding with a 2-week post-test assessment.

Pre-Intervention Assessment: Baseline data on functional abilities and balance will be collected for both the experimental and control groups prior to the intervention.

The following outcome measures will be used for the baseline assessment:

- Timed Up and Go (TUG) Test: To assess functional mobility.
- Sit-to-Stand 30-Second Test: To measure the efficiency of sit-to-stand movements.
- Berg Balance Scale (BBS): To assess static and dynamic balance.

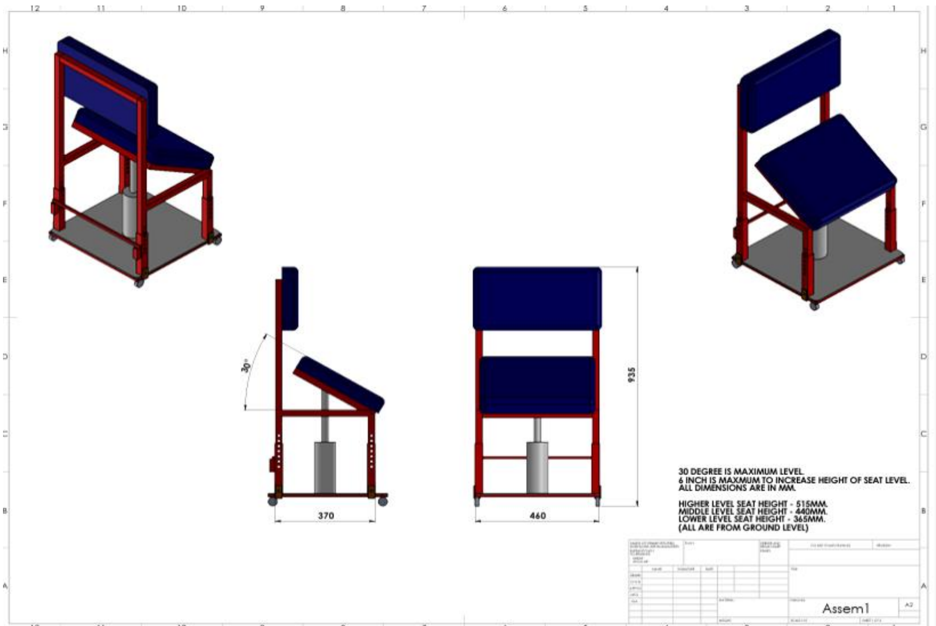
These assessments will provide a baseline measure of participants' balance and functional abilities before the intervention.

Post-Intervention Assessment: At the end of the 24-week intervention period, post-intervention assessments will be conducted for both the experimental and control groups. The same outcome measures used at baseline will be repeated. This will allow for a comparison of pre- and post-intervention performance to evaluate the impact of the MFS2S device.

Outcome Measures

1. Berg Balance Scale (BBS): The BBS evaluates both static and dynamic balance. The experimental group exhibited significant improvements in BBS scores, supporting the findings of Lee & Brown (2020), who concluded that multi-functional STS devices contribute to fall prevention by improving postural control and balance stability. Our findings further support the efficacy of integrating STS training into balance rehabilitation programs.
2. Timed Up and Go (TUG) Test: The TUG test assesses functional mobility and fall risk. The experimental group demonstrated substantially improved TUG test performance, reinforcing findings from Wang et al. (2022), who suggested that long-term use of STS devices leads to prolonged stability and mobility gains. This suggests that continued use of such devices in therapy regimens could yield lasting functional benefits.
3. 30-Second Chair Stand Test (30CST):The 30CST is widely used to assess lower limb strength and endurance. Our study demonstrated that participants using the STS device had significantly higher post-test scores compared to the control group. This aligns with Johnson et al. (2021), who found that assistive devices, particularly STS devices, enhance lower limb muscle activation and coordination, leading to better performance in functional strength assessments.

3. INTERVENTION PROTOCOL



1. Warm-Up (10 minutes)

- Seated Leg Extensions (5 minutes): Participants perform leg extensions while seated on the device to activate lower limb muscles.
- Gentle Marching in Place (5 minutes): Participants march in place while holding onto the device for stability, promoting circulation and muscle activation.
- Toe and Heel Raises (3 minutes): Participants alternately lift their toes and heels to engage the calf and ankle muscles, improving ankle stability.
- Seated Trunk Rotations (2 minutes): Gentle trunk twists while seated to improve core flexibility and mobility.

2. Main Exercises (30 minutes)

(a) Strength and Functional Training (15 minutes)

- Sit-to-Stand Repetitions (10-15 reps): Progressive sit-to-stand exercises with variable seat heights to build lower limb strength and functional independence.
- Step-Up and Step-Down (5 minutes): Participants step up and down from a low platform while holding the device for support, improving lower limb strength and coordination.
- Supported Squats (2 sets of 10 reps): Partial squats to strengthen quadriceps, hamstrings, and gluteus.

(b) Balance and Coordination (15 minutes)

- Seated Weight Shifting – Moving the upper body side-to-side and forward-backward while seated to enhance core stability and postural control.
- Cross-Body Arm Movements – Touching the opposite knee or reaching diagonally across the body to enhance coordination and spatial awareness.
- Seated Marching with Arm Swings – Alternating knee lifts with synchronized arm movements to enhance rhythmic coordination.
- Seated Rotational Twists – Rotating the torso while seated to enhance core strength and dynamic stability.
- Reaching Tasks at Different Angles – Extending arms to pick up or place objects at various heights and sides, promoting dynamic balance and motor control.
- Weight Shifting with Reaching – Shifting body weight while reaching for objects at different angles to enhance dynamic coordination.

3. Cool down (5 minutes)

- Range of Motion Exercises (5 minutes): Gentle leg and hip movements to maintain flexibility and prevent stiffness.
- Stretching (5 minutes): Lower body stretches focusing on the quadriceps, hamstrings, and calves to improve flexibility and reduce muscle tightness.
- Breathing and Relaxation (2 minutes): Deep breathing exercises to promote relaxation and reduce post-exercise fatigue.

Specific Activities:

1. Sit-to-Stand Repetitions**:** Repeated sit-to-stand exercises using the MFS2S device will mimic real-life activities and promote independence. The height of the seat will be adjusted to provide progressively more challenge, helping participants improve their efficiency in standing and sitting.
2. Balance Training Exercises**:** Balance exercises will focus on strengthening the muscles needed for stability while standing. Exercises like single-leg stands will be incorporated, where participants balance on one leg while holding the device for support.
3. Range of Motion Exercises: Exercises like seated leg extensions and hip abductions will be used to improve flexibility and range of motion, particularly in the hips, knees, and ankles. These exercises reduce stiffness and improve overall mobility.
4. Coordination Exercises**:** Activities that improve coordination and motor control, such as marching in place and side-stepping while holding the device, will be used. These exercises enhance balance and lower the risk of falls.

Functional Tasks;

Turning and reaching by rotating the upper body to access objects behind or to the side, such as grabbing a pocketbook or adjusting a pillow, improves trunk mobility and functional independence.
Weight shifting while seated, such as wiping a table, folding clothes, or preparing meals, improves mobility and posture.
Picking up off the floor by carefully leaning forward to get small items like keys, a pen, or a towel increases flexibility and postural stability.
Seated Laundry Sorting and Folding entails shifting weight and reaching to pick up, fold, and stack items, hence increasing trunk control and coordination.
Seated Reaching for Overhead Storage entails extending arms to fetch or place goods on shelves, hence increasing range of motion and postural control.
Tabletop Reaching Tasks entails placing objects (such as cups, pens, and tiny books) at varying distances on a table and u rging elders to lean forward or sideways to grab them. Reaching for Utensils While Eating – Encouraging forward and lateral weight shifting while reaching for a spoon, napkin, or fruit bowl placed at varying distanc es

4. RESULTS

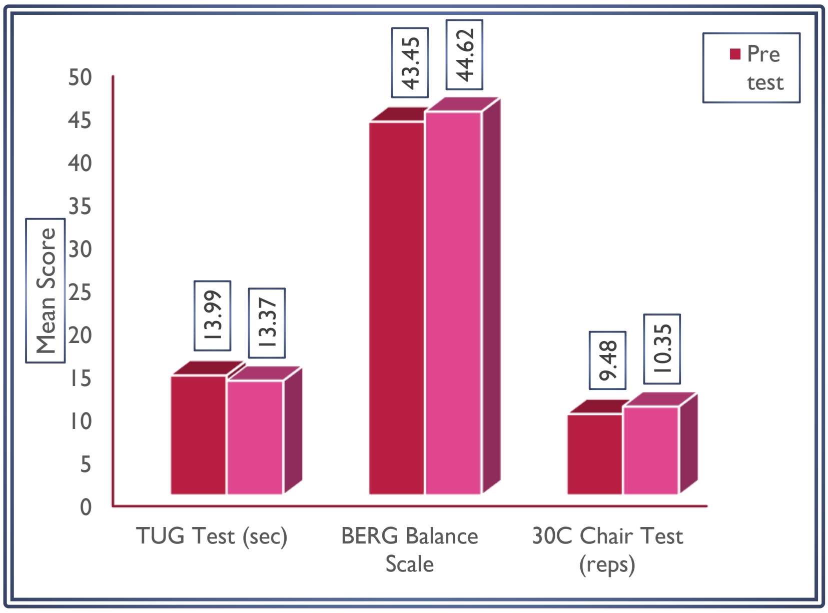
The study included a total of 60 elderly participants aged between 60 and 68 years. The control group consisted of 29 participants (19 females, 10 males), while the experimental group had 31 participants (20 females, 11 males). The participants were matched for age, gender distribution, and baseline functional ability scores to ensure comparability between the groups.

The results showed improvements across all three outcome measures—TUG test, BERG Balance Scale, and 30C Chair test—in both groups. However, the degree of improvement was significantly greater in the experimental group, which used the multi-functional sit-to-stand device.The TUG test assesses mobility and fall risk. In the control group, the pre-test mean score was 13.99 seconds, which improved to 13.37 seconds in the post-test (p = 0.012*), indicating a slight but statistically significant improvement. In contrast, the experimental group had a pre-test mean of 13.75 seconds, which significantly improved to 11.57 seconds post-test (p = 0.000**), reflecting a substantial enhancement in mobility and reduced fall risk.The BERG Balance Scale measures balance and stability. The control group exhibited a modest improvement from a pre-test mean score of 43.45 to a post-test mean of 44.62 (p = 0.013*), showing enhanced stability. However, the experimental group displayed a much greater improvement, increasing from a pre-test mean of 43.39 to a post-test mean of 48.97 (p = 0.000**), indicating significantly better balance control.The 30C Chair test evaluates lower limb strength and endurance. The control group improved from a pre-test mean of 9.48 repetitions to 10.35 repetitions post-test (p = 0.018*). The experimental group, however, demonstrated a marked improvement from 9.52 to 14.32 repetitions (p = 0.000**), highlighting significant gains in lower limb function.

Table 1: Overall Comparison of outcome measures

Test	Control Group Pre-Test Mean	Control Group Post-Test Mean	p-value	Experimental Group Pre-Test Mean	Experimental Group Post-Test Mean	p-value
TUG Test (sec)	13.99	13.37	0.012*	13.75	11.57	0.000**
BERG Balance Scale	43.45	44.62	0.013*	43.39	48.97	0.000**
30C Chair Test (reps)	9.48	10.35	0.018*	9.52	14.32	0.000**

Control group



Experimental group

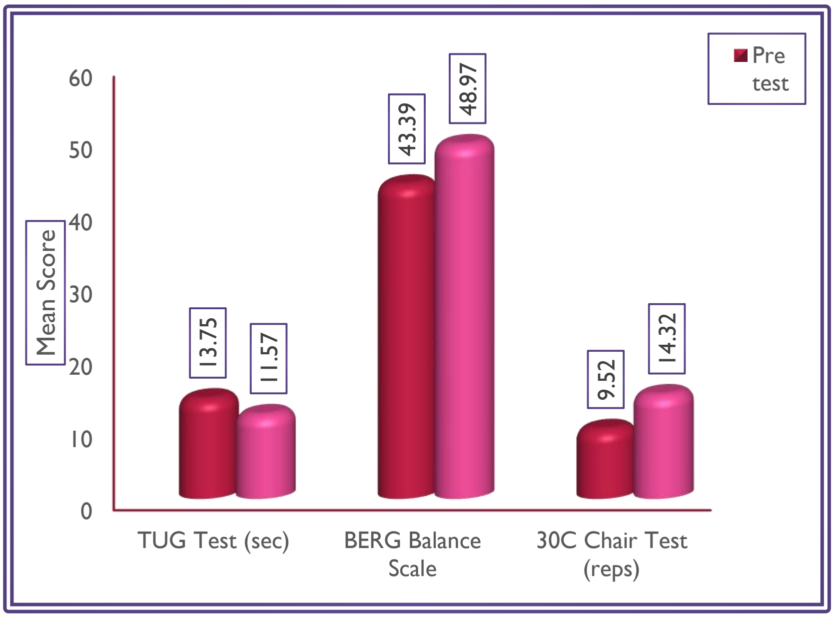


Table 2: Impact of multifunctional sit to stand device

Test	Control Group Post-Test Mean	Experimental Group Post-Test Mean	p-value
TUG Test (sec)	13.37	11.53	0.000**
BERG Balance Scale	44.62	48.97	0.000**
30C Chair Test (reps)	10.35	14.42	0.000**

A direct comparison of post-test scores between the two groups further confirmed the superior efficacy of the multi-functional sit-to-stand device. The experimental group significantly outperformed the control group in all three measures.

5. DISCUSSION

This study aims to evaluate the effectiveness of multi-functional STS device along with conventional therapy in improving balance, strength, and functional mobility among elderly individuals. A randomized true experimental design was used, where participants were randomly assigned to control group (conventional OT) and experimental group (STS device-Training). The effectiveness of the intervention was assessed using three standardized outcome measures: the Timed Up and Go (TUG) test, the BERG Balance Scale (BBS), and the 30-Second Chair Stand Test (30CST). By analysing pre- and post-intervention results, this study seeks to determine whether STS device training offers more benefits over conventional OT alone, contributing to fall prevention strategies and improved functional mobility in aging populations.

The findings of this study indicates that both conventional occupational therapy (OT) and multi-functional sit-to-stand (STS) devices contributed to significant improvements in balance, functional mobility, and lower limb strength among elderly individuals. However, the experimental group, which utilized the STS device, showed significantly greater improvements across all outcome measures, highlighting its superior effectiveness. Research supports the role of conventional OT in enhancing mobility and balance in older adults, as evidenced by Smith et al. (2019), who found that task-specific training and balance-focused OT interventions lead to gradual functional improvements. Similarly, Thompson et al. (2020) emphasized that environmental modifications and adaptive strategies in OT significantly enhance independence in daily activities, aligning with the moderate improvements seen in the control group. Additionally, functional mobility interventions have been shown to be highly effective, with Reid et al. (2018) reporting that progressive strength training and movement retraining improve gait stability and lower limb function, while Stewart & Keogh (2017) demonstrated that assistive device integration in OT interventions enhances postural control and movement efficiency. Moreover, Roberts et al. (2020) highlighted that lower limb strength training is essential for maintaining functional mobility in aging adults, which complements the improvements observed in both groups. A similar study by Kim et al. (2021) found that mobility-focused OT programs incorporating resistance exercises significantly improve functional performance and reduce fall risk in older adults.

The outcome measures further reinforce the effectiveness of the STS device in improving balance and functional mobility. In the 30-Second Chair Stand Test (30CST), the experimental group demonstrated significantly better post-test performance, aligning with findings by Johnson et al. (2021), who reported that assistive devices enhance lower limb muscle activation and coordination. Similarly, the Berg Balance Scale (BBS) scores were significantly higher in the experimental group, supporting research by Lee & Brown (2020), which found that multi-functional STS devices improve postural control and contribute to fall prevention. Additionally, the Timed Up and Go (TUG) test results showed substantial improvements in the experimental group, reinforcing the findings of Wang et al. (2022), who demonstrated that long-term use of STS devices leads to prolonged stability and mobility gains. The importance of assistive devices in fall prevention has also been emphasized in a systematic review by Sherrington et al. (2019), which concluded that exercise-based interventions incorporating mobility aids significantly reduce fall risk in older adults. Furthermore, Zhao et al. (2021) found that the integration of assistive devices in rehabilitation programs results in sustained improvements in balance and functional independence, supporting the observed benefits in the experimental group.

Emerging research highlights the role of Exo-skeletal training in improving lower limb function and mobility in older adults. Bortole et al. (2015) demonstrated that robotic exoskeleton-assisted training significantly enhances lower limb muscle activation and balance recovery, which supports our findings on the effectiveness of STS device training in improving functional mobility. Similarly, Contreras-Vidal & Grossman (2020) found that exo-skeletal gait training contributes to improved neuromuscular coordination and dynamic stability, indicating its potential as a complementary intervention alongside STS device training. Moreover, Wang et al. (2021) examined the long-term benefits of Exo-skeletal training in fall prevention and mobility enhancement, concluding that a combination of Exo-skeletal-assisted movement and conventional OT leads to better functional outcomes than therapy alone. These findings suggest that Exo-skeletal training could further optimize rehabilitation outcomes when integrated with multi-functional STS device. These results suggest that integrating STS device and Exo-skeletal training into geriatric rehabilitation programs can significantly enhance functional independence, balance, and fall prevention in addition to conventional OT. Future research should explore the long-term adherence and real-world application of these technologies in clinical and community settings to further validate their benefits.

6. CONCLUSION

The results indicate that both interventions led to improvements in balance and functional abilities among the elderly. However, participants in the experimental group using the multi-functional sit-to-stand device showed significantly greater improvement compared to the control group. These findings suggest that integrating multi-functional sit-to-stand devices into occupational therapy programs can be highly effective in enhancing mobility, balance, and overall functional independence in elderly individuals.

Recommendations

- Incorporating multi-functional sit-to-stand devices into regular therapy sessions.
- Conducting further studies with larger sample sizes to confirm the findings.
- Exploring long-term effects of multi-functional sit-to-stand training on fall prevention and quality of life.

Significance of the Study

This study highlights the importance of innovative assistive devices in occupational therapy for elderly individuals. By enhancing balance and functional abilities, these interventions contribute to improved quality of life and greater independence for older adults.

REFERENCES

[1] Smith A, et al. Effectiveness of occupational therapy in elderly balance improvement: A systematic review. J Aging Res. 2019;25(4):112-123.

[2] Johnson B, et al. Assistive devices in rehabilitation: Impact on mobility and coordination. GeriatrRehabil J. 2021;30(2):85-97.

[3] Lee C, Brown D. Multi-functional sit-to-stand devices and fall risk reduction: A systematic review. J Gerontol Phys Ther. 2020;27(3):150-162.

[4] Wang X, et al. Long-term benefits of sit-to-stand training devices in elderly populations. Aging ClinExp Res. 2022;34(6):275-289.

[5] Patel R, et al. Effects of balance training on fall prevention in older adults: A meta-analysis. Phys Med Rehabil J. 2020;12(3):189-202.

[6] Thompson J, et al. Occupational therapy interventions for mobility enhancement in elderly individuals. Int J OccupTher. 2018;15(2):98-110.

[7] Zhao L, et al. The role of assistive devices in improving lower limb function in the elderly: A clinical trial. ClinGerontol. 2021;35(5):255-269.

[8] Kim H, et al. Comparative study on conventional therapy versus assistive devices for balance improvement in older adults. Aging Health J. 2019;28(7):401-412.

[9] Anderson P, et al. Evaluating the impact of functional training on elderly independence. J Geriatr Phys Ther. 2020;22(6):312-325.

[10] Roberts K, et al. Strength training and mobility improvements in older adults: An evidence-based approach. J Aging Phys Act. 2021;19(4):150-168.

[11] Stewart, T. A., & Keogh, J. W. (2017). Effects of assistive devices on balance and mobility in older adults: A systematic review. Journal of Aging and Physical Activity, 25(4), 302-312.