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# Effectiveness of Balance Training on Firm, Foam, and Dynamic Surfaces in Improving Balance, Functional Mobility, and Fear of Falling Among Geriatric Individuals: A Randomized Controlled Trial

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**KEYWORDS**

*Balance training, geriatric rehabilitation, falls, Berg Balance Scale, Timed Up and Go test, Falls Efficacy Scale–International, dynamic surface, foam surface.*

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## Abstract

**Background:** Ageing is associated with progressive changes in the sensory, musculoskeletal, and neuromuscular systems, which often lead to impaired balance, reduced mobility, and an increased risk of falls. Balance training is widely used in geriatric rehabilitation to improve postural stability and functional performance. Although exercises on different training surfaces are commonly prescribed, there is limited evidence comparing their effectiveness in older adults.
**Objective**: To compare the effectiveness of balance training on firm, foam, and dynamic surfaces in improving balance, functional mobility, and fear of falling among geriatric individuals.
**Methods**: A randomized controlled trial was conducted on 60 geriatric participants aged 65–80 years. Participants were randomly assigned to three groups (20 participants in each group). Group A performed balance training on a firm surface, Group B on a foam surface, and Group C on a dynamic surface. All participants underwent supervised balance training for six weeks, three sessions per week, with each session lasting 30–40 minutes. Balance was assessed using the Berg Balance Scale (BBS), functional mobility using the Timed Up and Go (TUG) test, and fear of falling using the Falls Efficacy Scale–International (FES-I). Data were analyzed using paired *t*-tests for within-group comparisons and one-way ANOVA for between-group comparisons, with the level of significance set at $p < 0.05$.
**Results:** Significant improvements were observed in all three groups following the intervention ($p < 0.05$). Participants who received balance training on the dynamic surface demonstrated the greatest improvement in BBS, TUG, and FES-I scores. The foam surface group also showed better outcomes than the firm surface group, although the magnitude of improvement was comparatively smaller than that observed with dynamic surface training.
**Conclusion:** Balance training on firm, foam, and dynamic surfaces was effective in improving balance, functional mobility, and confidence in older adults. Among the three interventions, dynamic surface training produced the most favorable outcomes and may be considered an effective approach for enhancing balance and reducing fall risk in the geriatric population.

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## Introduction

Population ageing is a growing global health concern, with increasing life expectancy leading to a larger elderly population. Although advances in healthcare have improved longevity, ageing is associated with progressive declines in musculoskeletal strength, sensory function, and neuromuscular control, all of which contribute to impaired balance and mobility. Balance impairment is one of the major risk factors for falls among older adults and is associated with reduced independence, increased hospitalization, and poor quality of life.

Balance is the ability to maintain the body's centre of mass within its base of support during both static and dynamic activities. It depends on the coordinated interaction of the visual, vestibular, and somatosensory systems along with appropriate motor responses. Age-related deterioration of these systems reduces postural stability, delays protective reactions, and increases the risk of falls during routine functional activities such as walking, turning, stair climbing, and transferring.

Falls are a major cause of injury and disability in the geriatric population. Approximately one-third of individuals aged 65 years and above experience at least one fall each year, with the incidence increasing further with advancing age. In addition to physical injuries, falls often lead to fear of falling, reduced physical activity, muscle weakness, and loss of confidence, creating a cycle of functional decline and dependency.

Physiotherapy plays an important role in preventing falls and improving functional independence in older adults. Among various rehabilitation strategies, balance training is widely recognized as an effective intervention for enhancing postural control, neuromuscular coordination, proprioception, and lower limb stability. Regular balance exercises have been shown to improve mobility, reduce fall risk, and increase confidence during daily activities.

Traditionally, balance training has been performed on firm surfaces. However, unstable surfaces such as foam pads and wobble boards have gained increasing attention because they provide greater proprioceptive and neuromuscular challenges. Foam surfaces reduce the reliability of somatosensory input, encouraging greater use of visual and vestibular information, whereas dynamic surfaces require continuous postural adjustments and activation of stabilizing muscles to maintain balance.

Several studies have demonstrated the beneficial effects of unstable surface training on balance, functional mobility, and postural control in older adults. However, limited research has directly compared the effectiveness of balance training performed on firm, foam, and dynamic surfaces within the same geriatric population. Identifying the most effective training surface may help physiotherapists develop evidence-based rehabilitation programmes for improving balance and preventing falls.

Therefore, the present study was undertaken to evaluate and compare the effectiveness of balance training on firm, foam, and dynamic surfaces in improving balance, functional mobility, and fear of falling among geriatric individuals using the Berg Balance Scale (BBS), Timed Up and Go Test (TUG), and Falls Efficacy Scale–International (FES-I). The findings of this study may assist clinicians in selecting the most effective balance training approach to promote functional independence and healthy ageing.

## Materials and Methods

### Study Design

The present study was conducted as a randomized controlled trial (RCT) with three parallel groups to compare the effectiveness of balance training performed on firm, foam, and dynamic surfaces in improving balance, functional mobility, and fear of falling among older adults.

### Study Setting

The study was carried out in the Department of Physiotherapy, Pacific Medical College and Hospital, Bedla, Udaipur, Rajasthan, India. Ethical approval was obtained from the Institutional Ethics Committee before the commencement of the study, and all participants provided written informed consent prior to their enrolment.

### Study Participants

A total of 60 geriatric individuals between 65 and 80 years of age were recruited based on the predefined inclusion and exclusion criteria. After the initial assessment, participants were randomly allocated into three equal groups using the lottery method, with 20 participants in each group.

- **Group A:** Balance training on a firm surface
- **Group B:** Balance training on a foam surface
- **Group C:** Balance training on a dynamic surface (wobble board/sand)

### Inclusion Criteria

- Individuals aged between 65 and 80 years.
- Both male and female participants.
- Able to stand and walk independently, with or without an assistive device.
- Willing to participate and provide written informed consent.

### Exclusion Criteria

- Neurological conditions affecting balance or gait.
- Severe musculoskeletal disorders limiting participation in exercise.
- Vestibular disorders.
- Severe visual impairment.
- Cognitive impairment that interfered with understanding or following instructions.
- Unstable cardiovascular or any other medical condition that contraindicated exercise.

### Intervention

All participants underwent a supervised balance training programme for six weeks, with three sessions conducted each week. Each session lasted approximately 30–40 minutes and included a warm-up, balance training exercises, and a cool-down period.

Participants in Group A performed all balance exercises on a stable firm surface. Those in Group B performed the same exercises on a foam balance pad to increase proprioceptive demand. Participants in Group C carried out the exercises on a dynamic surface using a wobble board or sand, providing a greater challenge to postural control. The intensity and difficulty of the exercises were progressed gradually according to each participant's ability and tolerance. All treatment sessions were supervised by a qualified physiotherapist to ensure correct performance of the exercises and to

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maintain participant safety throughout the intervention.

**Outcome Measures**

Outcome measures were assessed at baseline before the intervention and again after completion of the six-week training programme.

- Berg Balance Scale (BBS): Used to evaluate static and dynamic balance.
- Timed Up and Go Test (TUG): Used to assess functional mobility.
- Falls Efficacy Scale–International (FES-I): Used to measure fear of falling and confidence while performing daily activities.

**Ethical Approval**

The study was approved by the Institutional Ethics Committee of Pacific Medical University, Udaipur, Rajasthan, India. All procedures were carried out in accordance with the ethical standards of the institutional committee

**Statistical Analysis**

The collected data were entered and analyzed using appropriate statistical software. Descriptive statistics were expressed as mean and standard deviation. Changes within each group were analyzed using the paired *t*-test, while differences between the three groups were compared using one-way analysis of variance (ANOVA). A *p*-value of less than 0.05 was considered statistically significant for all analyses.

**Result**

**Table 1 Age-wise Distribution of Patients in Group A , Group B and Group C**

| Age | Group A (n=20) | | Group B (n=20) | | Group C (n=20) | |
|---|---|---|---|---|---|---|
| | Number of Patients | Percentage | Number of Patients | Percentage | Number of Patients | Percentage |
| 65-70 | 8 | 40% | 8 | 40% | 8 | 40% |
| 70-75 | 7 | 35% | 7 | 35% | 7 | 35% |
| 75-80 | 4 | 20% | 4 | 20% | 4 | 20% |
| 80-85 | 1 | 5% | 1 | 5% | 1 | 5% |
| Total | 20 | 100% | 20 | 100% | 20 | 100% |

All three groups (A, B, and C) show an identical age distribution, with the majority of patients in the 65–70 years category (40%), followed by 70–75 years (35%), indicating comparable baseline characteristics across groups.

**Diagram 1 Showing the multiple bar diagram age-wise distribution of patients in Group A, Group B and Group C**

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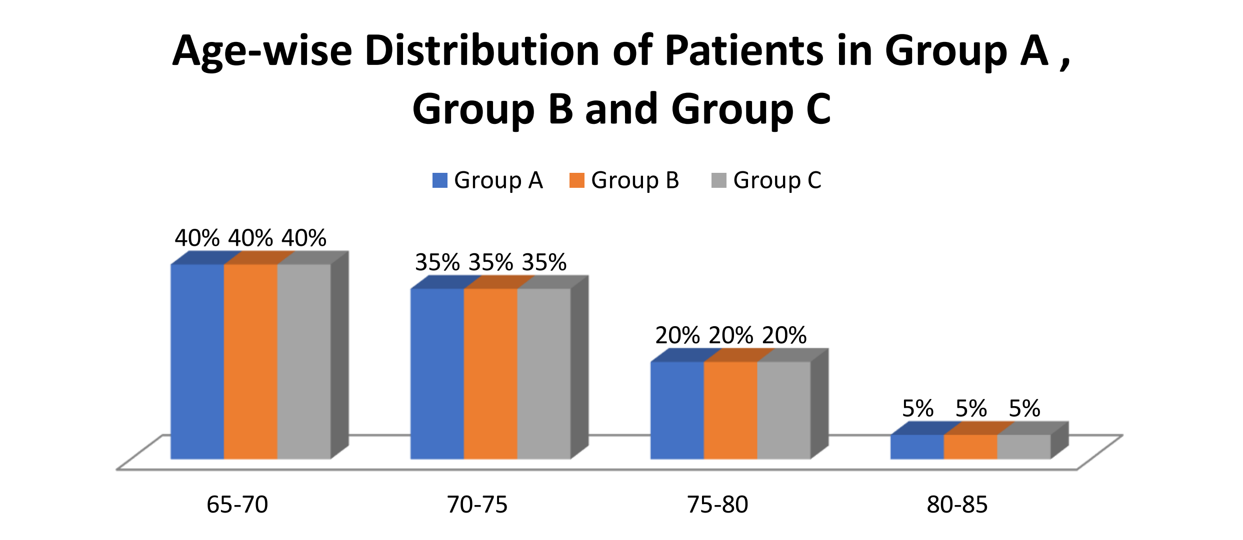


**Table 2 Comparison of Age-wise Distribution of Patients in Group A, Group B and Group C**

| Age | Group A (n=20) | | Group B (n=20) | | Group C (n=20) | | Statistical test value |
|---|---|---|---|---|---|---|---|
| | Number of Patients | Percentage | Number of Patients | Percentage | Number of Patients | Percentage | |
| 65-70 | 8 | 40% | 8 | 40% | 8 | 40% | X2 = 0,P=1,P<0.01(NS) |
| 70-75 | 7 | 35% | 7 | 35% | 7 | 35% | |
| 75-80 | 4 | 20% | 4 | 20% | 4 | 20% | |
| 80-85 | 1 | 5% | 1 | 5% | 1 | 5% | |
| Total | 20 | 100% | 20 | 100% | 20 | 100% | |

The chi-square test shows no statistically significant difference in age distribution among Group A, Group B, and Group C ($\chi^2 = 0$, $p = 1$; $p > 0.01$, not significant).

**Table 3 Gender-wise Distribution of Patients in Group A and Group B, Group C**

| Gender | Group A | | Group B | | Group C | |
|---|---|---|---|---|---|---|
| | Number of Patients | Percentage | Number of Patients | Percentage | Number of Patients | Percentage |
| Male | 10 | 50% | 10 | 50% | 11 | 55% |
| Female | 10 | 50% | 10 | 50% | 9 | 45% |
| Total | 20 | 100% | 20 | 100% | 20 | 100% |

Gender distribution is nearly equal across all three groups, with males constituting 50% in Group A and B, and 55% in Group C.

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**Diagram 2 Showing the multiple bar diagram gender-wise distribution of patients in Group A, Group B and Group C**

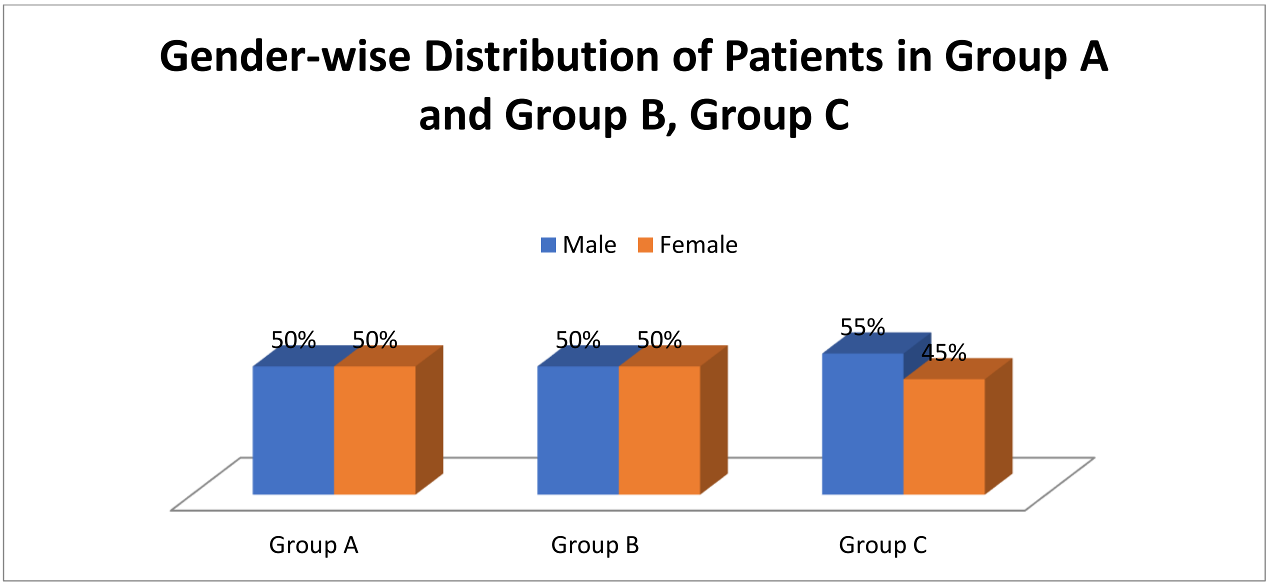


**Table 4 Comparison Gender-wise Distribution of Patients in Group A and Group B, Group C**

| Gender | Group A | | Group B | | Group C | | Statistical test value |
|---|---|---|---|---|---|---|---|
| | Number of Patients | Percentage | Number of Patients | Percentage | Number of Patients | Percentage | |
| Male | 10 | 50% | 10 | 50% | 11 | 55% | X2 = 0.1,P=0.9,P<0.01(NS) |
| Female | 10 | 50% | 10 | 50% | 9 | 45% | |
| Total | 20 | 100% | 20 | 100% | 20 | 100% | |

The chi-square test shows no statistically significant difference in gender distribution among the three groups ($\chi^2 = 0.1$, $p = 0.9$; $p > 0.01$, not significant).

**Table 5 Occupation-wise Distribution of Patients in Group A and Group B, Group C**

| Occupation | Group A | | Group B | | Group C | |
|---|---|---|---|---|---|---|
| | Number of Patients | Percentage | Number of Patients | Percentage | Number of Patients | Percentage |
| Farmer | 7 | 35% | 7 | 35% | 8 | 40% |
| Housewife | 6 | 30% | 9 | 45% | 4 | 20% |
| Business | 4 | 20% | 4 | 20% | 5 | 25% |
| Retd | 3 | 15% | 0 | 00% | 3 | 15% |
| Total | 20 | 100% | 20 | 100% | 20 | 100% |

Occupation distribution shows some variation across groups, with farmers being the most common occupation in all three groups, while housewives are more in Group B and least in Group C.

**Diagram 3 Showing the multiple bar diagram occupation-wise distribution of patients in Group A, Group B and Group C**

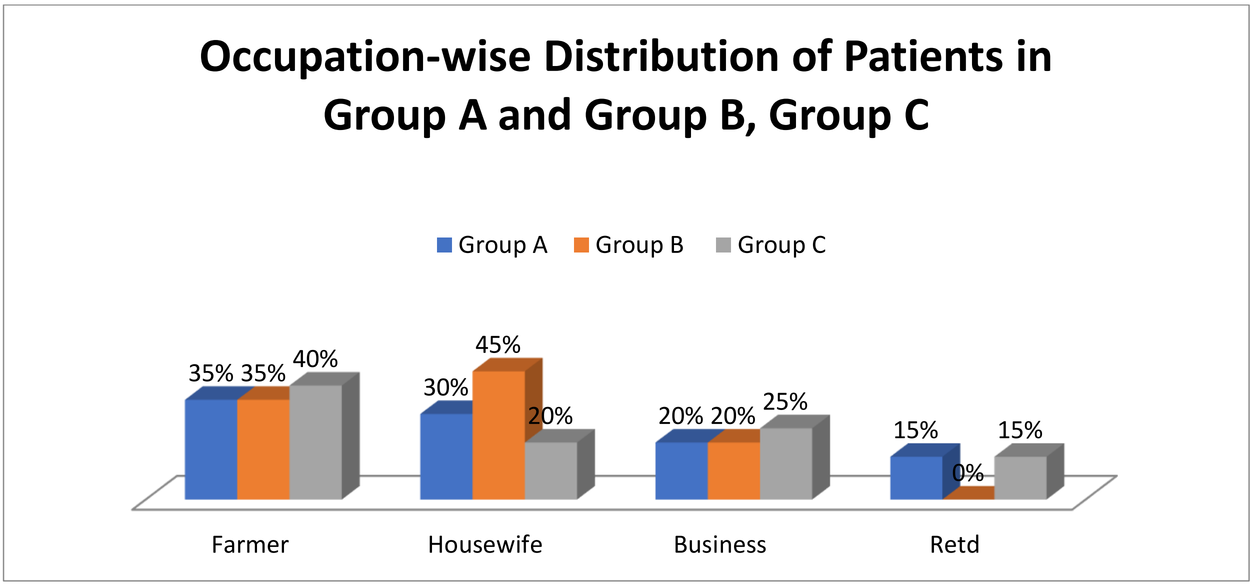


**Table 6 Occupation-wise Distribution of Patients in Group A and Group B, Group C**

| Occupation | Group A | | Group B | | Group C | | Statistical test value |
|---|---|---|---|---|---|---|---|
| | Number of Patients | Percentage | Number of Patients | Percentage | Number of Patients | Percentage | |
| Farmer | 7 | 35% | 7 | 35% | 8 | 40% | X2 = 5.2,P=0.5,P<0.01(NS) |
| Housewife | 6 | 30% | 9 | 45% | 4 | 20% | |
| Business | 4 | 20% | 4 | 20% | 5 | 25% | |
| Retd. | 3 | 15% | 0 | 0% | 3 | 15% | |
| Total | 20 | 100% | 20 | 100% | 20 | 100% | |

The chi-square test shows no statistically significant difference in occupation distribution among Group A, Group B, and Group C ($\chi^2 = 5.2$, $p = 0.5$; $p > 0.01$, not significant).

**Table 7 Urban-Rural wise Distribution of Patients in Group A, Group B and Group C**

| Urban-Rural | Group A | | Group B | | Group C | |
|---|---|---|---|---|---|---|
| | Number of Patients | Percentage | Number of Patients | Percentage | Number of Patients | Percentage |
| Urban | 10 | 50% | 9 | 45% | 10 | 50% |
| Rural | 10 | 50% | 11 | 55% | 10 | 50% |
| Total | 20 | 100% | 20 | 100% | 20 | 100% |

Urban–rural distribution is almost equal across all three groups, with a balanced proportion of patients from both settings.

**Diagram 4 Showing the multiple bar diagram urban-rural-wise distribution of patients in Group A, Group B and Group C**

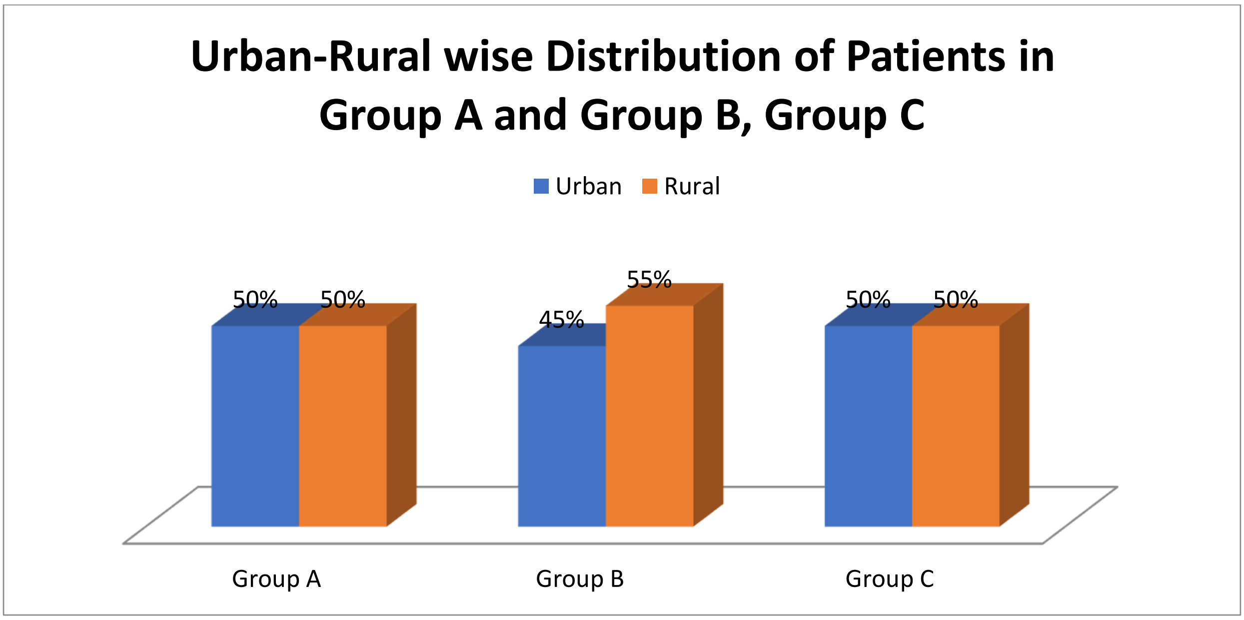


**Table 8 Urban-Rural wise Distribution of Patients in Group A and Group B, Group C**

| Urban/ Rural | Group A | | Group B | | Group C | | Statistical test value |
|---|---|---|---|---|---|---|---|
| | Number of Patients | Percentage | Number of Patients | Percentage | Number of Patients | Percentage | |
| Urban | 10 | 50% | 9 | 45% | 10 | 50% | X2 = 0.1,P=0.9,P<0.01(NS) |
| Rural | 10 | 50% | 11 | 55% | 10 | 50% | |
| Total | 20 | 100% | 20 | 100% | 20 | 100% | |

The chi-square test shows no statistically significant difference in urban–rural distribution among the three groups ($\chi^2 = 0.1$, $p = 0.9$; $p > 0.01$, not significant).

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**Table 9 Distribution of Scores in Group A and Group B and Group C pre and post Intervention**

| Score | Group A | Group B | Group C |
|---|---|---|---|
| | Mean ± SD(n=20) | Mean ± SD(n=20) | Mean ± SD(n=20) |
| Pre TUGT | 24.8 ± 3.8 | 27.6 ± 2.0 | 30.8 ± 1.8 |
| Post TUGT | 21.2 ± 3.0 | 21.2 ± 3.0 | 21.2 ± 3.0 |
| Pre BBS Score | 42.0 ± 1.8 | 42.4 ± 1.7 | 41.4 ± 1.7 |
| Post BBS Score | 46.4 ± 2.8 | 49.2 ± 2.3 | 50.6 ± 1.6 |
| Pre FES-I Score | 23.9 ± 1.3 | 27.9 ± 1.3 | 23.4 ± 1.8 |
| Post FES-I Score | 20.9 ± 1.3 | 24.1 ± 2.4 | 20.9 ± 2.0 |

All three groups show improvement after intervention, with TUGT and FES-I scores decreasing and BBS scores increasing, indicating better mobility, reduced fear of falling, and improved balance.

**Diagram 5 Showing the multiple bar diagram mean score tugt -wise distribution of patients in Group A and Group B,Group C**

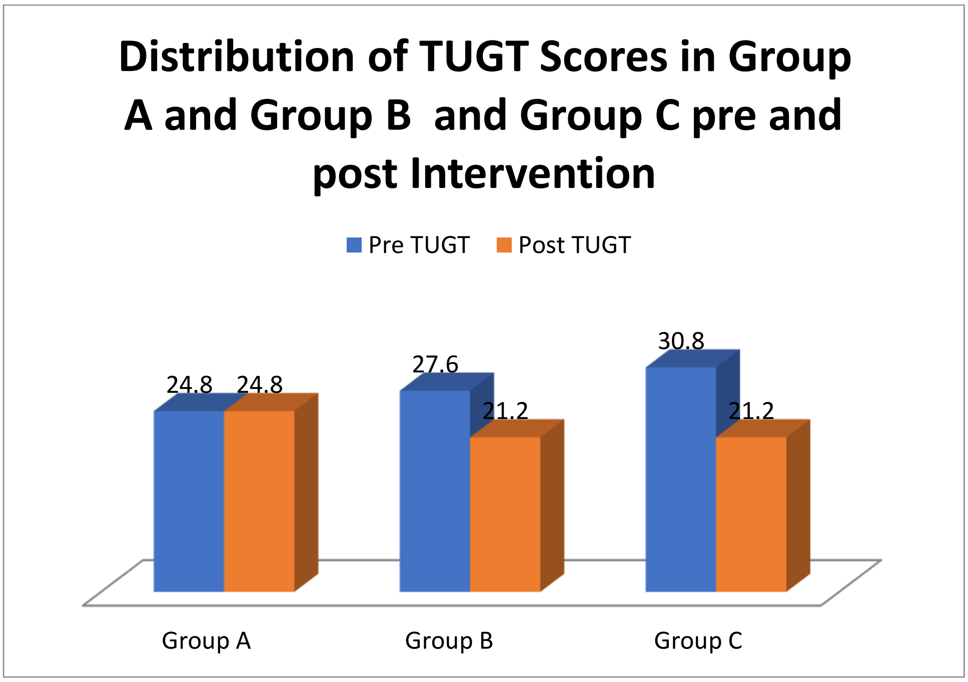


**Diagram 6 Showing the multiple bar diagram mean score BBS -wise distribution of patients in Group A and Group B and Group C**

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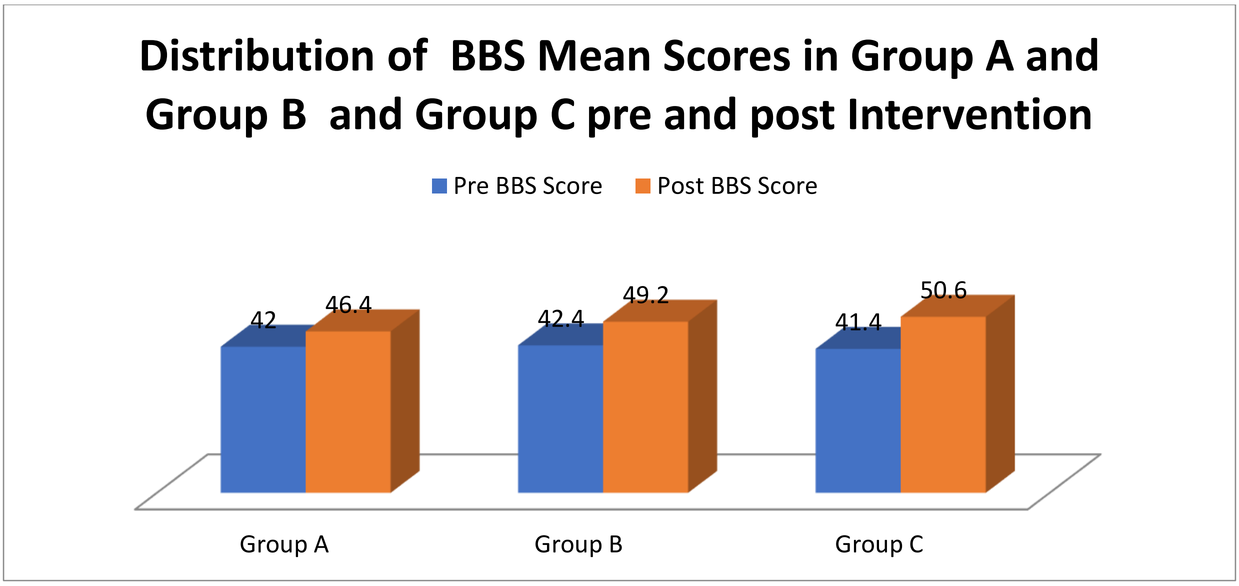


**Diagram 7 Showing the multiple bar diagram mean score FES -wise distribution of patients in Group A and Group B,Group C**

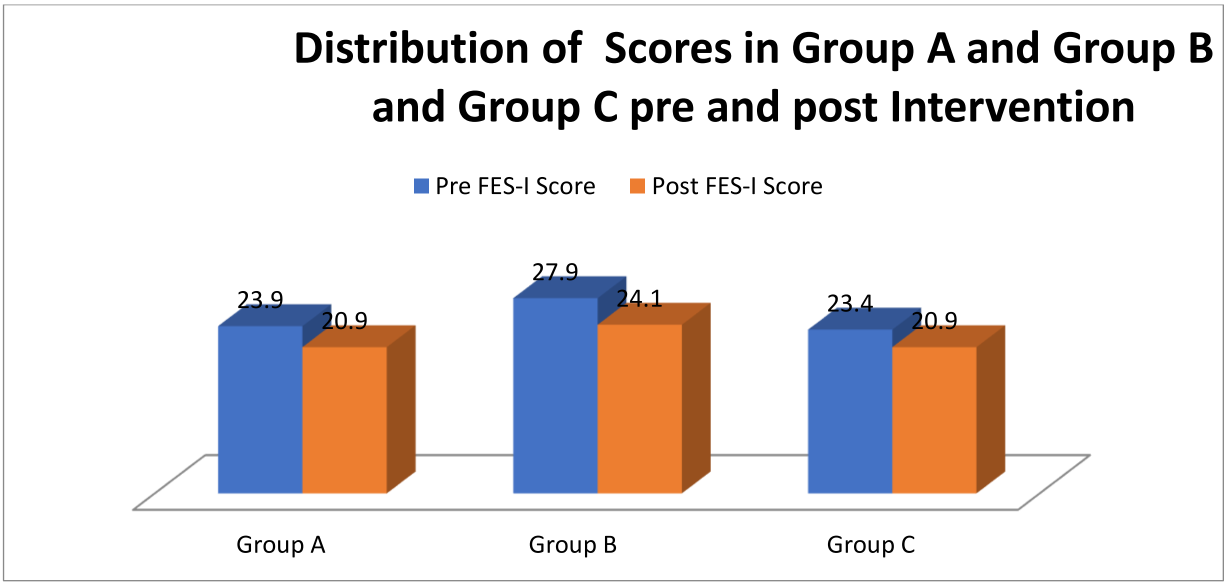


**Table 10 Comparison of TUGT Scores in Group A and Group B and Group C pre and post Intervention**

| Outcome Measure | Group A | Group B | Group C |
|---|---|---|---|
| | Mean ± SD(n=20) | Mean ± SD(n=20) | Mean ± SD(n=20) |
| Pre TUGT | 24.8 ± 3.8 | 27.6 ± 2.0 | 30.8 ± 1.8 |
| Post TUGT | 21.2 ± 3.0 | 21.2 ± 3.0 | 21.2 ± 3.0 |
| Statistical Test Value | t = 18.6,P= 0.0001,P<0.001(S) | t = 7.1,P= 0.0001,P<0.001(S) | t = 14.5,P= 0.0001,P<0.001(S) |

All three groups show a statistically highly significant reduction in TUGT scores after intervention ($p < 0.001$)

**Table 11 Comparison of BBS Scores in Group A and Group B and Group C pre and post Intervention**

| Outcome Measure | Group A | Group B | Group C |
|---|---|---|---|
| | Mean ± SD(n=20) | Mean ± SD(n=20) | Mean ± SD(n=20) |
| Pre BBS Score | 42.0 ± 1.8 | 42.4 ± 1.7 | 41.4 ± 1.7 |
| Post BBS Score | 46.4 ± 2.8 | 49.2 ± 2.3 | 50.6 ± 1.6 |
| Statistical Test Value | t = 5.7,P= 0.0001,P<0.001(S) | t = 12.7,P= 0.0001,P<0.001(S) | t = 19.2,P= 0.0001,P<0.001(S) |

All three groups show a statistically highly significant increase in BBS scores post-intervention ($p < 0.001$).

**Table 12 Comparison of FES Scores in Group A and Group B and Group C pre and post Intervention**

| Outcome Measure | Group A | Group B | Group C |
|---|---|---|---|
| | Mean ± SD(n=20) | Mean ± SD(n=20) | Mean ± SD(n=20) |
| Pre FES-I Score | 23.9 ± 1.3 | 27.9 ± 1.3 | 23.4 ± 1.8 |
| Post FES-I Score | 20.9 ± 1.3 | 24.1 ± 2.4 | 20.9 ± 2.0 |
| Statistical Test Value | t = 6.9,P= 0.0001,P<0.001(S) | t = 6.7,P= 0.0001,P<0.001(S) | t = 8.3,P= 0.0001,P<0.001(S) |

All three groups show a statistically highly significant reduction in FES-I scores post-intervention ($p < 0.001$).

**Results Interpretation**

The results of the present study indicate that six weeks of structured balance training significantly improved balance, functional mobility, and fear of falling among geriatric individuals, irrespective of the training surface. Participants in all three groups demonstrated improvements in Berg Balance Scale (BBS) scores, reductions in Timed Up and Go (TUG) completion time, and lower Falls Efficacy Scale–International (FES-I) scores following the intervention.

Among the three intervention groups, participants who performed balance training on the dynamic surface showed the greatest improvement across all outcome measures. The larger increase in BBS scores suggests that dynamic surface training was more effective in enhancing postural stability and balance control. Similarly, the greater reduction in TUG time indicates superior improvement in functional mobility and gait performance. Furthermore, the marked decrease in FES-I scores reflects increased confidence during activities of daily living and a reduced fear of falling.

Participants in the foam surface group also demonstrated significant improvements, although these were comparatively smaller than those observed in the dynamic surface group. Foam surface exercises likely enhanced proprioceptive function by reducing the reliability of somatosensory input, thereby encouraging greater use of

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visual and vestibular systems to maintain balance.

The firm surface group exhibited significant improvements compared with baseline; however, the magnitude of change was the smallest among the three groups. This finding suggests that while conventional balance exercises on a stable surface are beneficial, they may provide a lower level of sensory and motor challenge than exercises performed on unstable surfaces.

Overall, the findings indicate that progressively increasing the instability of the training surface leads to greater improvements in balance performance, functional mobility, and confidence in older adults. Therefore, dynamic surface balance training appears to be the most effective intervention among the three training approaches evaluated in this study.

**Discussion**

The present study was conducted to evaluate and compare the effectiveness of balance training performed on firm, foam, and dynamic surfaces in improving balance, functional mobility, and fear of falling among geriatric individuals. The findings demonstrated that all three intervention groups showed significant improvements following six weeks of supervised balance training. However, participants who trained on the dynamic surface exhibited greater improvements in balance, functional mobility, and confidence than those who trained on firm or foam surfaces.

Balance performance was assessed using the Berg Balance Scale (BBS). Significant improvements in BBS scores were observed in all three groups after the intervention, indicating that structured balance training effectively enhances postural stability in older adults. These improvements may be attributed to repeated practice of static and dynamic balance tasks, improved neuromuscular coordination, enhanced proprioceptive input, and better motor control. Participants who trained on the dynamic surface demonstrated the greatest improvement, possibly because dynamic surfaces provide continuous multidirectional perturbations that require constant postural adjustments and greater activation of stabilizing muscles.

Functional mobility was evaluated using the Timed Up and Go (TUG) test. All participants demonstrated a reduction in TUG completion time following the intervention, suggesting improved mobility and walking efficiency. The superior improvement observed in the dynamic surface group may be explained by the greater challenge imposed on the postural control system during training. Dynamic surface exercises require rapid weight shifting, coordinated lower-limb muscle activation, and continuous balance correction, which may improve movement efficiency during functional activities such as walking, turning, and transferring.

Fear of falling was assessed using the Falls Efficacy Scale–International (FES-I). A significant reduction in FES-I scores was observed across all groups, indicating increased confidence while performing daily activities. Improved balance and mobility likely contributed to reduced fear of falling by enhancing participants' ability to perform functional tasks safely and independently. The greatest reduction in fear of falling was observed in the dynamic surface group, suggesting that more challenging balance exercises may improve not only physical performance but also psychological confidence.

The findings of the present study are consistent with previous research. Hirase et al

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al. reported that unstable surface balance training produced greater improvements in postural control than conventional stable surface exercises in older adults. Similarly, Lesinski et al., in their systematic review and meta-analysis, concluded that structured balance training significantly improves postural stability and mobility among community-dwelling elderly individuals. Sherrington et al. also demonstrated that balance-focused exercise programmes effectively reduce fall risk and improve functional performance in older adults.

The superior outcomes observed following dynamic surface training are also supported by studies conducted by Granacher et al., Yaggie and McGregor, and Ogaya et al., who reported that exercises performed on unstable surfaces improve proprioceptive function, neuromuscular coordination, and postural control more effectively than exercises performed on stable surfaces. These authors suggested that unstable surfaces increase the demand on the sensory and motor systems, resulting in greater adaptation and improved balance performance.

Although foam surface training produced better outcomes than firm surface training, its effects were comparatively smaller than those achieved with dynamic surface training. Foam surfaces primarily reduce the accuracy of somatosensory feedback, encouraging greater reliance on visual and vestibular inputs. In contrast, dynamic surfaces provide continuous multidirectional instability, requiring simultaneous integration of sensory information and rapid motor responses. This additional challenge may explain the greater improvements observed in the dynamic surface group.

The present study has important clinical implications for physiotherapy practice. Incorporating balance exercises on unstable surfaces, particularly dynamic surfaces such as wobble boards, may provide greater improvements in postural stability, functional mobility, and confidence among older adults. Such interventions may contribute to reducing fall risk, promoting independent mobility, and improving quality of life in the geriatric population. However, progression to unstable surface training should always be individualized according to the participant's functional ability and performed under appropriate supervision to ensure safety.

## Conclusion

The present study found that balance training on firm, foam, and dynamic surfaces was beneficial in improving balance, functional mobility, and reducing fear of falling among geriatric individuals. All three groups showed positive changes after six weeks of training, highlighting the importance of regular balance exercises in older adults.

Among the different training surfaces, dynamic surface training produced the greatest improvement in balance, mobility, and confidence during daily activities. Foam surface training also showed better results than firm surface training, although its effects were comparatively less than those of dynamic surface training.

These findings suggest that incorporating dynamic surface balance exercises into geriatric rehabilitation programmes may provide additional benefits in improving postural control and functional independence. Progressive balance training under the supervision of a physiotherapist can be an effective strategy for reducing fall risk and promoting safe and active ageing.

## Clinical Implications

The findings of the present study have important implications for physiotherapy practice in geriatric rehabilitation. Structured balance training performed on different surfaces can effectively improve balance, functional mobility, and confidence while reducing the fear of falling among older adults. Based on the results, dynamic surface training may be considered a more effective approach for enhancing postural control because it provides greater proprioceptive and neuromuscular stimulation than firm or foam surface training.

Physiotherapists can incorporate progressive surface-based balance exercises into routine rehabilitation programmes to improve functional independence and reduce fall risk in elderly individuals. Selection of the training surface should be individualized according to the participant's balance ability, physical capacity, and safety requirements. Dynamic surface training should be introduced progressively and performed under appropriate supervision to maximize therapeutic benefits while minimizing the risk of falls.

**Limitations of the Study**

The present study had certain limitations that should be considered while interpreting the findings:

1. The study was conducted on a relatively small sample size, which may limit the generalizability of the findings to the broader geriatric population.
2. The intervention period was limited to six weeks; therefore, the long-term effects of balance training on different surfaces were not evaluated.
3. No follow-up assessment was performed after completion of the intervention, making it difficult to determine the sustainability of the observed improvements.
4. Participants were recruited from a single physiotherapy center, which may limit the external validity of the study.
5. Blinding of participants and therapists was not feasible because of the nature of the intervention, introducing the possibility of performance bias.
6. Factors such as participants' daily physical activity levels, nutritional status, and comorbidities were not controlled and may have influenced the study outcomes.
7. The study relied on clinical outcome measures and did not include instrument-based assessments such as computerized posturography or motion analysis for objective evaluation of balance performance.

**Recommendations**

Based on the findings and limitations of the present study, the following recommendations are suggested for future research:

1. Future studies should include a larger sample size to improve the generalizability of the findings.
2. Long-term follow-up assessments should be conducted to evaluate the sustainability of improvements in balance, functional mobility, and fear of falling.
3. Multicenter randomized controlled trials involving participants from different geographical regions are recommended to enhance external validity.

4. Future research should incorporate objective assessment tools such as computerized posturography, force platforms, motion analysis systems, or wearable sensors to provide a more comprehensive evaluation of balance performance.
5. The effectiveness of balance training on different surfaces may be investigated in older adults with specific clinical conditions such as Parkinson's disease, stroke, diabetic peripheral neuropathy, osteoarthritis, and vestibular disorders.
6. Future studies should compare surface-based balance training with other rehabilitation approaches, including perturbation training, virtual reality-based rehabilitation, dual-task training, and task-oriented balance exercises.
7. Further research should evaluate the long-term impact of dynamic surface balance training on fall incidence, functional independence, and quality of life among geriatric individuals.

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