

Effectiveness of Home-Based Otago Exercise Programme versus Traditional Exercises on Balance and Fall Risk among Elderly Adults

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Abstract

Background: Falls are a major geriatric health problem, with approximately 28–35% of community-dwelling adults aged 65 years and above falling each year, rising to 32–42% above the age of 70. Lower-limb muscle weakness and impaired postural control are among the most important intrinsic risk factors for falls in older adults. The Otago Exercise Programme (OEP) is a well-established, evidence-based, home-based exercise program for fall prevention, but comparative evidence against generalized traditional exercise approaches remains limited, particularly in the Indian elderly population.

Objectives: To compare the effectiveness of a Home-Based Otago Exercise Programme versus Traditional Exercises on balance, fear of falling, and lower-limb functional performance among elderly adults.

Methods: An experimental comparative study was conducted among 40 elderly adults aged 65–75 years, recruited from old-age homes and physiotherapy OPDs in and around Pune city, and randomly allocated to two groups of 20 each — Group A (Home-Based Otago Exercise Programme) and Group B (Traditional Exercises). Both groups performed their respective programs for 4 weeks (3 sessions per week, 30–45 minutes per session). Balance, fear of falling and lower-limb functional strength were assessed using the Berg Balance Scale (BBS), Falls Efficacy Scale (FES) and 30-second Chair to Stand (CTS) Test, respectively, before and after intervention. As change scores were not normally distributed (Shapiro–Wilk, $p < 0.05$), the Wilcoxon Signed-Rank test was used for within-group comparison and the Mann-Whitney U test for between-group comparison.

Results: Both groups showed statistically significant within-group improvement on all three outcomes (all $p < 0.001$). Mean BBS improved by 5.10 points in the Otago group (42.20 to 47.30) versus 3.90 points in the Traditional group (44.35 to 48.25); mean FES fell by 4.70 points in the Otago group (44.15 to 39.55) versus 3.80 points in the Traditional group (46.65 to 42.85), indicating reduced fear of falling in both groups; and mean CTS improved by 3.40 repetitions in the Otago group (11.30 to 14.70) versus 3.25 repetitions in the Traditional group (10.00 to 13.25). Between-group comparison of change scores favoured the Otago group for BBS (Mann-Whitney U, $p = 0.0009$, Cohen's $d = 1.28$, large effect) and FES ($p = 0.019$, $d = 0.93$, large effect), while the CTS change did not differ significantly between groups ($p = 0.522$, $d = 0.23$, small effect).

Conclusion: Both Home-Based Otago Exercises and Traditional Exercises significantly improve balance, fear of falling and lower-limb functional performance in elderly adults over a 4-week period. However, the Home-Based Otago Exercise Programme produces significantly greater improvement in balance and fear of falling than Traditional Exercises, while both are equally effective for lower-limb functional strength in the short term, supporting Otago as a low-cost, accessible, and effective fall-prevention intervention.

Keywords: Elderly Adults, Falls, Otago Exercise Programme, Traditional Exercises, Balance, Berg Balance Scale, Falls Efficacy Scale, Chair to Stand Test

1. Introduction

Ageing is an inevitable biological process associated with progressive decline in multiple physiological systems, including the musculoskeletal, neuromuscular, sensory and cardiovascular systems. According to the World Health Organization, the global population of adults aged 60 years and above is expected to double from 11% in 2006 to 22% by 2050, with a marked increase in developing countries such as India, where the elderly population is projected to reach 19% by 2050 [1]. This demographic transition has brought geriatric health issues, particularly falls, to the forefront of public health concerns.

A fall is defined as an unexpected event in which a person comes to rest on the ground, floor or a lower level [1]. Falls are among the most common and serious health problems in older adults, with approximately 28–35% of community-dwelling elderly above 65 years falling each year, rising to 32–42% above 70 years; Indian studies report a prevalence ranging from 14% to 53% [1, 2]. Falls often result in fractures, head injuries, soft-tissue injuries, hospitalisation, loss of independence and institutionalisation, and beyond physical injury they lead to fear of falling, activity avoidance, deconditioning, social isolation and reduced quality of life, a cycle of fear, inactivity, weakness and recurrent falls [1–3].

The aetiology of falls in the elderly is multifactorial, involving intrinsic factors such as age-related decline in lower-limb muscle strength and power, impaired postural control and balance, gait abnormalities, reduced proprioception, sensory deficits and polypharmacy, and extrinsic factors such as environmental hazards and inappropriate footwear. Among intrinsic factors, balance impairment and lower-limb weakness are the most significant modifiable risk factors; balance requires integration of visual, vestibular and somatosensory input with appropriate ankle, hip and stepping responses to keep the centre of gravity within the base of support, and age-related deterioration of these systems reduces the limits of stability and increases postural sway [2, 3]. Fear of falling, a lasting concern about falling that leads a person to avoid activities they remain capable of performing, is both a consequence and a risk factor for falls, present in 20–39% of elderly who have never fallen and up to 50–65% of fallers, and is assessed using tools such as the Falls Efficacy Scale (FES) [1, 3, 13].

Exercise has been identified as the single most effective intervention for fall prevention. A meta-analysis of 54 randomised controlled trials by Sherrington et al. reported that exercise reduces fall rate by 16% overall, rising to 25% for higher-dose programmes (more than 50 hours) that included balance training [4]. The Otago Exercise Programme (OEP), developed by Campbell and Robertson at the University of Otago, New Zealand, is an evidence-based, individually tailored, home-based programme specifically designed to prevent falls in older adults. It consists of progressive lower-limb strengthening exercises (knee extensors and flexors, hip abductors, ankle dorsiflexors and plantarflexors, using body weight), balance-retraining exercises (one-leg stand, tandem stand and walk, backward and sideways walk, heel-

toe walking) and a walking plan, requiring minimal equipment and making it low-cost, safe and feasible [6]. The original trials reported a 35% reduction in falls and fall-related injuries [6, 7], and subsequent studies have supported its effectiveness in improving balance, reducing fear of falling and improving lower-limb functional strength across settings including old-age homes [8, 10, 11].

Traditional exercise programmes commonly used in Indian physiotherapy practice for geriatric rehabilitation typically include general active range-of-motion exercises, static stretching, and general strengthening such as static quadriceps, static hamstrings, gluteal squeezes, straight-leg raises, seated marching, pelvic bridging and ankle movements, together with basic balance activities such as weight shifts and feet-together standing. While beneficial for joint mobility and general muscle performance, such programmes often lack structured progression, task-specificity and a targeted challenge to dynamic postural control, limits of stability and sensory integration, compared with standardised programmes such as OEP [5].

Although international literature supports the superiority of Otago over conventional exercise, comparative evidence in the Indian elderly population remains limited, particularly among those residing in old-age homes, where access to regular supervised physiotherapy is constrained by transport, cost, staffing and caregiver-support barriers [8, 10, 11]. A home-based programme that can be taught in a single session and performed near stable support with minimal supervision has considerable practical relevance in this context. The present study was therefore undertaken to compare the effectiveness of a Home-Based Otago Exercise Programme versus Traditional Exercises on balance and fall risk among elderly adults residing in old-age homes and attending physiotherapy OPDs in and around Pune city.

2. Need of the Study

Advancing age is associated with deterioration in muscle strength, postural stability and coordination, leading to increased balance impairment and a higher risk of falls among elderly adults. Falls are one of the leading causes of morbidity, mortality and loss of independence in this population, often resulting in fractures, fear of falling and reduced quality of life. Preventive exercise interventions focusing on balance and strength training are therefore essential to minimise fall risk and promote functional independence in the elderly.

The Otago Exercise Programme is an evidence-based, low-cost, home-based intervention specifically designed to improve strength, balance and mobility, thereby reducing fall incidence in older adults. Although traditional balance and strengthening exercises are widely used in clinical practice, there is limited research directly comparing their effectiveness with structured, home-based programmes such as Otago in the Indian elderly population. This study was undertaken to generate comparative evidence that can guide physiotherapists in selecting an effective, accessible and sustainable exercise approach for fall prevention in community-dwelling elderly adults.

3. Aim and Objectives

3.1 Aim

To compare the effectiveness of Home-Based Otago Exercise Programme versus Traditional Exercises on balance and fall risk among elderly adults.

3.2 Objectives

- To assess pre- and post-intervention balance performance using the Berg Balance Scale (BBS).
- To assess fear of falling using the Falls Efficacy Scale (FES).

- To evaluate lower-limb functional performance using the Chair to Stand (CTS) Test.
- To compare changes in outcome measures between the Otago and Traditional Exercise groups.

4. Materials and Methodology

4.1 Study Design and Setting

A randomised, experimental comparative study was conducted among elderly adults residing in old-age homes and attending physiotherapy OPDs in and around Pune city.

4.2 Sample

- Target population: elderly individuals aged 65–75 years.
- Sample size: N = 40 (20 in the Otago Exercise group and 20 in the Traditional Exercise group).
- Sampling method: simple random sampling.
- Intervention duration: 4 weeks (3 sessions per week, 30–45 minutes per session).

4.3 Materials

- Written informed consent form.
- Data collection sheet.
- Scales to assess balance and fear of falling (BBS, FES).
- Chair for the Chair to Stand Test.
- Pen and paper.

4.4 Inclusion Criteria

- Age 65–75 years, both male and female.
- Perceived fear of falling.
- Ability to understand and follow therapist instructions.
- History of multiple falls with minor or no injury.
- No pain, or mild musculoskeletal pain in the lower limb (VAS 3/10 or less) that does not restrict active participation in exercise.
- Willingness to give written informed consent and comply with the 4-week exercise schedule.

4.5 Exclusion Criteria

- Neurological deficits or severe visual impairment.
- Recent fractures, or inability to walk independently.
- Moderate to severe musculoskeletal pain (VAS greater than 3/10) in the back or lower limb limiting active participation.
- Acute inflammatory joint condition or post-surgical lower-limb pain within the preceding 3 months.
- Uncontrolled cardiovascular, respiratory or other condition limiting exercise tolerance.
- Cognitive impairment significant enough to prevent understanding or following exercise instructions.
- Vertigo or dizziness.

4.6 Outcome Measures

Berg Balance Scale (BBS): a widely used, performance-based outcome measure assessing functional balance through 14 tasks such as sitting to standing, standing unsupported, and reaching forward. Each item is scored 0–4, giving a maximum of 56; higher scores indicate better balance, and scores below 45 are generally associated with increased fall risk [12].

Falls Efficacy Scale (FES): a self-reported questionnaire assessing an individual's fear of falling and confidence in performing daily activities without falling; higher scores indicate greater fear of falling and

lower confidence [13, 14].

Chair to Stand (CTS) Test: evaluates lower-limb functional strength and power by measuring the number of times a participant can stand up from a seated position and sit back down within a fixed 30-second period; better performance indicates greater lower-limb strength and lower associated fall risk [15].

5. Procedure

- Ethical clearance was obtained from the Institutional Ethical Committee of Tilak Maharashtra Vidyapeeth, Department of Physiotherapy, prior to data collection.
- Elderly adults aged 65–75 years were screened, and a thorough history was taken to establish fear of falling and eligibility according to the inclusion and exclusion criteria.
- The purpose and procedure of the study were explained to all participants, and written informed consent was obtained from each participant.
- Baseline assessment of all participants was carried out using the BBS, CTS Test and FES before the intervention.
- Participants were randomly divided into two groups of 20 each, Group A (Home-Based Otago Exercise Programme) and Group B (Traditional Exercises).
- Group A received the Home-Based Otago Exercise Programme, comprising lower-limb strengthening, balance training and walking exercises.
- Group B received Traditional Exercises, comprising general lower-limb strengthening and balance activities.
- Both groups underwent their respective programmes for 4 weeks, 3 sessions per week, 30–45 minutes per session, with exercises performed near stable support to prevent falls.
- At the end of the intervention period, post-test assessment was carried out using the same outcome measures (BBS, CTS Test, FES).
- Pre-test and post-test values were recorded and analysed to determine the effectiveness of Home-Based Otago Exercises versus Traditional Exercises on balance and fall risk.

5.1 Group A — Home-Based Otago Exercise Programme

Lower-limb strengthening (8–10 repetitions, progressed gradually): knee extension, knee flexion, hip abduction, hip extension, calf raises and toe raises. Balance training and walking exercises: one-leg standing (10–30 seconds), backward walking (5–10 steps), heel-to-toe walking (5–10 steps), sideways walking (5–10 steps), obstacle walking, and walking at a comfortable pace.

5.2 Group B — Traditional Exercises

Lower-limb strengthening (8–10 repetitions with a 3-second hold, progressed gradually): seated marching, straight leg raises, static hamstrings, static quadriceps, pelvic bridging, gluteal squeezes, ankle dorsiflexion and ankle plantarflexion. Balance exercises: weight shifts side-to-side (15–30 seconds), weight shifts forward and backward (15–30 seconds), semi-tandem standing (15–30 seconds), feet-together standing (15–30 seconds) and standing marching (5–10 repetitions).

6. Statistical Analysis

Continuous variables were summarised as mean and standard deviation (SD), and categorical variables as frequencies and percentages. Change scores (post minus pre) were computed for BBS, FES and CTS in each group. Normality of the change scores was assessed using the Shapiro–Wilk test; as all six change-score distributions departed significantly from normality ($p < 0.05$), non-parametric tests were used

throughout. The Wilcoxon Signed-Rank test was used for within-group (pre- versus post-intervention) comparison, and the Mann-Whitney U test was used for between-group comparison of change scores, with effect size expressed as Cohen's d. Statistical significance was set at $p < 0.05$.

7. Data Analysis and Results

The study sample comprised 40 elderly participants, 20 in the Home-Based Otago Exercise group and 20 in the Traditional Exercise group. Data were collected before and after the 4-week intervention using the BBS, FES and CTS Test.

7.1 Participant Demographics

Table 1. Participant Demographics

Characteristic	Otago Group (n=20)	Traditional Group (n=20)
Mean age (years)	69.25 (SD 3.23)	69.85 (SD 2.68)
Male	11 (55%)	9 (45%)
Female	9 (45%)	11 (55%)

The two groups were comparable at baseline for age and sex distribution (Mann-Whitney U, $p = 0.48$ for age; Fisher's exact test, $p = 0.75$ for sex distribution).

7.2 Descriptive Statistics — Pre vs Post Scores

Table 2. Descriptive Statistics, Pre vs Post Scores (a Negative FES Change Denotes Reduced Fear of Falling)

Outcome	Group	Pre (Mean, SD)	Post (Mean, SD)	Mean Change
BBS	Otago	42.20 (5.07)	47.30 (4.77)	+5.10
BBS	Traditional	44.35 (4.34)	48.25 (3.95)	+3.90
FES	Otago	44.15 (7.92)	39.55 (7.56)	-4.70
FES	Traditional	46.65 (9.23)	42.85 (9.32)	-3.80
CTS	Otago	11.30 (1.81)	14.70 (1.78)	+3.40
CTS	Traditional	10.00 (1.62)	13.25 (1.65)	+3.25

Both groups improved across all three outcome measures. An increase from pre- to post-intervention indicates better balance (BBS) and greater lower-limb strength (CTS), while a reduction in FES indicates reduced fear of falling. The Otago group showed a numerically greater mean improvement than the Traditional group on every outcome measure, including a larger reduction in fear of falling.

7.3 Test for Normality (Shapiro–Wilk Test)

Table 3. Shapiro–Wilk Test of Normality for Change Scores

Outcome (Change)	Group	Shapiro-Wilk W	Sig. (p)	Interpretation
BBS	Otago	0.749	0.0002	Not normally distributed

Outcome (Change)	Group	Shapiro-Wilk W	Sig. (p)	Interpretation
BBS	Traditional	0.836	0.0032	Not normally distributed
FES	Otago	0.877	0.0155	Not normally distributed
FES	Traditional	0.807	0.0011	Not normally distributed
CTS	Otago	0.760	0.0002	Not normally distributed
CTS	Traditional	0.842	0.0040	Not normally distributed

As all six change-score distributions departed significantly from normality ($p < 0.05$), non-parametric tests were used for all outcomes, the Wilcoxon Signed-Rank test for within-group analysis and the Mann-Whitney U test for between-group comparison.

7.4 Within-Group Pre vs Post Analysis (Wilcoxon Signed-Rank Test)

Both the Otago and Traditional Exercise groups showed statistically significant pre- to post-intervention improvement on all three outcome measures (all $p < 0.001$).

Table 4. Within-Group Wilcoxon Signed-Rank Test (Pre vs Post)

Outcome	Group	Z	p-value	Decision
BBS	Otago	-3.94	<0.001	Reject null hypothesis, significant improvement
BBS	Traditional	-3.93	<0.001	Reject null hypothesis, significant improvement
FES	Otago	-3.94	<0.001	Reject null hypothesis, significant reduction
FES	Traditional	-3.92	<0.001	Reject null hypothesis, significant reduction
CTS	Otago	-3.92	<0.001	Reject null hypothesis, significant improvement
CTS	Traditional	-3.92	<0.001	Reject null hypothesis, significant improvement

7.5 Between-Group Comparison of Change Scores (Mann-Whitney U Test)

Table 5. Between-Group Comparison of Change Scores

Outcome	Otago Change	Traditional Change	U	p-value	Cohen's d	Interpretation
BBS	5.10	3.90	318.0	0.0009	1.28	Large effect, Otago superior

Outcome	Otago Change	Traditional Change	U	p-value	Cohen's d	Interpretation
FES	4.70 reduction	3.80 reduction	281.0	0.019	0.93	Large effect, Otago superior
CTS	3.40	3.25	222.0	0.522 (NS)	0.23	Small effect, equally effective

BBS and FES change scores differed significantly between groups, favouring Otago with a large effect size for both. CTS change did not differ significantly between groups, indicating both interventions were similarly effective for lower-limb functional strength in the short term.

7.6 Graphical Analysis

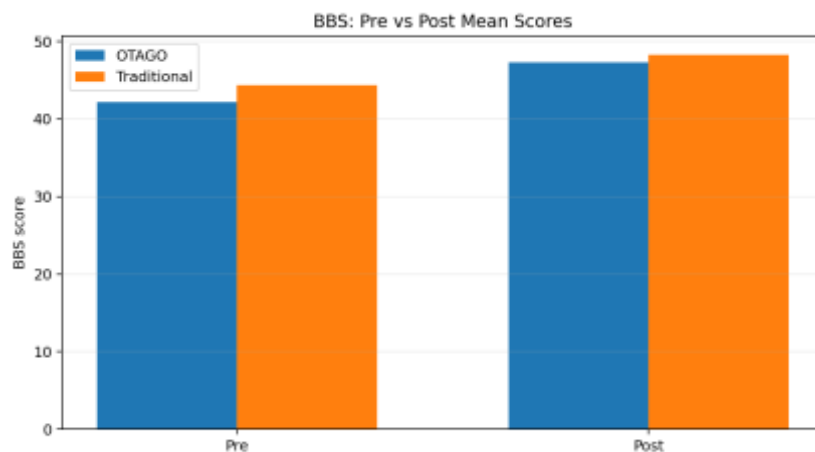


Figure 1. Pre- to Post-Intervention Change in BBS (OTAGO vs Traditional)

Both groups improved on the BBS after intervention. The Otago group showed a greater increase (5.10 points, 42.2 to 47.3) than the Traditional group (3.90 points, 44.3 to 48.2), a difference that was statistically significant (Mann-Whitney U, $p=0.0009$) with a large effect size ($d=1.28$).

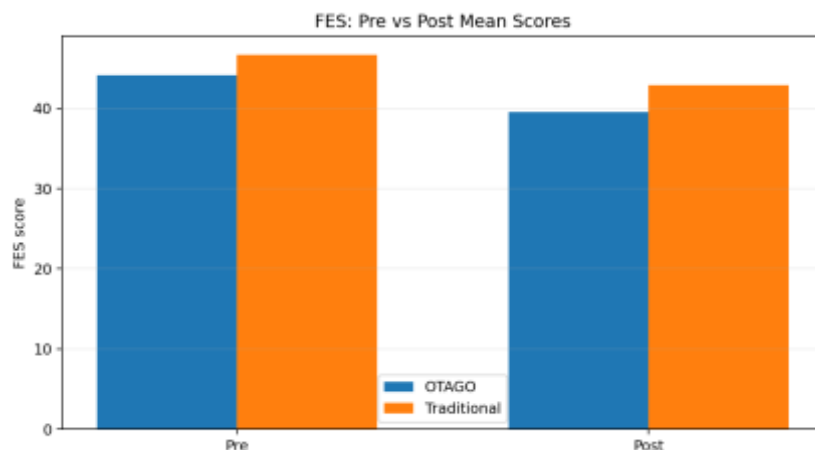


Figure 2. Pre- to Post-Intervention Change in FES (OTAGO vs Traditional)

The Otago group showed a 4.70-point reduction in FES (44.1 to 39.4) versus 3.80 points in the Traditional group (46.8 to 43.0). Since a lower FES score represents less fear of falling, the trend favoured Otago; this between-group difference was statistically significant ($p=0.019$) with a large effect size ($d=0.93$).

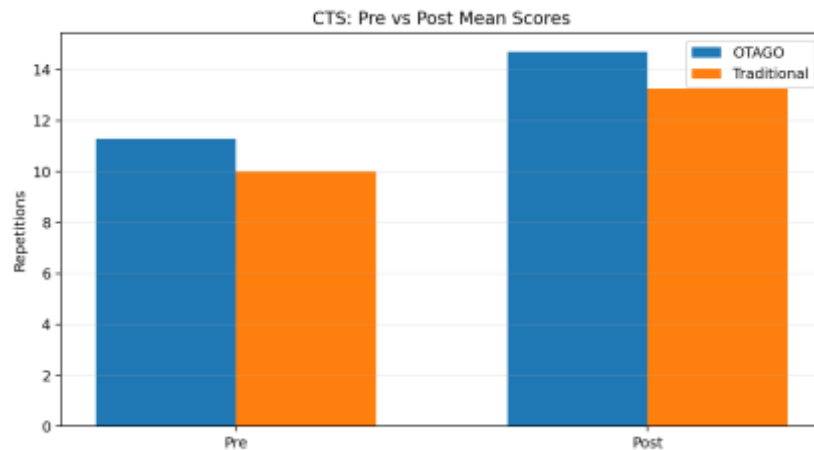


Figure 3. Pre- to Post-Intervention Change in CTS (OTAGO vs Traditional)

Both groups improved on the CTS Test. The Otago group showed a mean improvement of 3.40 repetitions (11.3 to 14.7) versus 3.25 repetitions in the Traditional group (10.0 to 13.25). This between-group difference was not statistically significant ($p=0.522$, $d=0.23$), suggesting both interventions are similarly effective for lower-limb functional strength in the short term.

8. Results

A total of 40 elderly adults aged 65–75 years were randomly divided into two groups of 20 each. Both the Home-Based Otago Exercise group and the Traditional Exercise group showed statistically significant within-group improvement after 4 weeks of intervention on all three outcome measures (all $p<0.001$, Wilcoxon Signed-Rank test). Mean BBS improved from 42.20 (SD 5.07) to 47.30 (SD 4.77), a change of 5.10, in the Otago group and from 44.35 (SD 4.34) to 48.25 (SD 3.95), a change of 3.90, in the Traditional group. Mean FES fell from 44.15 (SD 7.92) to 39.55 (SD 7.56), a reduction of 4.70, in the Otago group and from 46.65 (SD 9.23) to 42.85 (SD 9.32), a reduction of 3.80, in the Traditional group. Mean CTS improved from 11.30 (SD 1.81) to 14.70 (SD 1.78), a change of 3.40, in the Otago group and from 10.00 (SD 1.62) to 13.25 (SD 1.65), a change of 3.25, in the Traditional group.

On between-group comparison of change scores (Mann-Whitney U test), the Otago group showed significantly greater improvement than the Traditional group for BBS ($U=318.0$, $p=0.0009$, Cohen's $d=1.28$, large effect) and FES ($U=281.0$, $p=0.019$, $d=0.93$, large effect). The change in CTS did not differ significantly between groups ($U=222.0$, $p=0.522$, $d=0.23$, small effect), indicating that both exercise programmes were similarly effective for lower-limb functional strength over the 4-week period without the use of external weights.

9. Discussion

The present study compared the effectiveness of a Home-Based Otago Exercise Programme with Traditional Exercises on balance and fall risk among 40 elderly adults aged 65–75 years residing in old-age homes and attending physiotherapy OPDs in and around Pune city. Both groups demonstrated

statistically significant within-group improvement in balance (BBS), fear of falling (FES) and lower-limb functional performance (CTS) after 4 weeks of intervention, confirming that structured exercise, whether Otago-based or traditional, is beneficial for elderly adults at risk of falls, consistent with existing literature on exercise-based fall prevention [4, 5].

When change scores were compared between groups, the Otago group showed significantly greater improvement in balance ($p=0.0009$, large effect) and fear of falling ($p=0.019$, large effect), while the two groups were equally effective for lower-limb strength on the CTS Test ($p=0.522$, small effect). The superiority of Otago for balance can be explained by its structured and progressive balance-retraining component, which the Traditional programme lacks. The Otago protocol used in this study included single-leg standing, backward walking, sideways walking and heel-to-toe walking, tasks that specifically challenge the limits of stability, require continuous adjustment of the centre of gravity over the base of support, and stimulate ankle, hip and stepping strategies. World Health Organization and Rubenstein identified balance impairment, lower-limb weakness and gait dysfunction as major intrinsic risk factors for falls [1, 2], and the Otago programme, as described by Campbell and Robertson, directly addresses these through combined strengthening and balance retraining with a walking plan [6]. Traditional exercises in the present study focused mainly on general strengthening and static balance postures, which improve muscle performance but provide a comparatively limited challenge to dynamic postural control. These findings are consistent with earlier work. Rathi et al., in a study of 30 elderly adults, reported significantly greater improvement in Timed Up and Go, 30-second Chair-Stand and 10-metre Walk performance in an Otago group compared with a TheraBand-strengthening control group after 8 weeks [8]. Joshua et al. reported a significant correlation between impaired balance, reduced lower-limb strength and increased fall incidence, supporting balance training as a key preventive target [9]. Divya N. et al., studying elderly individuals with knee osteoarthritis and genu varum, found Otago more effective than proprioceptive training for functional mobility, strength and balance after 8 weeks [10], and Nimmi K.P. et al., in a randomised trial, reported Otago to be a more comprehensive and practical approach to improving balance and fear of falling than gaze stability exercises [11]. Benavent-Caballer et al. and Leem et al. similarly reported greater improvement in functional balance and fall-related efficacy with Otago-based programmes than with less structured alternatives [23, 24]. Meta-analyses and systematic reviews support these findings at a broader level: Sherrington et al. reported that exercise as a single intervention reduces fall rate by 16%, rising to 25% for higher-dose balance-training programmes [4]; Thomas et al. reported that Otago reduces both fall rate and mortality [16]; Robertson et al. reported a 35% reduction in serious fall-related injuries with the programme [17]; and Gardner et al. concluded that individually tailored home-based strength and balance-retraining programmes such as Otago significantly reduce falls [18]. Shubert et al., in a large US dissemination study, reported significant improvement in chair-stand performance and balance confidence with high participant satisfaction and adherence [19].

The significant reduction in FES observed with Otago (4.70 versus 3.80 points, $p=0.019$, large effect) is a particularly meaningful finding, since fear of falling independently contributes to activity avoidance, deconditioning and further fall risk, creating a self-reinforcing cycle, as described by Tinetti et al., who developed the Falls Efficacy Scale, and Yardley et al., who developed the FES-International [13, 14]. Both groups crossed the BBS cut-off of 45 associated with lower fall risk after intervention, as established by Berg et al. [12], but the Otago group showed the larger improvement. Otago's graded balance challenges and repeated practice of functional tasks may help build self-efficacy and confidence during activities of daily living, breaking the fear-avoidance cycle more effectively than unstructured traditional exercise.

For lower-limb strength (CTS), both interventions produced comparable short-term gains. Over a short duration of 4 weeks, strength gains are thought to occur primarily through neural adaptation, such as increased motor-unit recruitment and improved synchronisation, rather than muscle hypertrophy, which typically requires 8–12 weeks of progressive overload. Since neither protocol used external resistance, both groups received a broadly similar strengthening stimulus through body-weight exercise, measured using the 30-second Chair to Stand Test developed by Jones et al. [15]. This is consistent with Ishigaki et al., whose systematic review found lower-limb strengthening effective for fall prevention but noted that the optimal dose and protocol remain unclear [5], and broadly aligns with Chiu et al.'s meta-analysis, which found that Otago-based balance and strengthening protocols produced consistent improvements across a range of programme formats and durations [25]. A longer intervention with progressive resistance may be needed to detect a between-group difference in strength gains.

From a physiotherapy perspective, these findings support the use of a structured, home-based balance-retraining programme such as Otago as either a stand-alone intervention or an adjunct to traditional strengthening exercises in geriatric fall-prevention practice, particularly for elderly individuals who have difficulty attending supervised sessions. In the Indian context, and particularly in old-age homes, where access to regular supervised physiotherapy is often limited by transport, cost and staffing constraints, a home-based programme that can be taught in a single session and performed with minimal supervision offers considerable practical advantage for improving adherence and reducing dependency.

10. Conclusion

The present study concludes that both the Home-Based Otago Exercise Programme and Traditional Exercises are effective in improving balance, reducing fear of falling and improving lower-limb functional performance in elderly adults after 4 weeks of intervention. However, the Home-Based Otago Exercise Programme was significantly more effective than Traditional Exercises for improving balance and reducing fear of falling, while both programmes were equally effective for improving lower-limb functional strength in the short term. The structured balance-retraining component of the Otago programme appears to contribute to greater improvement in postural control and balance confidence compared with generalised traditional exercises. Home-Based Otago Exercise can therefore be considered a low-cost, safe, accessible and effective intervention for fall prevention in elderly adults, suitable for implementation in old-age homes and community settings to improve functional independence and reduce fall risk.

11. Limitations

- Small sample size (N=40), which may limit statistical power and generalizability of the findings.
- Short intervention duration of 4 weeks; the sustainability of the observed improvements beyond this period is unknown.
- No long-term follow-up was conducted to assess retention of gains or actual fall incidence after the intervention ended.
- The study was conducted in selected settings within Pune city, which may limit generalizability to other populations and settings.
- Baseline pain was screened only against the inclusion and exclusion cut-off (VAS 3/10 or less) and was not tracked as a continuous outcome, so any influence of residual mild pain on exercise performance could not be quantified.

12. Future Scope

- Use longer intervention and follow-up periods to assess the sustained effects of the Otago programme and durability of improvements.
- Include actual fall incidence and fall-related injuries as outcome measures, rather than fall-risk proxies alone.
- Track pain, for example using a Visual Analogue Scale, as a continuous outcome to examine its relationship with exercise adherence and functional improvement.
- Compare Otago with other structured fall-prevention programmes, and assess the cost-effectiveness of home-based versus supervised delivery.
- Assess exercise adherence and long-term feasibility of home-based Otago exercises using objective monitoring tools.
- Conduct multicentric studies across different regions and care settings to improve generalizability.

13. Clinical Implications

- Otago can be used as a home-based exercise intervention for elderly individuals at risk of falls.
- The programme targets lower-limb strength, balance and functional mobility, key components of fall prevention.
- It may help improve balance performance and confidence during functional activities.
- Its home-based format may improve accessibility for individuals who have difficulty attending regular supervised sessions.
- Otago may be incorporated into physiotherapy-based fall-prevention and geriatric rehabilitation programmes.
- Routine screening for balance impairment and fear of falling using tools such as the BBS and FES can help identify elderly individuals who would benefit most from a structured exercise programme.

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