Efficacy of Vivifrail Exercises on Functional Mobility among the Elderly Population Using POMA as an Outcome Measure: A Pilot Study

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Abstract:

Background: *Ageing is associated with a progressive decline in muscle strength, balance, and functional mobility, leading to an increased risk of falls and dependency. Multicomponent exercise programs such as Vivifrail have been recommended for frail and pre-frail older adults to improve functional outcomes.* ***Objective:*** *To evaluate the efficacy of Vivifrail exercises on functional mobility among elderly individuals using the Performance-Orientated Mobility Assessment (POMA).* ***Methods:*** *A pilot interventional study was conducted on six elderly participants aged ≥65 years. One participant dropped out, resulting in five participants completing the intervention. Vivifrail exercises were performed for 8 weeks. Functional mobility was assessed using POMA before and after the intervention.* ***Results:*** *Mean POMA scores improved from 19.0 ± 1.58 to 24.0 ± 1.58 following the intervention. The paired t-test showed a statistically significant improvement ($p < 0.001$).* ***Conclusion:*** *Vivifrail exercises significantly improved functional mobility among elderly participants. The findings support the feasibility and effectiveness of Vivifrail as a fall-prevention and mobility-enhancing intervention in geriatric rehabilitation.*

Keywords: *Vivifrail, elderly, functional mobility, POMA, falls prevention*

Introduction

Population ageing is a global demographic phenomenon, with a rapidly increasing proportion of individuals aged ≥ 60 years. Advanced age is associated with a progressive decline in neuromuscular, sensory, and cognitive systems, leading to impairments in balance, gait, and functional mobility. These age-related changes substantially increase the risk of falls, disability, loss of independence, and reduced quality of life in older adults [1–3].Functional mobility, defined as the ability to move safely and independently to perform activities of daily living, is a critical determinant of healthy ageing and successful community participation [4].

Falls are one of the most significant health concerns in the elderly population. Approximately one-third of community-dwelling older adults

experience at least one fall annually, with a higher incidence reported among frail individuals [5].Falls are multifactorial in origin and commonly result from muscle weakness, impaired postural control, slowed gait speed, and reduced coordination [6]. The consequences of falls include fractures, head injuries, fear of falling, activity restriction, institutionalisation, and increased mortality [7]. Hence, interventions aimed at improving balance and mobility are central to fall prevention strategies in geriatric rehabilitation settings.

Frailty is a geriatric syndrome characterized by reduced physiological reserve and increased vulnerability to stressors.It is strongly associated with mobility limitations, falls, hospitalization, and mortality [8].Exercise therapy has been consistently recognized as the most effective non-pharmacological intervention for counteracting frailty and mobility decline in older adults [9].Multicomponent exercise programs that incorporate strength, balance, flexibility, and endurance training have demonstrated superior outcomes compared with single-modality interventions [10].

The Vivifrail exercise program is a structured, individualized, multicomponent exercise intervention specifically designed for frail and prefrail older adults.Developed through European geriatric research initiatives, Vivifrail emphasizes functional strength, balance, gait training, and power-orientated exercises tailored to an individual's functional capacity and fall risk [11].Unlike conventional physiotherapy programmes, Vivifrail uses a standardized decision tree to prescribe exercise intensity and progression based on functional assessment, making it clinically practical and evidence-based [12].

Several studies have demonstrated the effectiveness of Vivifrail exercises in improving muscle strength, balance, gait speed, and functional independence in older adults [13–15].Evidence also suggests that Vivifrail-based interventions can reduce fall risk, improve activities of daily living, and enhance overall physical performance in both community-dwelling and institutionalised older adult populations [16]. However, despite growing evidence, limited pilot-level data exist exploring its specific impact on functional mobility using validated balance and gait outcome measures, particularly in resource-limited clinical settings.

The Performance-Oriented Mobility Assessment (POMA), also known as the Tinetti Balance and Gait Assessment, is a widely used, reliable, and valid clinical tool for evaluating balance, gait, and fall risk in older adults [17]. The POMA assesses key components of functional mobility, including sitting balance, transfers, standing balance, step length, symmetry, continuity, and trunk control during gait [18].Lower POMA scores are strongly associated with an increased fall risk and mobility impairment [19].Owing to its simplicity, clinical relevance, and strong psychometric

properties, the POMA is well-suited for pilot studies and geriatric exercise trials.

Although previous research supports the benefits of exercise-based interventions for improving balance and mobility, there is a paucity of pilot studies examining the efficacy of Vivifrail exercises on functional mobility outcomes measured using the POMA.Establishing preliminary efficacy through pilot data is essential for assessing feasibility, estimating effect size, and informing the design of larger randomized controlled trials [20].

Therefore, this pilot study aimed to evaluate the efficacy of Vivifrail exercises on functional mobility among the elderly population using POMA as an outcome measure.The findings of this study may provide valuable preliminary evidence supporting the integration of Vivifrail exercises into routine geriatric physiotherapy practice and fall prevention programs.

Methodology

This study was designed as a pilot pre–post experimental study aimed at evaluating the preliminary efficacy of Vivifrail exercise intervention on functional mobility among elderly individuals. A pilot design was chosen to assess feasibility, adherence, safety, and preliminary treatment effects before conducting a full-scale randomized controlled trial [2, 8, 15]. The study was conducted at ACS Medical College and Hospitals, involving elderly individuals attending outpatient and community-based physiotherapy services.The institutional ethics committee reviewed and discussed the study in detail, and clearing all queries raised in the meeting, the committee granted ethical clearance with the reference number (No. 1496/2024/IEC/ACSMCH Dt. 11.12.2024). Prior to participating in the study, the participant has signed their informed consent after being made aware of the study.

Participants were screened and recruited based on predefined eligibility criteria to ensure their clinical relevance and safety.A priori sample size estimation was performed using G*Power software version 3.1.9.7 (Heinrich-Heine-Universität Düsseldorf, Germany) to determine the required sample size for the full-scale study. The estimation was based on an effect size (ES) of 0.46, derived from previous research utilizing the Tinetti Performance-Oriented Mobility Assessment (POMA) as an outcome measure [Ivy Ren et al., 2022] [1,27]. With an alpha error probability set at 0.05 and a statistical power of 0.80, the estimated sample size required for adequate power was 47 participants. As this investigation was conducted as a pilot study, approximately 10% of the estimated sample size was considered appropriate, with an additional 10% allowance for potential dropouts [15]. Accordingly, six participants were initially recruited, of whom one participant (≈10%) discontinued the intervention for personal reasons.Therefore, the final analysis included five participants.A

convenience sampling method was employed, whereby eligible participants who met the inclusion criteria and were willing to participate during the study period were recruited for the study.This approach was deemed appropriate for the pilot feasibility study conducted in a clinical setting [24, 26]. Participants were included in the study if they were 65 years of age or older [16,25], were able to ambulate independently with or without the use of assistive devices, and demonstrated impaired functional mobility, as indicated by a POMA score of ≤25 [1,27]. Individuals were excluded if they had severe cognitive impairment that could interfere with comprehension or compliance [23], unstable cardiovascular or neurological conditions that posed a risk during exercise participation [7, 10], or a recent history of fractures or surgical procedures that could limit safe involvement in the intervention [17, 18]. Functional mobility was assessed using the Performance-Oriented Mobility Assessment (POMA), a validated and reliable clinical tool designed to evaluate balance and gait performance in older adults [1]. The assessment was administered at baseline (pre-intervention) and after the completion of the intervention period (post-intervention) by a trained physiotherapist [3, 15, 27]. Participants who met the eligibility criteria underwent the Vivifrail exercise program for 8 weeks with three sessions per week [2, 8]. Data were entered and analyzed using the appropriate statistical software.Descriptive statistics were used to summarise participant characteristics and outcome measures, and the results were expressed as mean ± standard deviation (SD).To evaluate the effect of the Vivifrail exercise intervention, pre- and post-intervention POMA scores were compared using paired t-tests.The level of statistical significance was set at $P < 0.05$.

Procedure of Intervention

Following participant recruitment and confirmation of eligibility, a baseline assessment of functional mobility was conducted using the Performance-Oriented Mobility Assessment (POMA) [1, 27]. All assessments were performed by a trained physiotherapist in a standardized clinical environment to ensure consistency and reliability [1, 15]. The participants were familiarised with the testing procedure prior to the assessment to minimise anxiety and learning effects.

After the baseline assessment, the participants underwent an 8-week Vivifrail exercise intervention program specifically designed to improve functional mobility in older adults [2, 8]. The intervention was structured as a multicomponent exercise program incorporating strength training, balance exercises, functional mobility tasks, and endurance training.Exercise prescription and progression were individualised according to each participant's baseline functional capacity, safety

considerations, and tolerance, in line with the Vivifrail programme principles [2, 6, 25].

Strength Training focuses primarily on the major lower limb muscle groups essential for mobility and postural control, including the quadriceps, hamstrings, gluteal muscles, and ankle musculature [12, 20, 22]. Exercises were performed using body weight and low-resistance modalities, emphasising controlled movement [17].Training intensity and repetitions were gradually increased based on participant performance and perceived exertion, ensuring adequate stimulus while minimising the risk of injury [7, 12, 20].

Balance Exercises target static and dynamic postural control[18,27].The activities included supported and unsupported standing, weight-shifting exercises, tandem and semi-tandem stances, and controlled changes in the base of support[13,14,22].Task complexity was progressively increased by reducing external support and incorporating the movement of the upper and lower limbs, as tolerated[13,24].

Functional Mobility tasks were integrated to enhance transfer ability and gait-related activity.These included sit-to-stand transitions, stepping activities, direction changes, and short-distance walking tasks designed to simulate activities of daily living (ADL). Emphasis was placed on movement efficiency, coordination, and safety during task performance[13,24].

Endurance Training was incorporated to improve cardiovascular tolerance and walking capacity[25,30]. Participants engaged in low- to moderate-intensity continuous activities, such as walking, with the duration and intensity adjusted according to individual tolerance and safety[7,16].Rest intervals were provided as required, and the participants were closely monitored for signs of fatigue or discomfort[10,17].

The exercise sessions were conducted thrice per week over a period of eight weeks, with each session supervised by a qualified physiotherapist to ensure correct technique, appropriate progression, and adherence to safety protocols[2,8,10].Vital signs were monitored as necessary, and adverse events were documented. Participants were encouraged to maintain regular attendance, and compliance was recorded throughout the intervention period[15,26].

Upon completion of the 8-week intervention, functional mobility was reassessed using the Performance-Oriented Mobility Assessment (POMA) following the same standardized protocol used during the baseline evaluation.Pre- and post-intervention scores were compared to determine the effect of the Vivifrail exercise program on functional mobility[3,8,28].

Outcome Measure

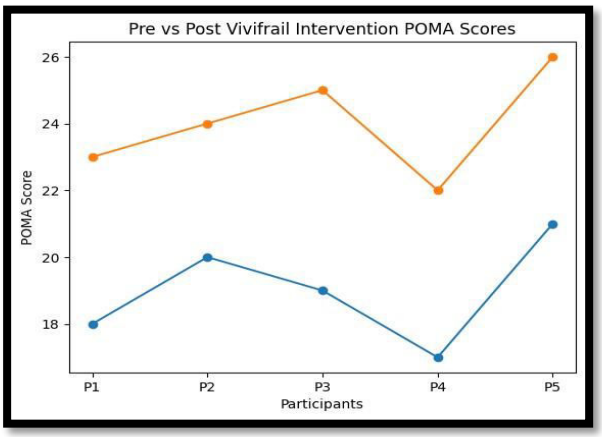
Performance-Oriented Mobility Assessment (POMA):

Assesses balance (16 points) and gait (12 points), with a total score of 28. Lower scores indicate a higher fall risk [9].

Table 1: Pre and Post test values with POMA

Participant	Pre POMA	Post POMA
1	18	23
2	20	24
3	19	25
4	17	22
5	21	26

Graph 1: Graphical representation of Pre and Post test values with POMA



Statistical Analysis

Descriptive statistics (mean ± SD) were used. Pre- and post-intervention scores were compared using paired t-tests.Statistical significance was set at $P < 0.05$.

Table 2: Descriptive analysis with the Pre and Post test values

Variable	**Pre-test (Mean ± SD)**	**Post-test (Mean ± SD)**
POMA Score	19.0 ± 1.58	24.0 ± 1.58

Results

Table 1 shows that there is significant improvement on functional mobility with the pre test and post test values following Vivifrail intervention

Table 2 Paired t-test revealed a **statistically significant improvement** in functional mobility following the Vivifrail intervention ($t = -15.81$, $p < 0.001$).

Discussion

This pilot pre–post experimental study evaluated the efficacy of an 8-week Vivifrail exercise program on functional mobility among older adults using the Performance-Oriented Mobility Assessment (POMA).The results demonstrated a **statistically and clinically significant improvement** in functional mobility after the intervention.The mean POMA scores increased from **19.0 ± 1.58 at baseline to 24.0 ± 1.58 post-intervention**, representing an average improvement of **five points** on the 28-point scale. This magnitude of change reflects a substantial enhancement in balance and gait performance, both of which are critical determinants of fall risk and functional independence in older adults.

Inferential analysis using a paired *t*-test revealed that this improvement was **statistically significant** ($t = -15.81$, $p < 0.001$).The large t value observed despite the small sample size indicates a strong treatment effect of the vivifrail exercise intervention. These findings suggest that the intervention produced consistent improvements across participants rather than isolated gains in only a few individuals.The absence of increased variability in post-intervention scores (the post-test SD remained at 1.58) further supports the uniform effectiveness of the intervention.

Clinically, a POMA score below 19 is associated with a high risk of falls, scores between 19 and 24 indicate a moderate risk, and scores above 24 reflect a low fall risk.At baseline, the mean POMA score of 19.0 placed the participants at the **threshold of high-to-moderate fall risk**.Following the intervention, the mean score of 24.0 shifted participants toward the **lower end of the moderate fall risk**, with some individuals achieving scores indicative of low fall risk. This transition underscores the clinical relevance of the observed statistical improvement, suggesting a meaningful reduction in fall susceptibility.

The improvement in the POMA scores can be attributed to the targeted components of the Vivifrail program.The strength training component likely contributed to enhanced lower limb force production, particularly in the quadriceps and ankle musculature, which are essential for postural stability and for gait propulsion.Improved muscle strength has been strongly associated with better balance performance and walking efficiency, which is reflected in the improved gait and balance subscores of the POMA.

Balance-specific exercises included in the intervention challenged both static and dynamic postural control, which may explain the observed improvements in standing balance, turning, and gait.These findings are consistent with previous studies reporting that multicomponent exercise programs emphasizing balance challenges yield significant improvements in functional mobility outcomes and fall risk reduction. The statistically significant increase in POMA scores observed in this study aligns with

earlier research demonstrating improvements of 3–6 points following structured balance and strength interventions in older adults.

Functional mobility tasks, such as sit-to-stand transitions and directional walking, likely enhance task-specific motor learning and neuromuscular coordination.The integration of these activities may have contributed to improved step symmetry, trunk control, and gait stability, as measured by the POMA gait assessment.Furthermore, the inclusion of endurance training may have indirectly influenced POMA performance by improving walking tolerance and reducing fatigue-related instability during walking.

The large effect observed in this pilot study is particularly noteworthy, given the small sample size (n = 5).Although pilot studies are not designed to provide definitive evidence, the statistically significant findings and large mean difference observed support the feasibility and preliminary efficacy of the Vivifrail intervention.These results also corroborate the a priori effect size (ES = 0.46) used for sample size estimation, suggesting that the selected outcome measure and intervention dosage were appropriate for the study.

Despite these positive outcomes, the results should be interpreted with caution because of the methodological limitations.The absence of a control group prevents the definitive attribution of the observed improvements solely to the intervention.Additionally, the small sample size limits the generalizability of the results.However, the consistency of improvements across participants, as evidenced by low variability and a highly significant *p-value*, strengthens confidence in the observed effect.

From a clinical and research perspective, these findings provide valuable pilot data to support the implementation of Vivifrail exercises in geriatric physiotherapy settings.The statistically and clinically significant improvements in POMA scores highlight the program's potential to improve functional mobility and reduce fall risk in the elderly population. The results of this study justify the need for a larger randomized controlled trial with adequate sample size, longer follow-up, and inclusion of additional outcome measures such as gait speed, muscle strength, and quality of life

Conclusion

This pilot pre–post experimental study demonstrated that an 8-week Vivifrail exercise program is effective, feasible, and safe for improving functional mobility among older adults, as measured by the Performance-Oriented Mobility Assessment (POMA).The significant improvement in POMA scores following the intervention indicated meaningful enhancements in balance and gait performance, which are critical determinants of fall risk and functional independence in older adults.

Limitations of the Study

Although the findings of the present pilot study provide preliminary evidence supporting the efficacy of Vivifrail exercises in improving functional mobility among older adults, certain limitations must be acknowledged.First, the small sample size and absence of a control group limit the generalizability of the results and preclude definitive conclusions regarding the causality.As this was a pilot study, the primary focus was on feasibility and preliminary effectiveness rather than on statistical power.

Second, the use of a convenience sampling method may have introduced selection bias, as participants who were more motivated or physically capable were more likely to participate.Third, the study employed a short intervention duration and no long-term follow-up, making it difficult to determine the sustainability of the functional gains over time.

Additionally, functional mobility was assessed using a single outcome measure (the POMA).While POMA is a valid and reliable tool, the inclusion of additional measures, such as gait speed, muscle strength, fear of falling, or quality of life, could have provided a more comprehensive evaluation of the intervention effects.Lastly, assessor blinding was not implemented, which may have introduced a measurement bias.

Conflict of Interest

The authors declare no conflicts of interest with respect to the research, authorship, or publication of this study.No financial or personal relationships could have inappropriately influenced the outcomes or interpretation of the findings.

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