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Functional Training effects on Gait Speed, COD Agility and Balance in Older Male Adults

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ABSTRACT

Objective: *Evaluate the effects of an 8-week supervised functional training programme on gait speed, change-of-direction (COD), and dynamic balance among community-dwelling older men.*

Methods: *Twenty older men participants (60 ≤ age ≤ 65) participated in a single group pre & post-trial. The intervention included four 35–45 min sessions per week for 8 weeks, integrating strength, balance, coordination, and aerobic components with progressive overload (RPE 5–7). Outcomes included the 400-metre Walk Test (gait speed), 505- test (change-of-direction) and Y-Balance Test (dynamic balance) assessed before and after training. Paired-sample t-tests determined pre–post differences, with 95 % confidence intervals (CIs) Cohen's d and percentage change (Δ%) calculated.*

Results: *All outcomes improved significantly (p < 0.001). COD Agility (505 test) time decreased from 6.00 ± 1.32 s to 4.01 ± 0.36 s (Δ = −33.2 %, d = 1.92), gait speed improved from 4.63 ± 0.65 min to 3.90 ± 0.63 min (Δ = −15.9 %, d = 1.24), and Y-Balance reach distance increased on the right leg from 193.6 ± 33.5 cm to 234.3 ± 27.6 cm (d = 1.58) and left leg from 194.4 ± 30.1 cm to 232.5 ± 28.8 cm (d = 1.55). The composite balance score improved by approximately 20 %. Attendance exceeded 95 %, and no adverse events occurred.*

Conclusions: *An 8-week functional training exercise programme produced large to very large improvements in gait speed, COD (change-of-direction) speed, and dynamic balance among community-dwelling male older adults. The programme was safe, feasible, and aligned with WHO (World health Authority) and ACSM recommendations for fall-prevention exercise, supporting its potential as a scalable strategy to enhance mobility and reduce fall risk in ageing populations.*

Keywords: *Functional training; Gait speed; Agility; Dynamic balance; Fall prevention; Older adults*

INTRODUCTION

Ageing is related with progressive losses in muscle strength, postural control, neuro-muscular coordination that compromise mobility and stability. These declines led directly to an increased risk of falls, which are the leading cause of injury-related morbidity and loss of independence among older adults worldwide. Around one in three community-dwelling adults over- 60 years experiences at least one fall annually, with extensive personal and healthcare costs (World Health Organization, 2021). Decline in gait speed, agility, and dynamic balance not only predicts fall episodes but also signals broader functional deterioration and future disability (Studenski et al., 2011). Preserving these attributes is therefore a public health priority in the context of the global population ageing.

Exercise based interventions are the most adequate strategy to prevent risk of falls and maintain mobility in older adults. Meta-analyses and umbrella reviews constantly demonstrate that progressive and structured exercise programmes can reduce fall rates by 20–30 % and significantly improve functional performance metrics such as gait speed, chair-rise ability, and balance control (Sherrington et al., 2023). The strongest effects are achieved when exercise challenges balance, includes progressive overload, and is delivered at a sufficient weekly dose (>3 hours per week). Accordingly, the World Health Organization (2020) and American College of Sports Medicine (ACSM, 2021) recommend multicomponent exercise for older adults, combining resistance, aerobic, and neuromotor training (balance, agility, coordination), to preserve function and reduce fall risk.

However, most community or clinical exercise programmes still emphasize isolated strength or aerobic training with limited emphasis on functional, task-specific movements that simulate the physical and cognitive demands of daily life. Functional training characterised by multi-joint and multi-planar movements that integrate muscular strength, balance, gait speed, coordination and agility within a single session, perform an evolution toward more ecologically valid exercise paradigms. These programmes not only enhance muscular capacity, neuro-muscular coordination but also improve proprioception, and movement efficiency, mechanisms central to safe mobility. Recent trials suggest that functional training can yield superior gains in balance, agility, and functional independence compared to conventional modalities (Granacher et al., 2022; Cadore et al., 2019). yet the evidence remains limited for short-term, high-frequency interventions among active, community-dwelling older adults.

Equally significant, the choice of product measures in elderly exercise research should capture functional and dynamic performance rather than isolated dimensions. The 400-Meter Walk Test provides a biologically effective index of walking endurance and functional mobility strongly linked to mortality and morbidity in older populations. The Y-Balance Test (YBT) quantifies dynamic balance and lower-limb reach control while the 505 COD test adapted from sports performance contexts offers a different metric of agility and turning ability key determinants of fall avoidance yet rarely assessed in ageing cohorts. Participating these measures enables a comprehensive evaluation of how functional training influences neuro-motor performance relevant to everyday mobility.

Despite increasing recognition of these principles, experiential evidence examining the combined impact of functional training on gait speed, change-of-direction speed, and dynamic balance in community-dwelling older adults is infrequent. Furthermore, little is known about the feasibility, safety, and responsiveness of such protocols when implemented at sufficient frequency and intensity in real-world community settings. Particularly in low- and middle-income countries where fall-prevention infrastructure is limited.

Therefore, the current study investigated the effects of an 8-week supervised functional training programme on (1) gait speed measured by the 400-Meter Walk Test (2) change-of-direction speed assessed by the 505 test and (3) dynamic balance evaluated using the Y-Balance Test in community-dwelling male older adults. It was hypothesised that the intervention would lead to significant improvements across all outcomes reflecting enhanced neuro-motor control, proprioception and movement efficiency thereby reduce fall-related risk factors in this population.

METHODS

Study Design and Setting

This study engaged a single-group pre–post feasibility design to evaluate the effects of an eight-week functional training programme on gait speed, COD (change-of-direction) and dynamic balance among community-dwelling active male older adults. The study was conducted in the local community club under controlled indoor conditions between March 2025 to May 2025. The design intended to assess feasibility, safety, and preliminary effect estimates to inform future randomised controlled trials. The study was approved by the University of Lahore Research Ethics Committee and all participants provided written informed consent prior to participation.

Participants

Twenty community-dwelling moderate active male older adults aged 60 to 65 years volunteered to participate. Eligibility criteria included participant's ability to ambulate independently without assistive devices absence of musculoskeletal, neurological or cardiovascular disorders limiting exercise participation. There were no history of falls or major surgery within the previous six months and engagement in light-to-moderate physical activity but not in structured resistance or balance training during the prior three months.

Participants were employed through community advertisements and university outreach programmes. Baseline screening included medical history, resting blood pressure, and informed consent.

Sample Size Rationale

The sample size was determined practically based on laboratory capacity and comparability with similar early-phase interventions in older adults (typically n = 15–25). This number was considered adequate to detect large within-group effects (Cohen's $d \approx 0.8$) while assessing adherence and safety outcomes.

Functional Training Intervention

The Participants successfully completed eight-week functional training program under supervision containing of 4 sessions each week, Total sessions timings were 35–45 minutes. All Sessions were managed in small groups (≤ 20 participants) in the community club in hometown with well-equipped gym/fitness centre under supervised by the certified exercise and sports specialist.

There were four structured components of each training sessions. A 05–07-minute warm-up static and dynamic mobility drills mix with light cardio. Incorporate strength and cardiovascular exercise's part involving body weight along with resistance-band exercises for the 15–20-minute targeting major muscle groups, combined with aerobic activities like brisk walking, step-ups. Incorporate 10–15-minute balance and functional trainings like multidirectional activities, tandem walking, equilibrium and stability drills, use ladder for agility exercises performed to improve neuro-muscular coordination, proprioception and COD control. finally, five minutes a cool-down period including normal stretching & breathing exercises to more facilitate recovery.

The program trailed a progressive multicomponent well- structured eight weeks (4 sessions each week) that combined strength, muscular endurance, balance, coordination, and cardiovascular fundamentals. Each week incorporated exercises from five main movement categories including push, pull, squat, hinge, and rotation combined with locomotor and proprioceptive challenging drills. Early sessions highlighted movement quality, postural control, and neuro-motor coordination using body weight and resistance bands, while later weeks introduced progressive overload in training pattern. Strength exercises (e.g., Assisted squats, assisted push-ups, partial deadlifts, glute bridges, core integration, eccentric hamstring holds and progressively more than 50 different structured exercises regimen were performed for 2–4 sets of 10–15 repetitions with work rest/ratio intervals of 30–60 seconds. Functional drills included tandem walking, Zig-Zag movements, multidirectional stepping, and ladder sequences, performed at moderate-to-vigorous intensity (RPE 5–7). Aerobic movements such as LSDR (low-Slow distance running) intervals were combined to maintain cardiorespiratory engagement. Balance progression advanced from bilateral to Unilateral Leg-stances, from static to dynamic reaches, and from linear to multidirectional patterns. The full week-by-week progression strategy, including exercise examples, duration, and intensity targets under critically evaluation by certified exercise professional.

With Borg Scale Rating of Perceived Exertion (RPE) Exercise intensity was continuously observed and maintained between 5–7 (“somewhat hard” to “hard”), corresponding to approximately 60–80 % of heart-rate reserve. All workouts adhered to the principle of progressive overload with systematic progression in movement complexity resistance and speed based on individual tolerance. Attendance was recorded at every session with participants completing ≥ 95 % of sessions. No adverse events or injuries occurred during the intervention.

Outcome Measures and Testing Procedures

All outcomes were measured one week before and within one week after the intervention. Testing remained performed under identical laboratory conditions such as same location, flooring, footwear and time of day to minimise variability. Participants refrained from strenuous activity for 24 h before testing.

Gait Speed *– 400-Metre Walk Test (400MWT):* Participants walked ten laps of a 40-m indoor circuit “as quickly as possible without running.” Time to completion was recorded to the nearest 0.1 s using a digital stopwatch. The 400MWT is a reliable (ICC > 0.90) and valid indicator of functional mobility and endurance in older adults. Shorter completion times indicated better performance.

Change-of-Direction Agility *– 505 Test:* Change-of-direction (COD) ability was evaluated using the 505 Test, adapted for older adults. After a 10-m acceleration, participants sprinted 5 m to a turning line, executed a controlled 180° pivot on the preferred leg, and returned to the 10-m mark. Time from start to return was measured to the nearest 0.01 s with electronic timing gates (or a handheld stopwatch where gates were unavailable). Lower times reflected faster COD ability.

Dynamic Balance *– Y-Balance Test (YBT):* Dynamic balance and proprioception were assessed using the Lower-Quarter Y-Balance Test. Standing on one leg, participants reached in the anterior, posteromedial, and posterolateral directions along a Y-shaped grid. Three successful trials per direction were averaged and normalised to leg length (anterior superior iliac spine to medial malleolus). The composite reach score was calculated as

$$(ANT+PMED+PLAT)/\,(3\times \text{leg length})\times 100$$

expressed as a percentage, where ANT = anterior reach, PMED = posteromedial reach, and PLAT = posterolateral reach, with leg length measured from the anterior superior iliac spine to the medial malleolus. Higher scores indicated better dynamic balance. The YBT demonstrates high reliability (ICC > 0.85) in older populations.

Statistical Analysis

All statistical analyses were performed using IBM SPSS Statistics version 26.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics (mean ± SD) were calculated for all variables. Data normality was verified using the Shapiro–Wilk test and inspection of histograms and Q–Q plots.

Pre- and post-intervention differences were analysed using paired-sample *t*-tests. Statistical significance was accepted at $p < 0.05$ (two-tailed). For each variable, 95 % confidence intervals (CIs) and Cohen’s *d* were computed to determine the magnitude of change (small = 0.2, moderate = 0.5, large ≥ 0.8). Percentage change (Δ %) from baseline was also reported to aid interpretation of practical relevance. All analyses were conducted on complete-case data, as no missing observations occurred.

Table 1. Participant characteristics (n = 20)

Variable	Mean ± SD	Minimum	Maximum	n	Notes / Units
Age (years)	62.9 ± 2.16	60	65	20	Chronological age
Height (cm)	175.2 ± 2.55	169.8	181.7	20	Measured using stadiometer
Weight (kg)	85.3 ± 8.23	71	104	20	Digital scale measurement
Body Mass Index $kg \cdot m^{-2}$	27.8 ± 2.30	23.3	31.9	20	Calculated as weight/height²
Resting Heart Rate $beats \cdot min^{-1}$	79.3 ± 4.02	72	85	20	After 5 min seated rest
Physical Activity Level	N/A	Moderate active	Active	20	Self-reported category
Comorbidities (n [%])	N/A	N/A	N/A	0%	e.g., Hypertension (%), Diabetes (%)
Medication use (n [%])	N/A	N/A	N/A	0%	If applicable
Attendance (% sessions completed)	98.8 ± 2.56	90	100	20	Adherence rate (~99%)

RESULTS

Participant Characteristics

Twenty community-dwelling older men (mean age = 62.9 ± 2.16 years) completed the 8-week functional training programme, achieving an attendance rate above 95 %. All participants tolerated the intervention without incident, and no adverse events were reported. Descriptive characteristics are presented in Table 1.

Pre–Post Changes in Physical Performance

All outcome measures demonstrated statistically significant improvement following training (Table 2 - Figure 1). Agility performance improved markedly, with 505 test completion time decreasing from 6.00 ± 1.32 s to 4.01 ± 0.36 s (t_{19} = 8.49, $p < 0.001$, $d = 1.92$ [very large]), representing a 33.2 % reduction in turning time. Gait performance also improved substantially as 400-m walk completion time decreased from 4.63 ± 0.65 min to 3.90 ± 0.63 min (t_{19} = 5.54, $p < 0.001$, $d = 1.24$ [large]) corresponding to a 15.9 % increase in walking velocity.

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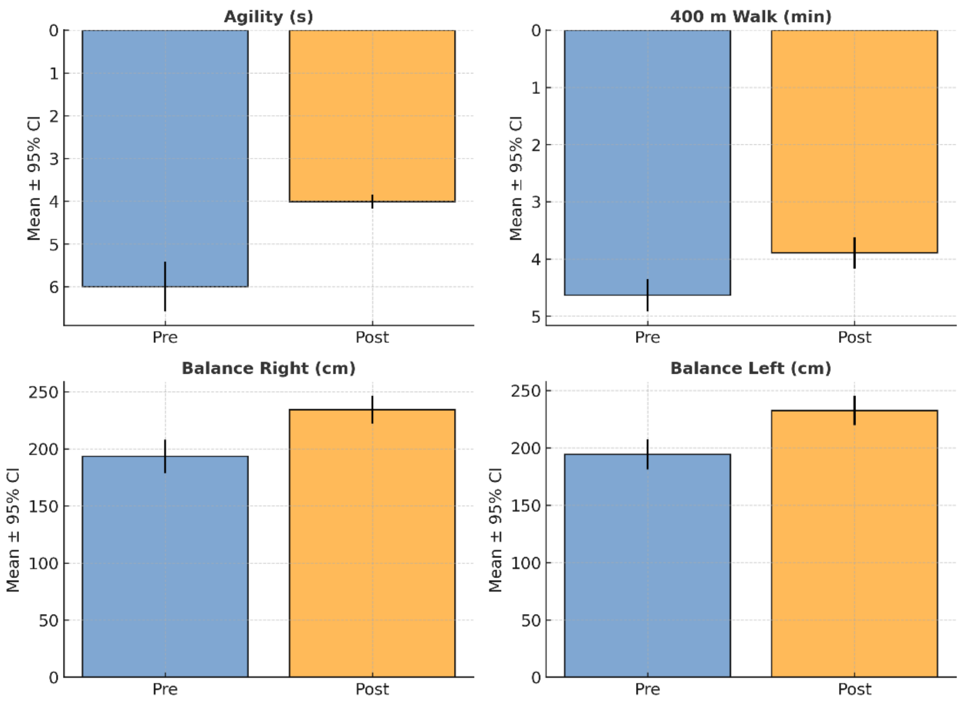
Figure 1. Pre- and Post-Training Mean ± 95% CI for Agility, Gait Speed, and Balance



Dynamic balance improved constantly across both lower limbs. The right-leg reach distance increased from 193.6 ± 33.5 cm to 234.3 ± 27.6 cm ($t_{19} = -7.08$, $p < 0.001$, $d = 1.58$ [very large]), while the left-leg reach improved from 194.4 ± 30.1 cm to 232.5 ± 28.8 cm ($t_{19} = -6.91$, $p < 0.001$, $d = 1.55$ [very large]). All progresses exceeded thresholds typically considered clinically meaningful for enhancing mobility and reducing fall risk in older adults. (Table 3).

Table 2. Pre- and post-training results for gait speed, COD agility and balance (n = 20)

Outcome measure	Pre-training Mean ± SD	Post-training Mean ± SD	Mean difference (95 % CI)	t (df = 19)	p-value	Cohen's d	% Change (Δ%)
Agility (505 test, s)	6.00 ± 1.32	4.01 ± 0.36	1.99 (1.50 – 2.48)	8.49	< 0.001	1.92	−33.2 % ↓
400 m Walk time (min)	4.63 ± 0.65	3.90 ± 0.63	0.74 (0.46 – 1.02)	5.54	< 0.001	1.24	−15.9 % ↓
Y-Balance Right (cm)	193.6 ± 33.5	234.3 ± 27.6	−40.8 (−52.8 to −28.7)*	−7.08	< 0.001	1.58	+21.1 % ↑

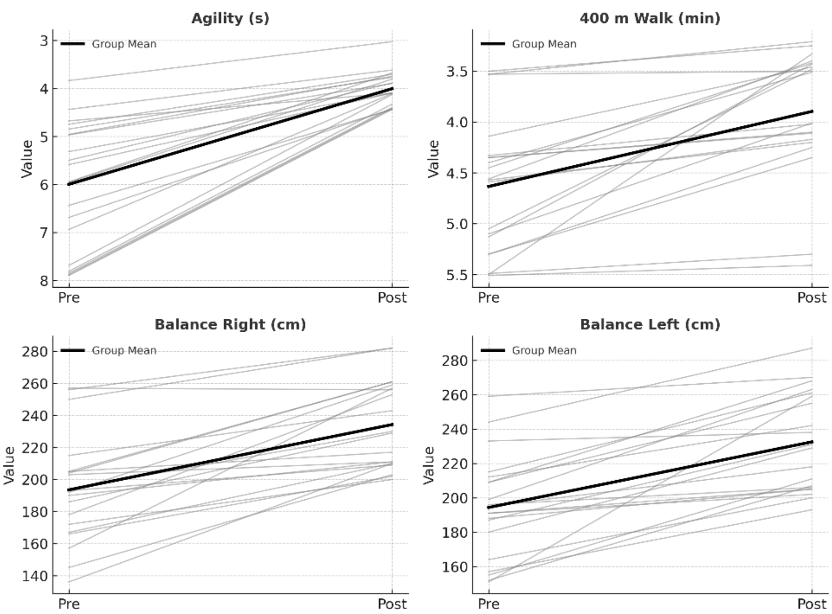
Y-Balance Left (cm)	194.4 ± 30.1	232.5 ± 28.8	−38.2 (−49.7 to −26.6)*	−6.91	< 0.001	1.55	+19.6 % ↑

**Note: Negative sign for mean difference indicates improvement (reduced time or increased distance).* *

Individual Response Patterns

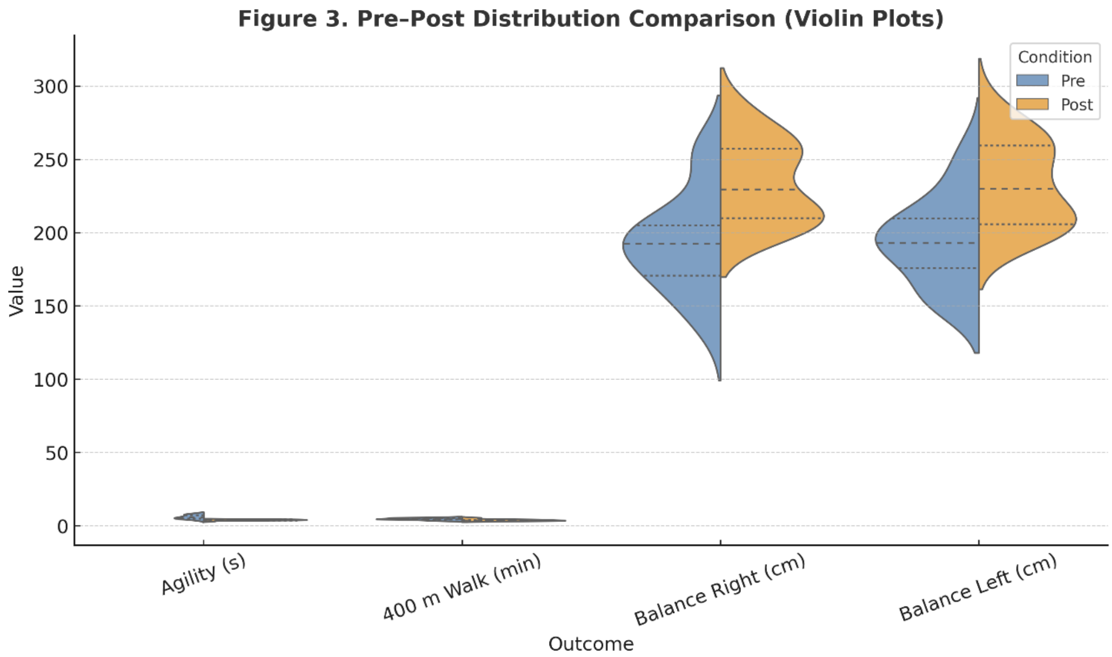
Individual participant trajectories are illustrated in Figure 2. All participants shown a clear pre-to-post development across every outcome signifying consistent responsiveness to the intervention. Reductions in agility and gait completion times were apparent across all individuals accompanied by corresponding increases in reach distances. The reliability of these patterns reflects the robustness and uniform efficiency of the functional training protocol.

Figure 2. Individual Pre-Post Changes for Agility, Gait Speed, and Balance



Data Distribution and Variability

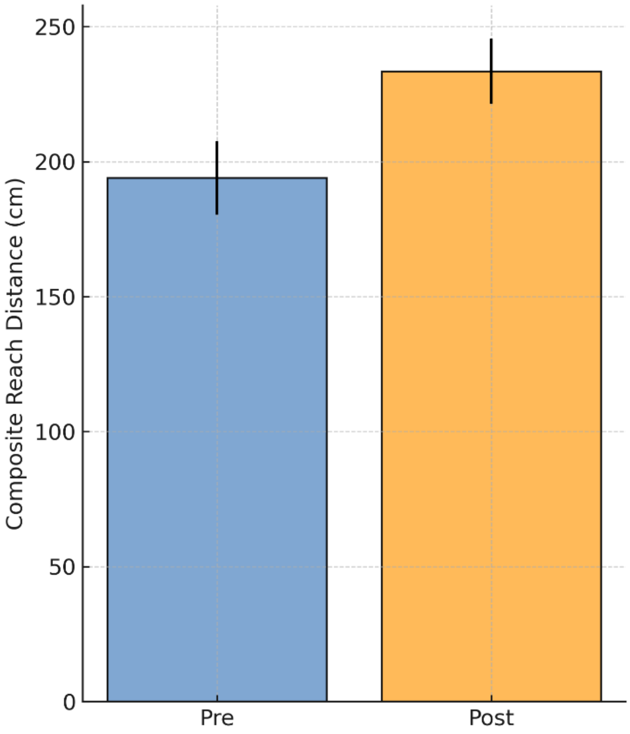
Figure 3 shows the pre- and post-intervention distributions for agility, gait speed, and balance performance. Post-training data presented reduced variability and greater cluster around superior performance values and for agility and walking time the post-intervention distributions shifted toward lower completion times whereas for balance post-intervention values were concentrated at higher reach distances. These distributional changes confirm that improvements were systematic rather than driven by a few outliers, further supporting the validity of the intervention effects.



Composite Dynamic Balance Score

When the right- and left-leg reach distances were averaged the composite dynamic-balance score increased from 193.9 ± 31.5 cm to 233.4 ± 27.6 cm ($p < 0.001$, $d = 1.56$ very large Figure 4). This signifies an overall enhancement of about 20 % in functional balance capacity signifying a substantial improvement in bilateral stability and proprioceptive control.

Figure 4. Composite Dynamic Balance Score (Mean ± 95% CI)



Overall, the 8-week functional training program prompted large to very large improvements in Gait speed, Agility and Dynamic balance among community-dwelling older men. All participants completed the intervention safely with remarkably high observance and no adverse events. The magnitude and consistency of observed gains exceeded commonly accepted thresholds for clinically meaningful change in older adults underlining the potential of functional training as a time-efficient, feasible, and effective approach to enhancing mobility and reducing fall risk in ageing populations.

Table 3. Magnitude of change based on standardised effect sizes

Outcome measure	**Cohen's d**	**95 % CI for d**	**Magnitude classification**	**Interpretation**
Agility (505 test)	1.92	≈ 1.2 – 2.6	Very large	Substantial improvement in change-of-direction speed
400 m Walk time	1.24	≈ 0.7 – 1.8	Large	Marked increase in gait speed/endurance
Y-Balance Right	1.58	≈ 1.0 – 2.2	Very large	Major gain in dynamic balance/proprioception
Y-Balance Left	1.55	≈ 1.0 – 2.1	Very large	Major gain in dynamic balance/proprioception

Note: Altogether four outcomes improved significantly (p < 0.001) with large-to-very-large effect sizes (d = 1.2–1.9). Average improvements ranged from ~16% faster gait speed to ~20–21% greater balance reach, beyond clinically meaningful thresholds for older adults.

DISCUSSION

The 8-week functional training program produced large and consistent improvements in agility (COD), gait speed and dynamic balance among community-dwelling older men. All participants completed the intervention safely achieved above 95 % attendance rate without adverse events. The magnitude of improvement was substantial 33 % faster agility performance by 16 % faster gait speed and 20 % greater balance reach with effect sizes ranging from large to very large (d = 1.2–1.9). These results establish that a brief progressive and well-structured and supervised functional training regimen can substantially enhance key physical capacities associated with mobility independence and fall-risk reduction.

The present results align with a robust body of evidence confirming that exercise is a cornerstone strategy for fall prevention and functional maintenance in ageing adults. Recent meta-analyses surrounding thousands of participants shows that structured balance-challenging exercise reduces fall rates by 20–30 % and improves balance and mobility performance metrics such as gait speed and Timed-Up-and-Go scores (Sherrington et al., 2016c).

The achieved gains in gait and balance in the current study are of comparable or greater magnitude than those typically reported after 12–24 weeks of training suggesting that the training frequency (4 sessions/week) and neuro-motor emphasis may have accelerated adaptation.

Functional training methods combining strength, balance, coordination, and aerobic training programs improves the longevity in older adults. The 8-week structured employed here closely mirrors the successful frameworks recommended by the World Health Organization (2020) and the American College of Sports Medicine (ACSM, 2021) which call for ≥150 min/week of moderate-to-vigorous physical activity incorporates balance and resistance training.

400-Meter Walk Test (400MWT) as a symbol of gait capacity adds clinical relevance as performance in this test predicts incident mobility limitation disability and mortality in older adults. The 15.9 % improvement observed here therefore represents not only faster walking but also a meaningful enhancement in functional reserve. Likewise, the inclusion of the 5-0-5 test provides a different insight into directional-change performance. Functional determinant of fall avoidance rarely examined in non-athletic older adults. Recent commentary on change-of-direction (COD) testing.

Nimphius et al. (2017) recommends its use as a proxy for rotating mobility rather than “agility” thus the present data extend COD testing validity to older populations.

The Y-Balance Test (YBT) for Dynamic balance was assessed using a reliable and sensitive indicator of lower-limb reach control. The ~20 % improvement in bilateral reach observed here exceeds the 4–5 % minimal detectable change reported in prior YBT proof studies indicating true neuro-muscular adaptation. Taken together these findings reinforce that task-specific, functional training can yield broad neuro-motor benefits over a short period.

The observed improvements parallel adaptations in muscle strength, inter-limb coordination, and sensory-motor control. Functional tasks including squats, step-ups, and multi-directional movements may have improved both concentric-eccentric strength and proprioceptive ability whereas repeated changes of direction and balance challenges may have refined anticipatory postural adjustments and movement efficiency. These mechanisms align with evidence that neuro-motor and balance-oriented exercises improve reaction time, joint-position sense and gait stability which are critical elements for fall avoidance.

Strengths and Limitations

Strengths include a high-fidelity, supervised intervention with excellent adherence and zero injuries objective performance outcomes with strong reliability (400MWT, 5-0-5 COD, YBT) and comprehensive reporting of effect sizes and confidence intervals. The main limitation is the single-group pre–post strategy which prevents causal inference improvements cannot be disentangled from potential learning or motivation effects. The sample size (n = 20) while typical for pilot feasibility trials limits generalizability and statistical power to detect smaller effects. All the Participants were active older adults so results may not extend to women or more fragile individuals. Lastly, the study did not include direct fall incidence monitoring the outcomes serve as validated fall-risk substitutions rather than actual event rates.

Practical and Clinical Implications

Despite these limitations the findings carry strong translational value. The intervention was practicable safe and time-efficient requiring minimal equipment resistance bands, cones, steps and administration by qualified instructors. Community or primary-care execution could feasibly deliver similar sessions 3-4 times per week to maintain the balance and mobility in older adults. Given the large effect sizes and adherence rate, this protocol offers a replicable framework for preventive exercise programming in community settings especially within resource-constrained environments where access to dedicated rehabilitation is limited.

Future Research Directions

Building on these findings future studies should employ randomized controlled designs with larger more diverse samples to confirm efficacy and generalizability. Incorporating female participants and older adults with higher baseline fall risk would broaden external validity. Including follow-up assessments (8–12 weeks post-intervention) could clarify retention of functional gains while combining performance tests with prospective fall monitoring would establish direct preventive impact. Exploring adjunct cognitive or dual-task components could further enhance agility and executive function, integrating physical and cognitive fall-risk factors.

CONCLUSIONS

In summary, this study demonstrates that an 8-week functional training programme integrating strength, balance, coordination, and aerobic components can produce large improvements in gait speed, change-of-direction performance, and dynamic balance among community-dwelling older men.

Functional training is the key to improving longevity and declining the risk of falls, particularly in older adults or active or non-active healthy individuals. Eight weeks are suitable for those individuals who are already doing some walking and strength training, but if they follow the customized exercise regimen, which mostly consists of unilateral and bilateral posterior lateral movements, etc., on unstable or stable surfaces, which mostly increases the proprioception ability, posture control, neuro-muscular coordination, motor control, gait speed, COD agility and dynamic balance while playing sports and physical activities, and saves them from severe injury and risk of falling.

The programme was safe, well tolerated, and aligned with WHO and ACSM endorsements for fall-prevention exercise. These findings provide a strong groundwork for a subsequent randomised controlled trial and highlight functional training as a viable scalable strategy for maintaining mobility and reducing fall risk in the ageing population.

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