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Impact of multicomponent training on functional fitness among older adults in rural India

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ABSTRACT

Introduction and aim. In rural India, preserving functional fitness is crucial for older adults to maintain independence and perform daily activities without assistance. This study examines the effectiveness of multicomponent training (MCT) in improving functional fitness among older adults in rural India.

Methods: Thirty participants (mean age 64.50±3.67 years) engaged in a structured low-to-moderate intensity exercise program three times per week for six weeks. Functional fitness was assessed at baseline, three weeks, and six weeks using the Senior Fitness Test (SFT).

Results. In a short period of six weeks, significant improvements were observed in lower-body strength ($p<0.001$), endurance ($p<0.001$), flexibility ($p<0.01$), and overall functional fitness ($p<0.001$), with lower-body strength and endurance surpassing minimal detectable change thresholds. Females had lower baseline performance but showed greater improvement.

Conclusion. MCT effectively enhances functional fitness in older adults. However, additional upper-body strength and balance exercises may be beneficial for comprehensive improvements.

Keywords. aged, aging, endurance training, exercise, muscle strength, physical fitness, resistance training

Introduction

Aging is a natural and inevitable process that affects all individuals, regardless of socioeconomic status or background. It is characterized by progressive anatomical and functional changes across various physiological systems, leading to a decline in mobility, strength, and overall functional capacity.[1,2] With increasing life expectancy, the global population of older adults is growing rapidly, particularly in developing nations.[3] According to the World Health Organization, individuals aged 60–74 are classified as elderly, while those aged 75 years and older are considered to be in the late-old age group.[4]

Aging-related physiological changes can impair an individual's ability to maintain physical independence and perform activities of daily living (ADLs).[5] However, regular physical activity can mitigate these effects by enhancing mobility, flexibility, and functional capacity while preserving muscle strength and joint range of motion.[6,7] exercise also contributes to reduced body fat, improves body composition, aids in weight control, and lowers the risk of chronic illnesses.[8] Despite these benefits, older adults often exhibit low participation in structured exercise programs, which can accelerate functional decline and dependence.[9,10]

Functional fitness is defined as the ability to perform everyday tasks safely and independently without undue fatigue.[11] Although traditionally associated with younger populations, functional fitness is especially critical for older adults, as it enables them to maintain their independence and quality of life. Regular exercise is defined as structured, repetitive movement intended to improve physical fitness,[12] plays a vital role in delaying physical decline and promoting healthy aging.

Various forms of physical activity programs have demonstrated benefits in improving the health and functional ability of older adults. These include aerobic exercises for cardiovascular endurance, resistance training to build muscle strength, balance and flexibility routines to reduce fall risk, and mobility-focused activities that support daily functioning.[13–16] Multicomponent approaches, which incorporate a combination of these elements, are considered effective in promoting overall functional fitness.

Aim

Although many previous studies have employed longer intervention durations, emerging evidence suggests that even six-week programs can produce meaningful improvement in physical function.[17,18] Motivated by these findings, the present study aims to examine whether a shorter-duration training program can effectively enhance senior fitness, particularly within the practical and logistical constraints of rural settings in India.

Material and methods

Setting and research design

The study was a six-week longitudinal study of an exercise program among older adults. All the assessments were conducted by the research investigator, and the collected data were subsequently analyzed. The study utilized an interrupted time series design without a control group, conducted in 2019.

All participants provided written informed consent prior to participation. The study obtained Institutional Ethics Committee permission (Ref no:G2-312/2015/CONTSR(7)).

The study was conducted in Ward XIII of Mundur village, involving a purposive sample of 30 older adults aged 60 years and above. No dropouts occurred during the intervention. Exclusion criteria included individuals who were unavailable during data collection, already engaged in regular exercise, or had sensory or cognitive impairments, acute or chronic illnesses, complete physical dependency, or cardiac and musculoskeletal conditions.

Socio-demographic data were collected through structured interviews, and functional fitness was assessed using an observational checklist. Data collection took place at the Peramangalam sub-center in Thrissur district.

Sample size calculation

The required sample size was determined using G*Power 3.1 software based on a repeated-measures ANOVA within-subjects design. The power analysis was conducted with the following parameters: medium effect size ($f=0.25$), significance level ($\alpha=0.05$), power ($1-\beta$)=0.80, one group, three measurement points, assumed correlation among repeated measures=0.5, and nonsphericity correction=1.

The estimated minimum sample size was 28 participants. To account for potential attrition, 2 additional participants were included, resulting in a final sample of 30 older adults.

Data collection instruments and procedures

Socio personal variables

The validated questionnaire was used to gather sociodemographic information through a face-to-face interview. Variables include age, gender, marital status, educational status, previous employment, type of family, and previous knowledge regarding exercise programs. Experts review was conducted to assess the tool's clarity, relevance, simplicity, yielding a content validity index (CVI) of 0.97.

Functional fitness

Functional fitness was assessed using the Senior Fitness Test (SFT) also known as Fullerton Functional Fitness test (FFFT). This standardized tool evaluates key components of functional fitness in older adults and measures an individual’s capacity to safely and independently perform daily activities without excessive fatigue. It typically takes around 30–40 minutes to complete.

The test included six components:

1. Lower-body strength: (30-second chair stand test) number of complete chair stands a person can perform within 30 seconds while keeping their arms folded across the chest.
2. Upper-body strength: (arm curl test), number of biceps curls completed in 30 seconds using 5 lb (2.27 kg) for women and 8 lb (3.63 kg) for men.
3. Endurance: (2-minute step test) number of steps with knees raised to a predefined height in 2 minutes.

4. Lower-body flexibility: (chair sit-and-reach test), the distance between the fingertips and toes while sitting at the edge of a chair and extending their hands toward their toes.
5. Upper-body flexibility: (back scratch), distance between fingers reaching from over the shoulder and behind the back.
6. Agility and balance**:** (8-foot up-and-go test), time taken to stand up from a seated position, walk 8 feet (2.44 m), turn around, and return to the seated position.

Six testing stations were established, one for each component. Standardized procedures were followed as per the SFT Manual.[19] Participants were briefed on each test, procedures, potential risks, and safety measures. Participants' performance was scored using age-specific normative values.

The reliability of the SFT employed in this investigation was determined using a test-retest methodology developed following a pilot study yielding a reliability coefficient of r=0.9352, indicating high dependability.[20]

Multicomponent training (MCT)

Thirty older adults participated in a 6-week MCT program, developed by the researcher in consultation with trained physical therapists. After receiving appropriate training, the researcher personally supervised and conducted all sessions to ensure the exercises were performed correctly, focusing n improving flexibility, strength, and posture through chair-based movements. The program included 12 sessions, each lasting 45 to 60 minutes, conducted three times a week (Tuesday, Thursday, and Saturday) with the aid of an LCD projector for guidance. Participants were divided into small groups of five for personalized instruction. The exercise routine included deep breathing (3 to 10 times) to enhance lung capacity and endurance. Chest stretches (hold for 5–10 seconds, repeat 5 times) improved posture and increased upper arm flexibility. Hip marching (5 lifts per leg) targeted lower arm strength, while ankle stretches (2 sets of 5 per foot) enhanced flexibility and reduced the risk of blood clots. Arm raises (5 repetitions) helped build upper arm strength.

Additionally, neck rotation (3 times per side) and neck stretching (holding for 5 seconds, repeating 3 times per side) improved upper arm flexibility and mobility. Sideway bend (3 times per side, hold for 2 seconds) promoted core flexibility and balance. Finally, sit-to-stand (5 slow repetitions) strengthened the legs, enhancing mobility and balance.

Participants followed six key exercise rules to ensure safety and effectiveness, including using a stable chair**,** maintaining steady movements, and progressing comfortably. Regular practice of these exercises can significantly enhance mobility, balance, and overall well-being in older adults. Additionally, an information booklet was provided for future reference, and a post-test assessment was conducted on days 21 and 42 to evaluate progress.

Plan for data analysis

Statistical analyses were conducted using SPSS Version 21 (IBM, Armonk, NY, USA). Descriptive statistics were computed to summarize the demographic and baseline characteristics of the participants, including frequencies, percentages, means, and standard deviations. The Normality test (Kolmogorov-Smirnov indicated that the data is not normally distributed (p<0.05). For the overall fitness scores, z-scores were calculated to normalize the data, allowing for comparison across the different components of the SFT. The Friedman test was used to assess differences in functional fitness across multiple test attempts, while the Wilcoxon signed-rank test was employed as a post hoc analysis to compare baseline with 3 weeks and 6 weeks of observation. o assess the practical relevance of observed changes, results were compared with established minimum detectable change (MDC) and minimal clinically important difference (MCID) values for each component of the SFT. Generalized estimating equations (GEE) were also employed to examine gender-related effects over time, considering the main effects of gender and time, and the interaction effects (gender × time). Wald chi-square statistics were used to determine significance, and unstandardized coefficients (B) with 95% confidence intervals (CI) were reported.

Statistical significance was set at p<0.05 for all analyses. Both statistical and clinical interpretations were used to evaluate the impact of the 6-week MCT intervention on strength, endurance, flexibility, agility, and overall functional fitness in older adults.

Results

The study included 30 participants with a mean age of 64.50±3.67 years, evenly distributed between the 60–64 (50%) and 65–69 (50%) age groups. Most were female (76.7%) and married (80%). Most participants had completed primary education (66.7%), while 23.3% had no formal education, and 10% had secondary education. Regarding employment history, 56.3% were homemakers and 23.3% had worked as coolie workers. At the time of the study, 70% remained homemakers, and 20% are unemployed. Additionally, 80% lived in nuclear families, and 76.7% reported no prior knowledge of the exercise program (Table 1).

Table 1. Frequency and percentage distribution of demographic variables

Sl no	Variable	Frequency	Percentage
1.	Age in years (Mean±SD)	64.50±3.67	
	60−64	15	50
	65−69	15	50
2.	Gender		
	Male	7	23.3
	Female	23	76.7
3	Marital status		

	Married	24	80
	Widow/widower	6	20
3	Education		
	No formal education	7	23.3
	Primary	20	66.7
	Secondary	3	10
4	Previous job		
	Coolie	7	23.3
	Homemaker	17	56.3
	Self-employed	2	6.7
	Private	3	10
	Government	1	3.3
5	Present job		
	Coolie	2	6.7
	Homemaker	21	70
	Self-employed	1	3.3
	Unemployed	6	20
6	Family		
	Joined	6	20
	Nuclear	24	80
7	Previous knowledge		
	Yes	7	23.3
	No	23	76.7

There were no dropouts, falls, fall-related injuries, emergencies or hospitalizations reported during the intervention.

Functional fitness improvements

Table 2. Effectiveness of MCT on functional fitness at baseline, 3 weeks, and 6 weeks[a]

Sl no	Activity/observation	Mean±SD	Median (IQR)	Mean Rank	Z value[#]
1	Lower-body strength (Chair sitting)				
	Baseline	9.33±1.66	9.50 (9 to 10)	1.03	
	3 weeks	12.43±2.11	13 (12 to 14)	2.08	55.83**
	6 weeks	14.06±0.95	14 (14 to 14)	2.88	

2	Upper-body strength (arm curl)				
	Baseline	7.96±2.11	9 (5 to 9)	1.88	
	3 weeks	8.20±2.08	9 (6 to 9)	2.08	5.20
	6 weeks	8.16±2.09	9 (6 to 9)	2.03	
3	Endurance (2-min step test)				
	Baseline	72.23±7.65	74 (64 to 79)	1.23	
	3 weeks	75.93±5.67	77 (72 to 82)	2.30	35.42**
	6 weeks	76.33±6.10	76 (72 to 82)	2.47	
4	Lower-body flexibility (chair sit and reach)				
	Baseline	-4.12±1.58	-4.8 (-5.99 to -2.3)	1.32	
	3 weeks	-3.26±1.08	-3.2 (-4.07 to -2.3)	2.20	31.00**
	6 weeks	-3.08±0.91	-3.05 (-4.0 to -2.27)	2.48	
5	Upper-body flexibility (back scratch)				
	Baseline	-5.58±1.84	-6 (-7 to -3)	1.57	
	3 weeks	-5.02±1.59	-5 (-6.02 to -3.75)	2.02	16.48**
	6 weeks	4.19±2.73	-4 (-5.08 to -3.57)	2.42	
6	Agility and balance (8-foot up and go)				
	Baseline	58.4±9.93	60 (52 to 60)	2.55	
	3 weeks	54±7.10	55 (50 to 59.5)	1.87	19.32**
	6 weeks	52.66±6.42	52 (50 to 58)	1.58	
7	FFT (overall)[##]				
	Baseline	2.69±1.30	2.57 (1.59 to 3.57)	1.27	
	3 weeks	3.31±1.06	3.17 (2.59 to 3.97)	2.67	29.60**
	6 weeks	3.15±3.74	2.95 (2.63 to 3.74)	2.07	

[a] [#] – Friedman test, ** – $p<0.01$, [##] – based on z scores

The Friedman test results indicate significant improvements across several fitness activities over time. For Chair Sitting, there was a notable increase in performance from pretest to post-tests, with median scores rising from 9.50 to 14 ($p<0.01$). The 2-min step test, chair sit and reach, back scratch, and 8 ft up and go all showed significant enhancements, with p-values less than 0.01, reflecting improved strength, endurance, flexibility, and agility. In contrast, the arm curl test did not show significant changes, suggesting no substantial improvement in upper-body strength. The FFT also significantly improved, with scores increasing from pretest to post-test ($p<0.01$). These results highlight that most fitness measures were substantially enhanced, except for upper-body strength (Table 2). The mean and standard deviation for each parameter of the DFT are shown in Fig. 1, which reflects the improvement of all SFT parameters over the study period.

Table 3. Post-Hoc test to assess the effectiveness of Multicomponent training between baseline, 3rd week, and 6th week[a]

Sl no	Activity/observation	Enhancement (reps/steps/sec/cms)	Test Statistics	p	MDC	MDC interpretation
1	Lower-body strength (chair sitting in reps)					
	Baseline vs 3 weeks	3.1	-4.06	<0.001**		CS
	Baseline vs 6 weeks	4.7	-7.16	<0.001**	1.15	CS
	3 weeks vs 6 weeks	1.63	-3.09	0.006**		CS
2	Upper-body strength (arm curl in reps)					
	Baseline vs 3 weeks	0.23	NS	NS		CNS
	Baseline vs 6 weeks	0.20	NS	NS	2.53	CNS
	3 weeks vs 6 weeks	0.03	NS	NS		CNS
2	Endurance (2-min step test in steps)					
	Baseline vs 3 weeks	3.70	-4.13	<0.001**		CS
	Baseline vs 6 weeks	4.10	-4.77	<0.001**	1.40	CS
	3 weeks vs 6 weeks	0.40	-0.64	>0.99		CNS
3	Lower-body flexibility (chair sit and reach in cms)					
	Baseline vs 3 weeks	0.85	-3.42	0.002**		CNS
	Baseline vs 6 weeks	1.04	-4.51	<0.001**	1.55	CNS
	3 weeks vs 6 weeks	0.18	-1.09	0.817		CNS
4	Upper-body flexibility (back scratch in cms)					
	Baseline vs 3 weeks	0.56	-0.43	0.28		CNS
	Baseline vs 6 weeks	0.82	-0.76	0.009**	1.41	CNS
	3 weeks vs 6 weeks	0.26	-0.33	0.59		CNS
5	Agility and balance (8-foot up and go in sec)					
	Baseline vs 3 weeks	0.44	2.64	0.024*		CNS
	Baseline vs 6 weeks	0.57	3.74	<0.001**	1.47	CNS
	3 weeks vs 6 weeks	0.13	1.097	0.81		CNS
6	Functional Fitness test- FFT (overall)					
	Baseline vs 3 weeks	NA	-1.40	<0.001**	NA	NA
	Baseline vs 6 weeks	NA	-0.80	<0.006**	NA	NA
	3 weeks vs 6 weeks	NA	0.60	0.06	NA	NA

[a] *– significant, Test statistics – Wilcoxon Sign test, Reps – repetition, NS – no post hoc performed due to non-significance, NA – not applicable, MDC – minimum detectable change, CS – clinically significant, CNS – clinically non-significant

Post-hoc analysis using the Wilcoxon signed-rank test showed improving trends in most of the components of SFT. Lower-body strength, assessed via the Chair Sitting Test, improved significantly from baseline to 3 weeks (p<0.001) and further enhanced at 6 weeks (p<0.001). A significant difference was also observed between 3 and 6 weeks (p=0.006), indicating progressive gains in strength. Endurance, measured through the 2-Minute Step Test, showed significant improvements from baseline to both 3 weeks (p<0.001) and 6 weeks (p<0.001), but no significant change between 3 and 6 weeks (p>0.99), suggesting early adaptation with no further substantial gains. For lower-body flexibility (chair sit and reach), significant improvements were observed from baseline to 3 weeks **(**p=0.002) and 6 weeks (p<0.001), though no significant difference was noted between 3 and 6 weeks (p=0.817). Similarly, upper-body flexibility (back scratch) significantly improved from the baseline to 6 weeks (p=0.009). In contrast, changes between baseline and 3 weeks (p=0.28) and 3 to 6 weeks (p=0.59) were not statistically significant. Complex coordination, agility, and balance (8-ft up and go) demonstrated a significant improvement between baseline and 3 weeks (p=0.024) and an even more significant improvement at 6 weeks (p<0.001). However, no significant change was observed between 3 and 6 weeks (p=0.81), indicating that most improvements occurred within the first 3 weeks.

The overall FFT scores showed significant improvements from baseline to both 3 weeks (p<0.001) and 6 weeks (p<0.006), while the difference between 3 and 6 weeks was not significant (p=0.06). Upper-body strength (arm curl test) could not be analyzed post hoc due to a lack of significant differences between time points (Table 3).

These findings suggest that substantial gains in strength, endurance, flexibility, and coordination occur within the first 3 weeks of training, with further significant improvements seen at 6 weeks in most areas, particularly in lower-body strength and functional fitness.

The GEE model analysis revealed significant effects in the 2-minute step and FFT, with the female gender as the reference. In the 2-minute step test, a significant interaction between gender and time was observed *(*W=4.33, B=-1.79; 95% CI=-3.49, -0.10*)*, indicating that females showed a lower rate of improvement over time compared to males. Similarly, in the Functional Fitness Test, a significant gender difference was found *(*W=3.86, B=-1.348; 95% CI=-2.69, -0.004*)*, suggesting that females had lower baseline performance than males. However, a significant gender-by-time interaction (W=5.44, B=0.516; 95% CI=0.08, 0.94*) indicated that females improved more over time than males (Table 4).

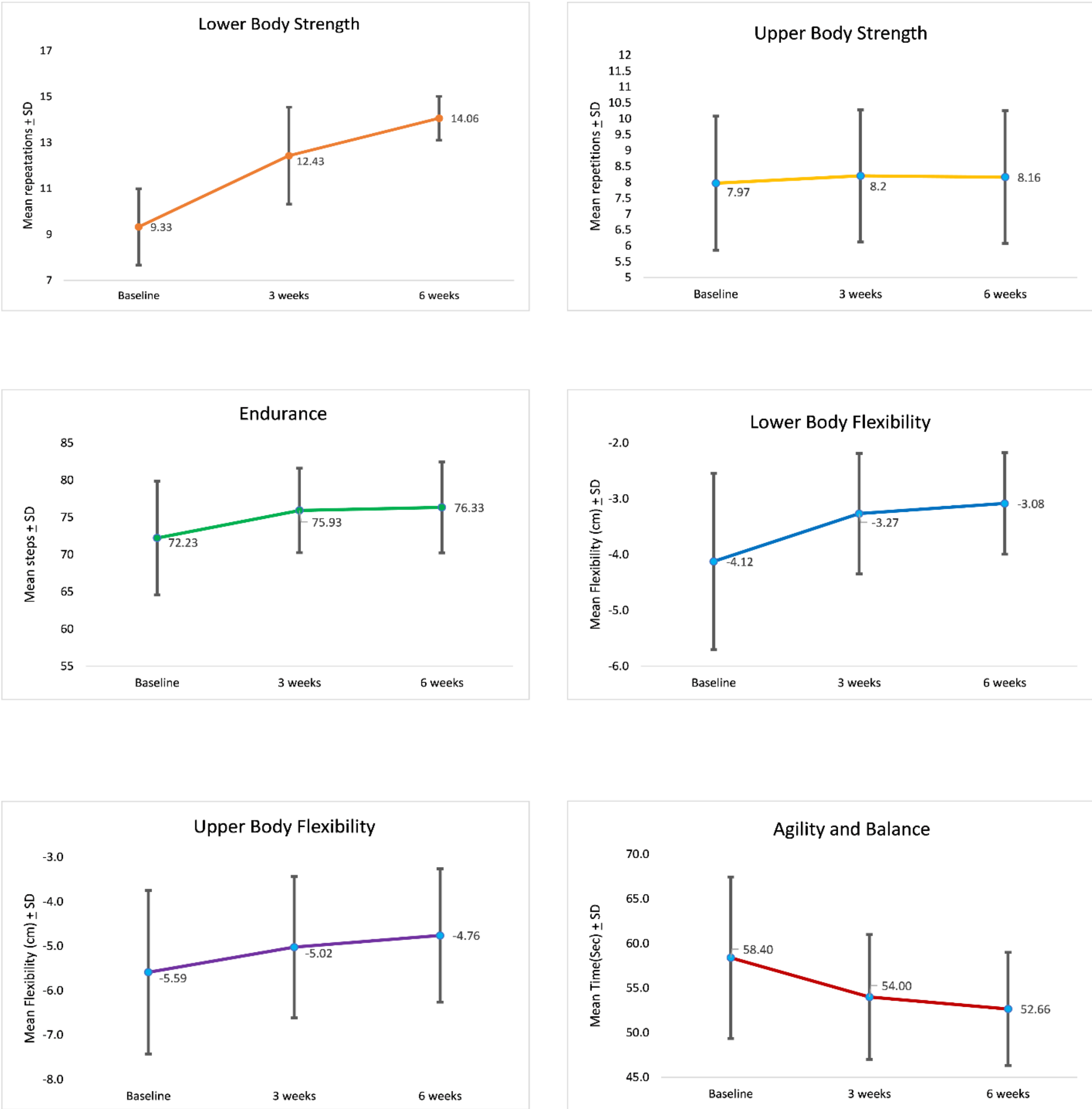

Fig 1. Mean±SD of each parameter of the SFT among the older adults

Table 4. Comparison of senior fitness parameters between male and female over time[a]

Sl no	Activity/ observation	Frequency (Percentage)						Source	B	W
		Total (30)		Male (7)		Female (23)				
		BA	A/AA	BA	A/AA	BA	A/AA			
1	Lower-body strength (chair sitting)									
	Pretest	26 (86.7)	4 (13.4)	6 (85.7)	1 (14.3)	20 (87)	3 (13)			
	Post-test 1	5 (16.7)	25 (83.3)	1 (14.3)	6 (85.7)	4 (17.4)	19 (82.6)	G(F)	-0.53	0.22
	Post-test 2	1 (3.3)	29 (96.7)	-	7 (100)	1 (4.3)	22 (95.9)	GxT(F)	-0.08	0.120
2	Arm curl									
	Pretest	30 (100)		7 (100)	-	23 (100)	-			
	Post-test 1	30 (100)		7 (100)	-	23 (100)	-	G(F)	-1.11	1.09
	Post-test 2	30 (100)		7 (100)	-	23 (100)	-	GxT(F)	-0.56	0.137
3	Endurance (2-min step test)									
	Pretest	16 (53.3)	14 (46.7)	3 (42.9)	4 (57.1)	13 (56.5)	10 (43.5)			
	Post-test 1	14 (46.7)	16 (53.3)	3 (42.9)	4 (57.1)	11 (47.8)	12 (52.2)	G(F)	0.70	0.02
	Post-test 2	15 (50)	15 (50)	4 (57.1)	3 (42.9)	11 (47.8)	12 (52.2)	GxT(F))	-1.79	4.33*
4	Lower-body flexibility (chair sit and reach)									
	Pretest	26 (86.7)	4 (13.3)	7 (100)	-	19 (82.6)	4 (17.4)			
	Post-test 1	25 (83.3)	5 (16.7)	7 (100)	-	18 (78.3)	5 (21.7)	G(F)	-1.003	1.60
	Post-test 2	25 (76.7)	5 (16.7)	7 (100)	-	18 (78.3)	5 (21.7)	GxT(F)	0.101	0.23
5	Upper-body flexibility (back scratch)									
	Pretest	23 (76.7)	7 (23.3)	6 (85.7)	1 (14.3)	17 (73.9)	6 (26.1)			
	Post-test 1	23 (76.7)	7 (23.3)	7 (100)	-	16 (69.6)	7 (30.4)	G(F)	-1.64	2.15
	Post-test 2	21 (70)	9 (30)	7 (100)	-	14 (60.9)	9 (39.1)	GxT(F)	0.56	2.05

6	Complex coordination: agility and balance (8-foot up and go)									
	Pretest	6 (20)	24 (80)	-	7 (100)	6 (26.1)	17 (73.9)			
	Post-test 1	3 (10)	27 (90)	-	7 (100)	3 (13)	20 (87)	G(F)	0.359	0.25
	Post-test 2	2 (6.7)	28 (93.3)	-	7 (100)	2 (8.7)	21 (91.3)	GxT(F)	0.017	0.007
7	FFT (Mean±SD)									
	Pretest	9.06±1.52		9.71±1.38		8.87±1.54				
	Post-test 1	10.63±1.58		10.85±1.57		10.56±1.61		G(F)	-1.348	3.86*
	Post-test 2	11.00±1.48		10.85±1.06		11.04±1.60		GxT(F)	0.516	5.44*

[a] BA – below average, A – average, AA – above average, G(F) – gender (female), GxT – gender x time, GEE model test: W – wald Chi-square, * – significant $p<0.05$, B – unstandardized coefficient

Discussion

This study demonstrates that a 6-week, low-to-moderate intensity MCT program performed three times weekly significantly improves functional fitness in older adults. These results support the hypothesis that structured exercise positively impacts age-related functional decline.

Several studies have been conducted to enhance senior fitness among older people over varying durations, such as 12 weeks[21], 24 weeks[16], and 32 weeks[15], often incorporating control groups.[22–25] However, only a few studies have reported that even a 6-week training program can lead to improvements in physical attributes among older adults.[17,18]. Some Studies have explored links to psychological well-being[23], Cognition, and Activities of Daily Living,[13] and, in some cases, extended their scope to examine relationships with factors like resilience, happiness, perceived stress, and overall well-being.[26] Notably, this is the first study conducted in a rural South Indian setting, offering a unique perspective and aiming to evaluate whether a shorter, 6-week intervention can effectively enhance senior fitness in a context where longer-duration programs may not be feasible.

Compared with the MDC values established for the Indian older adult population[27] highlights the effectiveness of the Multicomponent training in enhancing various fitness components (Table 3). Notably, the program led to clinically significant gains in lower-body strength (30-second chair stand) and aerobic endurance (2-minute step test), surpassing the MDC thresholds of 1.15 repetitions and 1.40 steps, respectively. Upper-body flexibility (back scratch) showed near-clinical significance, with a gain of 1.39 cm, just below the MDC of 1.41 cm. However, lower-body flexibility (chair sit-and-reach test) and agility and dynamic balance (8-foot up-and-go test) did not reach their MDC thresholds of 1.55 cm and 1.47 sec, respectively, suggesting that the observed changes may not be functionally significant.

Additionally, upper-body strength (30-second arm curl test) showed minimal changes (0.23 reps at 3 weeks and 0.20 reps at 6 weeks), which fall well below the MDC value of 2.53 reps, indicating no clinically meaningful improvement. Currently, minimal clinically significant difference (MCID) values are not established for the Indian context; hence, they are not compared with it. In contrast, in a 10-year study conducted in the USA (2005–2016),[28] reported clinically significant improvements across all SFT parameters**.** Further, the study also revealed that less improvement was associated with being female, being aged more than 75, not being married, having one or more falls, and having a disability.

Upper and lower-body strength (arm curl and chair sitting)

The study intervention resulted in a notable increase in lower-body strength, while no significant improvement was observed in upper-body strength. Maintaining optimal upper and lower-body strength is crucial for older adults to preserve physical function, prevent chronic diseases, and perform daily activities independently.[29] Research has consistently shown that enhancing upper and lower-body strength is vital in safeguarding functional ability in older adults.[30] This study's results are similar to a study conducted in

Hungary [26] where a 12-week FFFT, which is otherwise called the SFT, was conducted along with the control group, reported a significant increase in upper-body strength at 8 and 12 weeks, with notable improvements in lower-body strength observed at the 12-week mark. This difference may be attributed to the longer session duration (50 minutes) and the inclusion of three specific exercises targeting both upper and lower limb strength in the Hungarian study.

Upper and lower-body flexibility (chair sit and reach, back scratch)

The flexibility had increased significantly in 3 weeks and 6 weeks after the intervention. A decline in flexibility among older adults is strongly associated with the onset of musculoskeletal impairments and the advancement of disabilities. Reduced flexibility leads to a decline in functional ability, making everyday tasks such as getting up from a bed or chair, using the toilet, and navigating stairs increasingly challenging.[31] Studies have shown that older men are more flexible than older women.[32] The results are similar to the studies conducted in Australia[33], USA[28], 16-week programs, where improved upper and lower flexibility was significant; additionally, studies have found an association between Pilates flexibility exercises and reduced fall risk.[34,35] A study comparing a 16-week program with sessions three times versus twice per week found a significant difference in upper-body flexibility, suggesting that both frequency and duration of exercise play a crucial role in enhancing flexibility.[25]

Agility and balance (8-foot up and go)

Agility and balance are essential for many daily activities, including walking, climbing stairs, navigating obstacles, using the bathroom, boarding and exiting vehicles, crossing the street, and responding to a phone call or doorbell**.**[25] The study revealed a statistically significant time reduction in completing the 8 Ft up and test ($p<0.05$), But when compared to the MDC value of the Indian population[27], it's not clinically significant. Research suggests that performance in the Eight-Foot Up-and-Go Test can effectively distinguish between different functional levels in this population and is responsive to improvements resulting from increased physical activity. Studies have shown that physically active older adults completed the Eight-Foot Up-and-Go Test faster than their inactive counterparts.[9,36] Similarly, a study conducted in S. Africa[25], found that all SFT parameters showed statistically significant improvements from baseline ($p<0.05$), except for agility and balance, which remained unchanged even after 16 weeks of a structured exercise program. The no significant improvement may be related to the large number of older women; the population under study may not be active.

Endurance/aerobic capacity (2-min step test)

Endurance or Aerobic capacity is directly related to oxygen intake capacity.[37] Studies have shown a decline of 15 to 20 % per decade.[38] Endurance exercise can increase cardiorespiratory fitness, decrease insulin resistance, and reduce body fat [39] and lipid levels in diabetic patients, one of the most chronic disorders in Old age.[40] The study revealed that the Multicomponent training increased endurance and was significant statistically and clinically. The 2-minute step test numbers improve from 72 steps to 76 steps at the end of the program. On the contrary, a study was conducted to validate a 2-minute step test among healthy older adults and found a mean step of 81 in men and 92 steps in women, which is higher than the current study.[41] The Multicomponent training led to clinically meaningful improvements in lower-body strength and aerobic endurance, with borderline effects on upper-body flexibility. However, gains in upper-body strength, lower-body flexibility, agility, and balance did not exceed the MDC, suggesting they may not significantly impact daily functional activities in older adults. Additionally, the sample consisted predominantly of female participants, potentially limiting the findings' generalizability to older men. These results highlight the need for program modifications, including enhanced flexibility and balance training, to maximize functional fitness benefits.

Study limitations

This study has several limitations. The sample was predominantly female, which may limit the generalizability of the results to older men. Additionally, the lack of data on participants' sports background and current physical activity levels makes it difficult to account for individual differences, as improvements are often more pronounced in those with lower baseline activity. The absence of a control group also limits our ability to draw definitive conclusions about the specific effects of the intervention, as observed improvements could be influenced by other factors. While significant improvements were noted in some areas, certain measures (e.g., upper-body strength, lower-body flexibility, and agility) did not exceed the MDC thresholds, suggesting these changes may not be functionally significant. Lastly, the 6-week duration may have been too short to produce substantial improvements in all fitness domains. Future research should include a more balanced sample, a control group, and longer interventions to better assess the impact on functional fitness.

Conclusion

The findings highlight the effectiveness of structured exercise programs in improving strength, endurance, flexibility, agility, and balance in older adults. While lower-body strength, flexibility, endurance, agility, and balance showed statistically significant improvements, upper-body strength showed limited improvements. Enhancing exercise frequency, duration, and targeted training may optimize functional fitness outcomes.

Declarations

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Author contributions

Conceptualization, K.K. and S.S.; Methodology, K.K. and J.J.; Software, Validation: J.J.; Formal Analysis: J.J.; Investigation, K.K. and A.S.N.; Resources, K.K. and A.S.N.; Data Curation, A.S.N.; Writing – Original Draft Preparation, K.K. and S.S.; Writing – Review & Editing, J.J. and A.S.N.; Visualization, J.J.; Supervision, S.S.; Project Administration, K.K. and S.S.; Funding Acquisition, K.K.

Conflicts of interest

The authors declare no conflict of interest.

Data availability

The data that support the findings of this study are available from the first author, on request.

Ethics approval

The study obtained Institutional Ethics Committee permission (Ref no:G2-312/2015/CONTSR(7)).

Reference

1. Larsson L, Degens H, Li M, et al. Sarcopenia: Aging-Related Loss of Muscle Mass and Function. *Physiol Rev*. 2019;99(1):427-511. doi: 10.1152/physrev.00061.2017
2. Navaratnarajah A, Jackson SHD. The physiology of ageing. *Medicine (Baltimore)*. 2017;45(1):6-10. doi: 10.1016/j.mpmed.2016.10.008
3. Khavinson V, Popovich I, Mikhailova O. Towards realization of longer life. *Acta Biomed*. 91(3):e2020054. doi: 10.23750/abm.v91i3.10079
4. WHO. Ageing: Global population. https://www.who.int/news-room/questions-and-answers/item/population-ageing. Accessed March 2, 2025.
5. Gao J, Gao Q, Huo L, Yang J. Impaired Activity of Daily Living Status of the Older Adults and Its Influencing Factors: A Cross-Sectional Study. *Int J Environ Res Public Health*. 2022;19(23):15607. doi: 10.3390/ijerph192315607
6. Valenzuela PL, Saco-Ledo G, Morales JS, et al. Effects of physical exercise on physical function in older adults in residential care: a systematic review and network meta-analysis of randomised controlled trials. *Lancet Healthy Longev*. 2023;4(6):e247-e256. doi: 10.1016/S2666-7568(23)00057-0
7. Wickramarachchi B, Torabi MR, Perera B. Effects of Physical Activity on Physical Fitness and Functional Ability in Older Adults. *Gerontol Geriatr Med*. 2023;9:23337214231158476. doi: 10.1177/23337214231158476

8. Drenowatz C, Hand GA, Sagner M, Shook RP, Burgess S, Blair SN. The prospective association between different types of exercise and body composition. *Med Sci Sports Exerc*. 2015;47(12):2535. doi: 10.1249/MSS.0000000000000701
9. Meneguci CAG, Meneguci J, Sasaki JE, Tribess S, Júnior JSV. Physical activity, sedentary behavior and functionality in older adults: A cross-sectional path analysis. *PLoS ONE*. 2021;16(1):e0246275. doi: 10.1371/journal.pone.0246275
10. Chodzko-Zajko WJ, Proctor DN, Fiatarone Singh MA, et al. Exercise and physical activity for older adults. *Med Sci Sports Exerc*. 2009;41(7):1510-1530. doi: 10.1249/MSS.0b013e3181a0c95c
11. Santos DA, Silva AM, Baptista F, et al. Sedentary behavior and physical activity are independently related to functional fitness in older adults. *Exp Gerontol*. 2012;47(12):908-912. doi: 10.1016/j.exger.2012.07.011
12. Caspersen CJ, Powell KE, Christenson GM. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public Health Rep*. 1985;100(2):126-131.
13. Borges-Machado F, Silva N, Farinatti P, Poton R, Ribeiro Ó, Carvalho J. Effectiveness of Multicomponent Exercise Interventions in Older Adults With Dementia: A Meta-Analysis. *The Gerontologist*. 2021;61(8):e449-e462. doi: 10.1093/geront/gnaa091
14. Li Y, Yan Y, Chen H, Zhang M, Yang Y, Liu Y. Effects of multicomponent exercise on the muscle strength, muscle endurance and balance of frail older adults: A meta-analysis of randomised controlled trials. *Jounral Clin Nurs*. 32:1795-1805. doi: 10.1111/jocn.16196
15. Monteiro AM, Rodrigues S, Matos S, Teixeira JE, Barbosa TM, Forte P. The Effects of 32 Weeks of Multicomponent Training with Different Exercises Order in Elderly Women's Functional Fitness and Body Composition. *Medicina (Mex)*. 2022;58(5):628. doi: 10.3390/medicina58050628
16. Oh G, Lee H, Park CM, et al. Long-term effect of a 24-week multicomponent intervention on physical performance and frailty in community-dwelling older adults. *Age Ageing*. 2021;50(6):2157-2166. doi: 10.1093/ageing/afab149
17. Cavani V, Mier CM, Musto AA, Tummers N. Effects of a 6-Week Resistance-Training Program on Functional Fitness of Older Adults. *J Aging Phys Act*. 2002;10(4):443-452. doi: 10.1123/japa.10.4.443
18. Chen B, Li M, Zhao H, et al. Effect of Multicomponent Intervention on Functional Decline in Chinese Older Adults: A Multicenter Randomized Clinical Trial. *J Nutr Health Aging*. 2023;27(11):1063-1075. doi: 10.1007/s12603-023-2031-9
19. Rikli R, Jones J. *Senior Fitness Test Human Kinetics*. 2nd ed. https://www.scribd.com/document/516700679/Senior-Fitness-Test-PDFDrive. Accessed February 6, 2025.
20. Jacob J. Reliability: How? When? What? *Int J Adv Nurs Manag*. 2017;5:372. doi: 10.5958/2454-2652.2017.00080.4

21. Brañas F, Díaz-Álvarez J, Fernández-Luna J, et al. A 12-week multicomponent exercise program enhances frailty by increasing robustness, improves physical performance, and preserves muscle mass in older adults with HIV: MOVIhNG study. *Front Public Health*. 2024;12. doi: 10.3389/fpubh.2024.1373910
22. Fiatarone MA, O'Neill EF, Ryan ND, et al. Exercise training and nutritional supplementation for physical frailty in very elderly people. *N Engl J Med*. 1994;330(25):1769-1775. doi: 10.1056/NEJM199406233302501
23. Tóth EE, Vujić A, Ihász F, Ruíz-Barquín R, Szabo A. Functional fitness and psychological well-being in older adults. *BMC Geriatr*. 2025;25(1):9. doi: 10.1186/s12877-024-05654-2
24. Concha-Cisternas Y, Castro-Piñero J, Vásquez-Muñoz M, Molina-Márquez I, Vásquez-Gómez J, Guzmán-Muñoz E. Effects of Neuromuscular Training on Postural Balance and Physical Performance in Older Women: Randomized Controlled Trial. *J Funct Morphol Kinesiol*. 2024;9(4):195. doi: 10.3390/jfmk9040195
25. Chetty L, Ramklass SS, McKUNE AJ. The effects of a structured group exercise programme on functional fitness of older persons living in old-age homes. *Ageing Soc*. 2019;39(9):1857-1872. doi: 10.1017/S0144686X18000235
26. Toth EE, Vujić A, Ihász F, Ruíz-Barquín R, Szabo A. A Fullerton Functional Fitness Test-based exercise intervention for older adults yields quick physical and psychological benefits. *Complement Ther Clin Pract*. 2024;57:101880. doi: 10.1016/j.ctcp.2024.101880
27. Bhattacharya PK, Deka K, Roy A. Assessment of inter-rater variability of the Senior Fitness Test in the geriatric population: A community based study. *Int J Biomed Adv Res*. 2016;7(5):208. doi: 10.7439/ijbar.v7i5.3249
28. Fishleder S, Petrescu-Prahova M, Harris JR, et al. Predictors of Improvement in Physical Function in Older Adults in an Evidence-Based Physical Activity Program (EnhanceFitness). *J Geriatr Phys Ther*. 2019;42(4):230-242. doi: 10.1519/JPT.0000000000000202
29. Forrest KYZ, Zmuda JM, Cauley JA. Patterns and correlates of muscle strength loss in older women. *Gerontology*. 2007;53(3):140-147. doi: 10.1159/000097979
30. Garatachea N, Pareja-Galeano H, Sanchis-Gomar F, et al. Exercise Attenuates the Major Hallmarks of Aging - PMC. *REJUVENATION Res*. 18(1):57-89. doi: 10.1089/rej.2014.1623
31. Stathokostas L, Little RMD, Vandervoort AA, Paterson DH. Flexibility Training and Functional Ability in Older Adults: A Systematic Review. *J Aging Res*. 2012;2012:306818. doi: 10.1155/2012/306818
32. Bhattacharya PK, Deka K, Barman B, Jamil M. Association between Physical Fitness and Perceived Well-Being in Functionally Independent Community Dwelling Elderly of North-Eastern India. *Acta Medica Litu*. 2023;30(1):6. doi: 10.15388/Amed.2023.30.1.1

33. Bird ML, Hill K, Ball M, Williams AD. Effects of resistance- and flexibility-exercise interventions on balance and related measures in older adults. *J Aging Phys Act*. 2009;17(4):444-454. doi: 10.1123/japa.17.4.444
34. Silva LD da, Shiel A, McIntosh C. Pilates Reducing Falls Risk Factors in Healthy Older Adults: A Systematic Review and Meta-Analysis. *Front Med*. 2021;8:708883. doi: 10.3389/fmed.2021.708883
35. Wiedenmann T, Held S, Rappelt L, Grauduszus M, Spickermann S, Donath L. Exercise based reduction of falls in communitydwelling older adults: a network meta-analysis. *Eur Rev Aging Phys Act*. 2023;20(1):1. doi: 10.1186/s11556-023-00311-w
36. Miotto JM, Chodzko-Zajko WJ, Reich JL, Supler MM. Reliability and validity of the Fullerton Functional Fitness Test: An independent replication study. *J Aging Phys Act*. 1999;7(4):339-353. doi: 10.1123/japa.7.4.339
37. Hollenberg M, Yang J, Haight TJ, Tager IB. Longitudinal changes in aerobic capacity: implications for concepts of aging. *J Gerontol A Biol Sci Med Sci*. 2006;61(8):851-858. doi: 10.1093/gerona/61.8.851
38. Letnes JM, Nes BM, Wisløff U. Age-related decline in peak oxygen uptake: Cross-sectional vs. longitudinal findings. A review. *Int J Cardiol Cardiovasc Risk Prev*. 2023;16:200171. doi: 10.1016/j.ijcrp.2023.200171
39. Strasser B, Keinrad M, Haber P, Schobersberger W. Efficacy of systematic endurance and resistance training on muscle strength and endurance performance in elderly adults--a randomized controlled trial. *Wien Klin Wochenschr*. 2009;121(23-24):757-764. doi: 10.1007/s00508-009-1273-9
40. Chimen M, Kennedy A, Nirantharakumar K, Pang TT, Andrews R, Narendran P. What are the health benefits of physical activity in type 1 diabetes mellitus? A literature review. *Diabetologia*. 2012;55(3):542-551. doi: 10.1007/s00125-011-2403-2
41. Berlanga LA, Matos-Duarte M, Abdalla P, Alves E, Mota J, Bohn L. Validity of the two-minute step test for healthy older adults. *Geriatr Nur (Lond)*. 2023;51:415-421. doi: 10.1016/j.gerinurse.2023.04.009