

## Effect of mat pilates training program on functional fitness in older adults

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### Abstract

**Background and Study Aim** The increasing recognition of pilates as a comprehensive exercise regimen tailored to the needs of the elderly population underscores its growing importance. This shift in emphasis reflects a growing awareness of the potential benefits of pilates for older adults' overall well-being. Study Aim - to investigate the potential benefits of a six-week mat pilates training (MPT) program on the functional fitness of older adults.

**Material and Methods** In total, a group of 30 elderly individuals (i.e.,  $N_{\text{Male}}=18$  and  $N_{\text{Female}}=12$ ), who regularly frequented a local playground, participated in a quasi-experimental study. The study involved pre-test and post-test assessments and was conducted over a period of six weeks. Participants underwent an MPT program (six days a week for six weeks, 60 minutes per session). Were assessed for various functional fitness parameters: lower-body strength (LBS), upper-body strength (UBS), aerobic endurance (AE), lower-body flexibility (LBF), upper-body flexibility (UBF), agility (AG), and Body Mass Index (BMI). A paired-sample t-test was used for statistical analysis.

**Results** The MPT resulted in significant ( $p<0.001$ ) improvement in LBS (9.71%), UBS (8.33%), AE (7.11%), LBF (13.48%), UBF (98.78%) and AG (10.52%) post-intervention. However, no significant change was noted in the BMI.

**Conclusions** A MPT program significantly enhances various dimensions of functional fitness in older adults, excluding BMI. The study results have profound implications for older individuals' well-being and quality of life. Given the global trend towards an ageing population, pilates emerges as an essential intervention for promoting active ageing, potentially improving daily functioning, reducing fall risk, and enhancing independence in the elderly.

**Keywords:** pilates, older adults, functional fitness, aerobic endurance, flexibility, strength, agility, ageing population

### Introduction

In older age, the quality of life is intricately linked to the capability of performing day-to-day tasks without discomfort for as long as possible [1]. As advancements in medical science prolong life expectancy, the emphasis on sustaining physical fitness parallelly intensifies. Nevertheless, while technological innovations in medicine have augmented life expectancy, they have simultaneously played a role in cultivating a sedentary lifestyle,

characterised by physical inactivity and subsequent health complications [2]. In earlier times, everyday activities such as stairs climbing or cultivating gardens provided inherent physical exertion [3]. Presently, however, technological conveniences, although advantageous, have inadvertently diminished these naturally occurring physical engagements, thus propagating health issues. It is of paramount importance, especially for the ageing population, to prioritise functional fitness, refers to the aptitude to undertake daily activities safely and independently without undue fatigue [4]. Various international governing bodies have recommended various physical activities to provide an overview of

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the benefits of physical activities for older people [5, 6, 7, 8]. Contrarily, empirical evidence indicates a substantial portion of older adults remain detached from sufficient physical exercises, possibly deterred by the potentially daunting ambiance of fitness centers or vigorous movement activities [9]. So, a question arises, “Is there any suitable and effective fitness training method available for older people?”

Since the development of the pilates physical training method, it has become one of the popular ways to be fit among fitness enthusiasts. Pilates cannot just be said as some bunches of exercises; it is a fun way of performing some particular movement [10]. It is an innovative way to increase vigour, enhance physical strength and flexibility, and control some psychological and psychophysiological problems [11]. Pilates exercises are designed to involve the body’s postural muscles, aiming to improve stability and strength within the core of the body, which can help them achieve overall body balance [12, 13]. It can help in reducing stress. Pilates can also help an individual to improve his sense of well-being and can help in focusing on day-to-day tasks [11]. Over the years, the principles and methods of pilates have been tried and tested by various professionals in various ways. Based on the equipment used and the level of difficulty, pilates exercises can be broadly categorised into six types, among which mat pilates training (MPT) involves body weight as resistance and is favorite among older adults due to its low-impact on body [14]. Though many different approaches to pilates exercises have evolved, the primary exercise method is based on six principles, i.e.: breath, concentration, control, precision, centre and flow [15]. These methods aim to increase the core strength of an individual. It also aims to lengthen the spine and build muscle tone, increasing awareness about an individual’s physique [16] which can be a very effective method to develop the physical fitness of older people [15].

Researchers have conducted a numbers of investigations on the impacts of pilates exercises on the human body under various circumstances. One such investigation revealed that pilates exercises resulted positive outcomes in enhancing dynamic balance, flexibility, reaction time, and muscular strength while concurrently reducing the likelihood of falls in elderly women [17]. Another study focused on assessing the impact of pilates exercises on the overall health of women diagnosed with type 2 diabetes, deduced that pilates can be considered a viable and safe approach for ameliorating the general health of this specific patient demographic [18]. Review research concluded that pilates was a better intervention for chronic low back pain patients to reduce pain and disability; however, pilates was not better for short-term pain reduction than other types of practice [19]. Though so much research has been performed on pilates exercise, no

one could clearly demonstrate the effect of MPT on the functional fitness of older adults.

The aim of the study is to provide new and valuable information on the potential benefits of pilates exercise on functional fitness in older adults.

## Materials and Methods

### *Participants*

A total of 30 older adults ( $N_{All}=30$ ,  $N_{Male}=18$ ,  $N_{Female}=12$ ;  $Age_{All}=63.40\pm 1.77$ ,  $Age_{Male}=63.06\pm 1.73$  years,  $Age_{Female}=63.91\pm 1.78$  years) who regularly visited a local community playground for morning walk had voluntarily participated in the study, however towards the end of the study 3 male and 2 female didn’t qualify or attended the post-test session (Figure 1). G\*Power (version 3.1.9.2, University of Kiel, Kiel, Germany) was utilised to conduct a priori power analysis to determine the requisite sample size prior to participant selection. This analysis adopted an effect size of 0.80, an alpha error probability of 0.05, and a power of 0.95, in accordance with the methodology delineated by Kang [20]. The sample size determination test revealed a sample size of 23 for the study. However, to compensate for participant attrition, initially, 30 participants were considered as the sample for the study, which was further reduced to 25 at the final stage of the study. All the included participants of the study were aged 60 years and older and free from acute or chronic medical conditions. The participants possessing metallic implants or those with serious medical contraindications (hypertension, recent heart surgery, uncontrolled diabetes) or with significant cognitive impairments, as advised by physicians, precluding them from engaging in vigorous physical activities, were excluded from the study. The research received approval from the Institutional Ethical Committee of SRM Medical College Hospital & Research Centre, ensuring that it adhered to requisite ethical standards and guidelines (8498/IEC/2022). Furthermore, the study adhered to the guidelines outlined in the Declaration of Helsinki [21]. The participants had given written consent after thoroughly understanding the study’s objectives, potential benefits, risks and future implications.

### *Research Design*

The research employed a quasi-experiment utilizing a one-group pretest-posttest design (Figure 1), citing the limited number of participants [22]. The participants were tested before and after the exposure to six weeks of MPT program. The participants were instructed not to be involved in any other types of physical interventions which might have influenced the sole effect of the MPT program. The pre-test was completed within three days before the start of the training program, whereas the post-test was completed within three days after the completion of the six weeks MPT program.

*Training Intervention*

The participants were trained inside a community hall six days a week for six weeks. The duration of each training session was 60 minutes. The training program was constructed to promote the holistic development of functional fitness. Each session commenced with a 10-minute limbering-up, using basic exercises like deep breathing and gentle stretches, preparing participants both mentally and physically. The main exercise section, spanning 40 minutes, served as the core of the intervention. Across the six weeks, the program introduced and progressively intensified exercises such as the Pelvic Curl, The Hundred, the Crisscross, and the Side Kick Series. Each week offered a combination of familiar exercises, ensuring consistent engagement and mastery while introducing new ones to challenge participants and prevent adaptability stagnation. Repetitions, sets, and rest intervals were methodically structured to balance exertion and recovery, optimising the benefits of each exercise. The sessions concluded with a 10-minute limbering-down, comprising stretches and relaxation techniques, aiding in muscle recovery and mental relaxation. The progression from week one to six was meticulously crafted to ensure participants

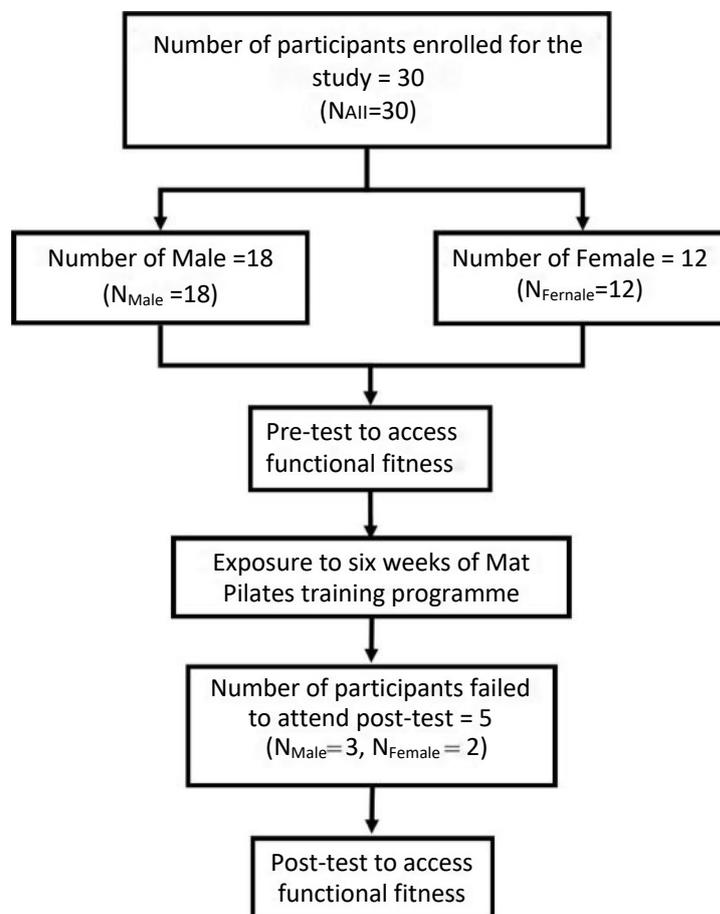
not only improved their pilates technique but also experienced quantifiable improvements in their functional fitness. Table 1 displays the training intervention for the first week.

*Testing protocol*

Senior Fitness Test [23] items were employed to evaluate the functional fitness of the older adults. The test items exhibited high reliability and validity as elucidated by Rikli & Jones [23]. The testing procedures are explained below.

*Lower-body strength (LBS): 30-second chair stand test for lower-body strength*

The 30-second chair stand test, as explained by Rikli and Jones [23], was employed to measure the LBS of the older adults. A chair was positioned against a wall and secured it using a nail for safety. Participants were instructed to position themselves centrally on the seat, ensuring their feet were flat and spaced shoulder-width apart. Additionally, they were directed to cross their arms at the wrists and keep them adjacent to the torso. The participants were asked to start from the seated position to fully stand up and then fully sit back down and were asked to repeat it for 30 seconds. The cumulative count of full chair stands was considered (one stand



**Figure 1.** Flow of the experiment

**Table 1.** Pilate training intervention for first weeks\*

WEEK 1				
Day	Warm-Up (10m)	Main Exercises (40m) (Sets x Reps)	Rest (between sets/exercises)	Cool Down (10m)
1	Deep Breathing, Pelvic Tilts, Cat-Cow, Gentle Spinal Rotations	Pelvic Curls (3x10), The Hundred (3x75 pumps), Spine Twist (3x12), Leg Circles (3x10 each leg), Single Leg Stretch (3x10 each leg)	30s/1m	Spinal twists, Child's Pose, Gentle Leg Swings
2	Leg swings, Dynamic leg stretches, Hip circles, Ankle Rotations	Standing Leg Lifts (3x10 each direction), Double Leg Stretch (3x12), Rolling Like a Ball (3x10), Scissors (3x10 each leg), Double Leg Lifts (3x10)	30s/1m	Hamstring, quad, calf stretch, Gentle Hip Rotations
3	Arm circles, Shoulder rolls, Neck tilts & turns, Wrist rotations	Arm Scissors (3x12), Push-Ups (3x12), Tricep Dips (3x12), Plank (3x40s), Side Plank (3x30s each side)	30s/1m	Shoulder stretch, Tricep stretch, Arm Swings
4	Deep Breathing, Side bending, Spinal rotations, Neck Rolls	The Saw (3x12), Spine Stretch Forward (3x12), Corkscrew (3x12), Open Leg Rocker (3x10), Single Leg Teaser (3x10 each leg)	30s/1m	Gentle Spinal Rolls, Neck Stretches, Forward Bend
5	Full body twist, Dynamic leg & arm stretches, Gentle Torso Twists	The Seal (3x10), Shoulder Bridge (3x12), Side Kick Series (2x10 each exercise), Double Leg Kicks (3x12), The Teaser (3x8)	30s/1m	Full Body Relax, Deep Breathing, Gentle Torso Twists
6	Gentle jog in place, Arm & leg dynamic stretches, Hip Rotations	The Hundred (3x100 pumps), Neck Pull (3x10), Jackknife (3x10), Rollover (3x8), Swimming (3x30s)	30s/1m	Gentle Side Stretches, Hamstring Stretch, Deep Breathing

\* Only focused exercises are mentioned here. Notes: m, minute; s, seconds; reps, repetitions

includes both standing up and sitting down) as the test score.

*Upper-body strength (UBS): 30-second arm curl test for upper-body strength*

The 30-second arm curl test was utilized to assess the UBS of older adults [23]. Participants were instructed to sit on a chair and hold a weight with their dominant hand using a suitcase grip, wherein the palm faced their body. The upper arm remained stationary and braced against the body, positioned vertically beside the chair, allowing only the forearm to move. Participants were directed to elevate their arm, encompassing its entire range of motion, subtly rotating the palm upward. Subsequently, they lowered the arm through the same range, reverting it back to its initial posture. The arm should be completely flexed and subsequently fully extended at the elbow joint. Participants were instructed to repeat the action as many times as possible within 30 seconds. The score was determined by the total number of controlled arm curls completed in 30 seconds.

*Aerobic endurance (AE): 2-minute step test for aerobic endurance*

The 2-minute step test was employed to assess the AE of the older adults [23]. Participants were

instructed to stand upright adjacent to a wall. A mark was established on the wall, positioned midway between the individual's patella and iliac crest. Subsequently, participants were directed to march on the spot for a duration of two minutes, ensuring their knees reached the height of the designated mark on the wall. Participants were permitted to rest or seek support by holding onto the wall or a sturdy chair if needed. The score for the test was determined by recording the total number of occurrences where the right knee raised to the level of the tape within the span of two minutes.

*Lower-body flexibility (LBF): Chair sit-and-reach test for lower-body flexibility*

The chair sit-and-reach test was used to assess the LBF of the older adults [23]. A chair was secured against a wall, with participants seated at the edge. Participants positioned one foot flat on the floor, knee bent, and extended the other leg forward, heel on the floor, and ankle at a 90° angle. Hands were stacked, middle finger tips aligned. Participants inhaled, exhaling while reaching towards their toes, bending from the hip, maintaining a straight back and elevated head, avoiding bouncing or overstretching. The final position, held for 2 seconds

with a straight knee, determined the score based on the distance between fingertips and toes, measured to the nearest 1/2 inch. Touching the toes scored zero, not touching resulted in a negative score, and overlapping fingers and toes gave a positive score.

*Upper-body flexibility (UBF): Back scratch test*

To assess the UBF of the older adults, the back scratch test was utilized [23]. Participants stood upright, reaching one hand over their shoulder, palm against the body and fingers directed downward. The opposite hand went behind their back, palm out and fingers pointing upward, trying to touch or overlap the middle fingers of both hands. An assistant ensured proper alignment and measured the fingertip distance. A score of zero was given if fingertips touched; non-touching distances resulted in a negative score, while overlap was recorded as a positive score. After two practice tries, one test attempt was made, which could be stopped if pain occurred. The best result, rounded to the nearest 1/2 inch, determined the test score.

*Agility (AG): 8-foot up-and-go test*

The AE of elderly participants was assessed using the 2-minute step test [23]. A chair was positioned against a wall, and a marker was placed 8 feet in front of it. There were no objects in between the chair and the marker to obstruct the normal movement between them. Participants began the test seated with hands on their knees and feet flat. At the “Go” command, they swiftly and safely walked around a cone before returning to sit. The timer stopped once seated. After two attempts, the fastest time, rounded to the nearest 1/10<sup>th</sup> of a second, determined the test score

*Body Mass Index (BMI):*

Height was measured using a stadiometer (SECA model 213, Hamburg, Germany), following the conventional method. Body mass was assessed using an electronic scale (SECA model 813, Hamburg, Germany) following the method used by Minu et al. [24]. BMI was calculated following the method described by Nuttall [25].

*Statistical analysis*

Descriptive statistics were first computed, with results being presented as mean±standard deviation for both pre and post-test measurements. To evaluate of the mean differences between pre and post-test measurements, the paired t-test was employed as the statistical technique. All statistical tests were calculated using the IBM SPSS version 27 [26]. Prior to the application of the t-test, the associated assumptions were rigorously examined. For the statistical calculations, the level of significance was set at p<0.05. In addition to the t-test results, the effect size was ascertained using Cohen’s d, and the 95% Confidence Interval (CI) was delineated. Moreover, the percentage changes relative to pertinent variables were also calculated. A correlation coefficient (ICC) was calculated for each variable using before and post-test data from the MPT group. According to Koo & Li [27], test-retest reliability was calculated using two-way mixed models and expressed as ICCs. According to [27], in general, ICCs below 0.5 indicate poor reliability, 0.75 to 0.9 indicate moderate reliability, and over 0.90 indicate excellent reliability. All examined parameters’ ICC values are shown in Table 2. Whenever there is a pre-test or post-design for intervention studies, reliability is crucial as a sign of measurement error.

**Results**

The results of the statistical tests are displayed in Table 3. Paired-sample t-tests were conducted to assess changes in functional fitness variables from pre-test to post-test separately for male, female and combined group. The results indicated a statistically significant increase in LBS both among males (p=0.015) and females (p=0.002), with an overarching significant increase in the combine group (p<0.001). The UBS demonstrated significant improvements in males (p=0.002) and, importantly, in the combine group (p<0.001), while the female group did not achieve statistical significance (p=0.117). The AE witnessed marked enhancements across all

**Table 2.** Intraclass correlation coefficients (ICCs) for all analysed variables using pre and post data of the participants

<b>Variables</b>	<b>ICC</b>	<b>95 % CI</b>
Lower-body strength (number)	0.92	0.838-0.969
Upper-body strength (number)	0.95	0.897-0.980
Aerobic endurance (number)	0.97	0.951-0.991
Lower-body flexibility (inches)	0.99	0.995-0.999
Upper-body flexibility (inches)	0.96	0.928-0.986
Agility (seconds)	0.95	0.894-0.979
BMI (kg.m <sup>-2</sup> )	0.98	0.967-0.994

Notes: BMI, Body mass Index; ICC, intraclass correlation; CI, confidence interval.

**Table 3.** Mean differences between pre and post-test performance of functional fitness variables

Variables	Mean ( $\pm$ SD)	Mean Difference (Post-Pre)	t-value	Sig. value (p)	Cohen's d	Percentage change		
LBS (number)	Male	Pre	14.73 $\pm$ 2.84	1.07 $\pm$ 1.49	-2.779	0.015	1.49	7.26
		Post	15.80 $\pm$ 3.03					
	Female	Pre	12.90 $\pm$ 2.28	1.80 $\pm$ 1.32	-4.323	0.002	1.32	13.95
		Post	14.70 $\pm$ 2.54					
	Combine	Pre	14.00 $\pm$ 2.74	1.36 $\pm$ 1.44	-4.723	0.001	1.44	9.71
		Post	15.36 $\pm$ 2.84					
UBS (number)	Male	Pre	16.67 $\pm$ 3.94	1.47 $\pm$ 1.51	-3.773	0.002	1.51	8.76
		Post	18.13 $\pm$ 4.07					
	Female	Pre	13.40 $\pm$ 2.27	1.00 $\pm$ 1.83	-1.732	0.117	1.83	7.46
		Post	14.40 $\pm$ 3.03					
	Combine	Pre	15.36 $\pm$ 3.70	1.28 $\pm$ 1.62	-3.949	0.001	1.62	8.33
		Post	16.64 $\pm$ 4.07					
AE (number)	Male	Pre	82.80 $\pm$ 13.64	5.80 $\pm$ 4.06	-5.537	0.000	4.06	7.00
		Post	88.60 $\pm$ 13.45					
	Female	Pre	79.80 $\pm$ 9.14	5.80 $\pm$ 2.39	-7.660	0.000	2.39	7.27
		Post	85.60 $\pm$ 8.96					
	Combine	Pre	81.60 $\pm$ 11.92	5.80 $\pm$ 3.43	-8.460	0.001	3.43	7.11
		Post	87.40 $\pm$ 11.74					
LBF (inches)	Male	Pre	1.70 $\pm$ 2.48	0.31 $\pm$ 0.21	-5.779	0.000	0.21	18.24
		Post	2.01 $\pm$ 2.37					
	Female	Pre	3.21 $\pm$ 1.11	0.31 $\pm$ 0.18	-5.471	0.000	0.18	9.66
		Post	3.52 $\pm$ 1.00					
	Combine	Pre	2.30 $\pm$ 2.15	0.31 $\pm$ 0.19	-8.027	0.001	0.19	13.54
		Post	2.62 $\pm$ 2.05					
UBF (inches)	Male	Pre	-1.62 $\pm$ 2.04	0.98 $\pm$ 0.77	-4.922	0.000	0.77	-60.49
		Post	-0.64 $\pm$ 1.53					
	Female	Pre	0.37 $\pm$ 1.02	0.57 $\pm$ 0.27	-6.754	0.000	0.27	154.05
		Post	0.94 $\pm$ 0.96					
	Combine	Pre	-0.82 $\pm$ 1.95	0.82 $\pm$ 0.64	-6.329	0.001	0.64	-99.03
		Post	-0.01 $\pm$ 1.53					
AG (seconds)	Male	Pre	4.89 $\pm$ 0.77	-0.54 $\pm$ 0.36	5.775	0.000	0.36	-11.04
		Post	4.35 $\pm$ 0.63					
	Female	Pre	5.26 $\pm$ 0.85	-0.51 $\pm$ 0.28	5.746	0.000	0.28	-9.70
		Post	4.75 $\pm$ 0.86					
	Combine	Pre	5.04 $\pm$ 0.80	-0.53 $\pm$ 0.33	8.099	0.001	0.33	-10.48
		Post	4.51 $\pm$ 0.74					
BMI (kg.m <sup>-2</sup> )	Male	Pre	23.51 $\pm$ 0.92	0.07 $\pm$ 0.22	-1.199	0.251	0.22	0.30
		Post	23.58 $\pm$ 0.89					
	Female	Pre	24.18 $\pm$ 0.67	0.04 $\pm$ 0.21	-0.618	0.552	0.21	0.17
		Post	24.22 $\pm$ 0.77					
	Combine	Pre	23.78 $\pm$ 0.88	0.06 $\pm$ 0.21	-1.346	0.191	0.21	0.24
		Post	23.84 $\pm$ 0.89					

Notes: LBS, lower-body strength; UBS, upper-body strength; AE, aerobic endurance; LBF, lower-body flexibility; UBF, upper-body flexibility; A, agility; BMI, body mass index; SD, standard deviation.

categories, with males, females, and the combined group showing p-values of less than 0.001. Both LBF and UBF experienced significant increases from pre to post-test measurements across all gender and combined group (all  $p < 0.001$ ). Notably, AG underwent a significant decrease in the post-test measurements for males, females, and the overall group, all with p-values less than 0.001, indicating improved agility. In contrast, BMI exhibited negligible changes across genders and combined data, with the overall change not reaching statistical significance ( $p = 0.191$ ).

## Discussion

The present research aimed to understand the potential benefits of a six-week MPT program on the functional fitness of older adults. This objective emerged from the growing acknowledgement of pilates as a holistic exercise program with potential implications for enhancing physical capabilities, especially among the elderly population. Our findings provide substantial evidence that MPT can be a valuable intervention in promoting several dimensions of functional fitness in older adults, except BMI.

A cornerstone finding of this study was the significant improvement in both lower- and upper-body strength. The gains in LBS and UBS corroborate prior research that has reported the potential of Pilates-based exercises in enhancing muscular strength. Campos de Oliveira et al. [28] conducted an extensive study on older adults and observed that those who practised pilates regularly displayed marked improvements in muscle strength and posture. Similarly, our research aligns with this trend, suggesting that the structured and controlled movements in pilates, which emphasise core stability and alignment, are particularly effective for this demographic. The ageing process typically results in a gradual decline in muscle mass and strength, a phenomenon known as sarcopenia [29]. Pilates, with its focus on controlled resistance and full range of motion, may offer an effective countermeasure against this natural decline.

Our results demonstrated a noteworthy improvement in aerobic endurance following the pilates intervention. This aligns with the findings of Fernández-Rodríguez et al. [30] and Lim & Yoon [31], who argued that consistent pilates practice can have a positive impact on cardiovascular health. The unique combination of rhythmic movements, coupled with deep, controlled breathing emphasised in pilates, can enhance oxygen utilisation and improve cardiovascular efficiency [16]. Moreover, as cardiovascular diseases remain a leading cause of morbidity among older adults [32], the potential of pilates to bolster heart health cannot be understated.

Flexibility is an often-overlooked aspect of fitness that plays a pivotal role in the daily functioning and overall quality of life of older adults. Our findings

highlighted significant advancements in both lower- and upper-body flexibility post-intervention. This is consistent with previous studies that have emphasised the stretching and lengthening movements inherent in pilates as being especially effective in enhancing flexibility [33]. An increase in flexibility can reduce the risk of injuries, alleviate joint pain, and improve overall mobility [34], all of which are essential for maintaining independence and high quality of life in older age [35].

The improvement in agility, as reflected in our study, underscores another dimension of functional fitness. Agility involves not just speed but also balance, coordination, and spatial orientation [36, 37], all crucial for daily activities and preventing falls in older adults [38, 39]. Donath et al. [40] and Rodrigues et al. [41] emphasised that agility training, as offered through dynamic pilates movements, can significantly reduce the risk of falls, which remains a prevalent concern among the elderly. By enhancing agility, pilates not only improves physical capabilities but potentially offers psychological benefits by boosting confidence in movement and reducing fear of falls [42, 43].

While the MPT program manifested significant improvements in most functional fitness parameters, BMI remained largely unchanged. This observation is in line with prior research. Aladro-Gonzalvo et al. [44] and Sharma [45] asserted that while pilates offers numerous functional and health benefits, it may not be the primary choice for weight management. The calorie expenditure in a typical pilates session might not be as substantial as more aerobic-centric programs [46]. However, it's essential to understand that BMI alone is not a comprehensive indicator of health, especially in older adults, where muscle mass and functional capabilities are of paramount importance [47].

It is evident that a MPT program offers a multifaceted approach to enhancing functional fitness in older adults. The benefits span from muscular strength to cardiovascular health, flexibility, and agility. Such comprehensive improvements have profound implications for the well-being and quality of life of older individuals. With the challenges of ageing, such as sarcopenia, reduced cardiovascular efficiency, and decreased flexibility, interventions like pilates can play a pivotal role in not just halting but potentially reversing some of these declines. Furthermore, given the non-significant change in BMI, it might be beneficial to integrate pilates with other aerobic exercises for older adults aiming for weight management.

## Conclusions

With the global population ageing, our research highlights a pressing social imperative to prioritise interventions that promote longevity and quality of life. Pilates, as our study demonstrates, emerges as a

pivotal solution. Beyond individual improvements in muscular strength, cardiovascular health, flexibility, and agility, pilates offers older adults tangible benefits such as improved daily functionality, diminished fall risks, and a bolstered sense of independence and confidence. These outcomes pave the way for older adults to remain active and engaged in various social and recreational activities, combating feelings of dependency or isolation. From a broader vantage point, these findings bear significant implications for healthcare systems, policy formulations, and community engagement.

The study recommend for the inclusion of pilates in rehabilitation programs, the establishment of community-based pilates workshops, widespread awareness campaigns detailing its myriad benefits for the elderly, and a continued commitment to research, exploring the comprehensive advantages of pilates in the area of public health.

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