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Abstract

Introduction: As age increases, declines in basic motor skills are observed in older men. Limited physical activity-based interventions, such as Pilates exercises, focus on enhancing these basic motor skills. This study aimed to identify the benefits of Pilates exercises on functional fitness and the quality of life in older men.

Material and Methods: Older men were randomly assigned to either a Pilates exercises group or a control group. Balance, strength, flexibility, and agility were tested using the Senior Fitness Test (SFT). The Quality-of-Life Questionnaire (SF-36) assessed the quality of life before and after 6 weeks of Pilates exercises. Differences over time between the experimental and control groups were assessed by 2×2 (group by time) repeated-measures analysis of variance.

Results: The mean scores of dynamic balance and lower body strength significantly improved post-intervention in both groups, but the level of significance was higher in the Pilates group. Flexibility, agility, and quality of life significantly improved in the Pilates group.

Conclusions: Pilates exercises may improve the physical and social independence of older men. Designing appropriate protocols for Pilates exercises and doing these exercises correctly and regularly by older men may reduce their common mobility problems and limit the risk of falls that cause severe injuries in older people. However, further research is needed.

Keywords

SFT, Pilates for older men, physical activity, quality of life, balance performance

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Article

Benefits of Pilates exercises on functional fitness and quality of life in older men: A quasi-experimental study

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Abstract: Introduction: As age increases, declines in basic motor skills are observed in older men. Limited physical activity-based interventions, such as Pilates exercises, focus on enhancing these basic motor skills. This study aimed to identify the benefits of Pilates exercises on functional fitness and the quality of life in older men. Material and Methods: Older men were randomly assigned to either a Pilates exercises group or a control group. Balance, strength, flexibility, and agility were tested using the Senior Fitness Test (SFT). The Quality-of-Life Questionnaire (SF-36) assessed the quality of life before and after 6 weeks of Pilates exercises. Differences over time between the experimental and control groups were assessed by 2×2 (group by time) repeated-measures analysis of variance. Results: The mean scores of dynamic balance and lower body strength significantly improved post-intervention in both groups, but the level of significance was higher in the Pilates group. Flexibility, agility, and quality of life significantly improved in the Pilates group. Conclusions: Pilates exercises may improve the physical and social independence of older men. Designing appropriate protocols for Pilates exercises and doing these exercises correctly and regularly by older men may reduce their common mobility problems and limit the risk of falls that cause severe injuries in older people. However, further research is needed.

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1. Introduction

In recent decades, the older population has significantly increased [1], and aging has been associated with physiological and functional decline [2]. Compared to younger adults, older adults are at increased risk of experiencing gradual regression of motor function and balance. Above all, balance impairment is an important risk factor for falls in this age group. Indeed, the severities of fall-related complications increase with age [2]. Decreased functional performance and fear of falling are among the factors that affect the quality of life in older adults [3]. Therefore, the growing trend of the aging population is a clinical priority and given that increasing age and disability are the determining factors in using effective methods to improve and enhance the function of the human locomotors system, it has become a particular health challenge [4].

Most importantly, sedentary older adults show a greater risk of a decline in basic motor skill and a greater risk of falls [2]. Moreover, motor dysfunctions among older people in society are a significant issue that gradually jeopardizes their self-confidence, independence, and quality of life. These are exacerbated by physical immobility, which is associated with substantial negative consequences for their general health [5]. In this regard, other research claimed that the prevalence of falling in older adults had a significant relationship with other diseases, such as osteoporosis, myocardial infarction, fractures, cognitive impairment, and headache [6].

The Pilates exercises approach is a unique method of physical fitness associated with a combination of strength movements, muscle stretching, and breathing. Unlike traditional resistance exercises in which muscles are trained separately, Pilates exercises require simultaneous activation and coordination of several muscle groups [7]. In this regard, the effect of various Pilates exercises on older adults has been studied and it has been found that Pilates exercises could improve static and dynamic balance and functional stability [8], as well as muscle strength, balance, endurance, flexibility, gait, and physical functioning [9]. Additionally, positive effects on psychological health parameters have been observed, including better quality of life, a lower level of depression, improved sleep quality, a lower fear of falling, lower pain, higher health perception [9], better short-term memory [10], mobility, performance, and quality of life [11].

The effect of Pilates exercises on physical function, balance, and quality of life in older adults remains controversial. In planning the training program, recommendations regarding the type of training, intensity, and amount of participation are considered. The Pilates exercise approach largely avoids high impact, high power output, and heavy muscular and skeletal loading [12]. To close this gap, the main purpose of the present study was to identify the benefits of a six-week selected Pilates exercises program as regular training on functional fitness and quality of life in healthy older men.

2. Materials and Methods

2.1. Participants and Procedure

Men aged 66 to 78 yrs old took part in the study. All participants were fully aware of the purposes of the study and anonymous data collection. They were randomly divided into two groups: the Pilates exercises group and the control group. The design of the present study was a pre-test-post-test with a control group.

Participants were eligible for the present study if they met the following inclusion criteria: 1) men, 2) 66 yrs. old or older; 2) no regular physical activity (regular physical activity was defined as at least 30 minutes of moderate to vigorous activity, three times a week); 3) written permission from a doctor; 4) no specific respiratory or musculoskeletal disorders; 5) score 24 or above in the Mini-Mental State Examination (MMSE); and 6) no loss of any relative or loved one during the past six months.

Exclusion criteria were: 1) uncontrolled diabetes, 2) uncontrolled blood pressure; 3) Alzheimer's disease; 4) mental disorders, such as substance use disorder, Major Depressive Disorder (MDD), Posttraumatic Stress Disorder (PTSD), Neurological disorders, such as seizures, Multiple Sclerosis (MS), Parkinson's Disease; 5) visual impairments; and 6) participation in less than 80% of Pilates training sessions. In total, 30 older men met the inclusion criteria and were able to comply with the study conditions.

This study was approved by the ethics committee of Imam Reza International University of Mashhad, Iran (IR.IMAMREZA.REC.1401.011).

2.2. Sample Size Calculations

A power analysis (using G*Power 3.1 software) indicated to detect an effect of moderate magnitude (f = 0.25; alfa-error = 0.05, power = 0.8, groups = 2, number of measurements = 2.00, correlation among repeated measures = 0.50) in repeated-measures analyses of variance (ANOVA), at least 28 participants were required to conduct this study (14 per group).

2.3. Randomization

For this random group assignment, a computer-generated random-number sequence was prepared in advance and sealed in opaque, consecutively numbered envelopes by an independent researcher. Once the envelope was drawn, it was put aside and not returned to the ballot box again.

2.4. Outcome measures

2.4.1. Basic motor skills

Measurements of balance, strength, flexibility, and agility were assessed using the Senior Fitness Test (SFT; this tool is also known as the Fullerton Functional Fitness Test). In the present study, the SFT was used to assess age-related changes that reduce basic motor skills in physiological items that support the behavioral needs to perform daily activities required for independent living. The SFT was designed specifically for older people through research that is easy to conduct and is also safe for older people [13]. There are four tests in the SFT battery dedicated to assessing physical fitness: 1) Chair Stand Test: to assess lower body strength, the test lasted 30s; 2) Back Scratch Test: to measure the flexibility of the upper body (shoulder) and the distance between the fingers on the back (+/- in cm); 3) Chair Sit and Reach Test: to assess the flexibility of the lower body (mainly hamstring muscles) and the distance between the thumb to the tips of the middle fingers (+/- in cm); 4) 8-Foot Up and Go Test: to assess physical mobility, the time required to get up from the chair, bypass the obstacle and sit on the chair. In the literature, there are norms for the American population [14] and for the Polish population [15], but there are no norms dedicated to the Iranian population.

2.4.2. Quality of Life

The quality-of-life questionnaire (SF-36) was used to assess older adults' health-related quality of life. This questionnaire consists of three dimensions: 1) physical functioning; 2) mental health; 3) social functioning [16]. The items are scored from 0 to 100, in which 0 indicates the worst condition and 100 represents the best. In the present study, a score below 50 was defined as low health-related quality of life, 50 to 75 represented moderate health-related quality of life, and a score above 75 denoted high health-related quality of life [17].

2.4.3. Intervention: the Pilates Exercise Program

The Pilates exercise program was performed for 36 sessions. Each training session lasted one hour. In this regard, three experts were responsible for measuring the level of physical fitness of the lower body before and after the intervention program. The content of the whole Pilates exercise intervention sessions is described in Appendix A.

2.4.4. Control Condition

To control possible effects of social interaction with other participants or study personnel, the participants assigned to the control group gathered at the clinic. During this time, they could talk to each other and medical staff members. Additionally, they were asked to maintain their current daily physical activity levels and to refrain from additional exercises during the six-week intervention period. During this period, the control group received their usual care; of course, it was ensured that none of the participants in the control group participated in the Pilates exercises program. It should be noted that during the study, there were no restrictions or changes in the daily life routine of participants in these two groups. They could continue their previous regular activities and programs of personal life.

2.5. Data Analysis

All calculations were done by the SPSS software version 24. After data collection, the Shapiro-Wilk test was conducted to check the normality of data distribution. Then, using Levene's test, the homogeneity of the variables was investigated in the two groups. One-way analysis of covariance (ANCOVA) was performed to identify and compare the effects of the Pilates program on each dependent variable, given that the influence of pre-intervention values on post-intervention ones was controlled in this study. In all the statistical tests, a P-value of 0.05 was considered indicative of significance. The effect size for ANCOVA was calculated using partial eta square (ηp^2), with $0.01 \geq \eta p^2 \geq 0.059$ indicating small effect, $0.06 \geq \eta p^2 \geq 0.139$ indicating medium effect, and $\eta p^2 \geq 0.14$ indicating large effect sizes [18].

3. Results

The participants' demographic characteristics are presented in Table 1.

Using Levene's test, the homogeneity of the variables was investigated in the pre-intervention phase in the Pilates and the control group. Considering that the significance level of all variables was more than 0.05, all variables were homogeneous (Table 2).

Table 1. Participants' demographic characteristics.

Group		Number of participants	Percentage [%]	Number of attended Pilates class (n = 36)
Age [Years]				
66 to 70	Pilates	6	0.40	36
	Control	9	0.60	0
71 to 75	Pilates	5	33.3	36
	Control	3	20.0	0
Over 76	Pilates	4	26.7	36
	Control	3	20.0	0
Marital Status				
Single	Pilates	3	20.0	36
	Control	3	20.0	0
Married	Pilates	7	46.7	36
	Control	8	53.3	0
Lost partner	Pilates	5	33.3	36
	Control	4	26.7	0

Table 2. Levene's test of the equality of error variances for the SFT-pre-test and QoL-pre-test.

Variables	F	Df1	Df2	p
Balance	0.879	2	12	0.440
Strength	1.299	2	12	0.309
Flexibility	0.541	2	12	0.596
Agility	0.383	2	12	0.690
Physical functioning	4.751	2	12	0.560
Mental health	0.840	2	12	0.455
Social functioning	0.241	2	12	0.789
Quality of life	0.047	2	12	0.955

Legend: F = Fischer; Df1 = Degree of freedom; Df2 = Degree of freedom; *$p < 0.05$

Basic Motor Skills

Balance scores increased significantly more from the baseline up to the end of the study (F = 31.46, p = 0.001; significant time effect) in the Pilates group. Compared to the control group, the Pilates group achieved higher dynamic balance scores (significant group effect). Effect size calculations (Table 3) showed that in the Pilates group balance scores largely increased from the baseline up to the post-intervention (large effect size: 0.46). Strength scores increased from baseline up to the end of the study (F = 196.78, p = 0.001) more in the Pilates group than in the control group. Effect size calculations showed that strength scores largely increased from the baseline up to the post-intervention in the Pilates group (large effect size: 0.67). Flexibility scores increased from the baseline up to the end of the study in the Pilates group, (F = 39.18, p = 0.001; large effect size: 0.79). Agility performance increased from the baseline up to study completion in the Pilates group (F = 32.21, p = 0.001; large effect size: 0.69).

Table 3. ANCOVA for basic motor skills between the groups at the different stage of the study.

	M	SD	M	SD	F	p	ES
Pilates Group							
Balance: Chair Stand Test [s]	16.9	2.9	23.3	3.3	31.46	0.001	0.46
Strength: Back Scratch Test [cm]	-0.79	6.5	-2.9	5.6	196.78	0.001	0.67
Flexibility: Chair Sit and Reach Test [s]	-4.5	8.7	-7.9	4.6	39.18	0.001	0.79
Agility: 8-Foot Up and Go Test [s]	5.4	0.8	5	0.5	32.21	0.001	0.69
Control Group							
Balance: Chair Stand Test [s]	18.9	3.9	19.3	4.9	31.46	0.001	0.46
Strength: Back Scratch Test [cm]	6.9	8.4	7.5	10.2	196.78	0.001	0.67
Flexibility: Chair Sit and Reach Test [s]	-7.3	7.2	-6.2	8	39.18	0.001	0.79
Agility: 8-Foot Up and Go Test [s]	5.2	0.7	5.4	0.9	32.21	0.001	0.69

Legend: M = Mean; SD = Standard Deviation; F = Fischer; p = Sig. or p-value; ES = Effect Size

Quality of Life

The total score of the quality of life improved over time (F = 31.10, p = 0.001) more in the Pilates than in the control group. Effect size calculations (Table 4) showed that within the Pilates group physical functioning scores significantly increased from the baseline up to the post-intervention (large effect size: 0.58; F = 30.25, p = 0.001). Effect size calculations showed that within the Pilates group physical functioning scores largely increased from the baseline up to the post-intervention (large effect size: 0.57). Furthermore, mental health improved significantly more (F = 15.69, p = 0.001; large effect size: 0.40) in the Pilates group. Lastly, social functioning improved more (F = 29.72, p = 0.001; large effect size: 0.52) in the Pilates than in the control group.

Table 4. ANCOVA for the quality of life between the groups at the different stages of the study.

	M	SD	M	SD	F	*p*	ES
Pilates Group							
Physical functioning	45.22	11.77	67.20	14.82	30.25	0.001	0.57
Mental health	46.85	14.32	66.22	13.68	15.69	0.003	0.40
Social functioning	44.65	17.52	68.23	12.56	29.74	0.005	0.52
Total score	52.96	10.65	67.21	11.35	31.10	0.001	0.58
Control Group							
Physical functioning	38.48	18.86	38.26	18.54	30.25	0.001	0.57
Mental health	38.62	14.58	39.73	15.23	15.69	0.003	0.40
Social functioning	40.23	11.92	42.36	12.89	29.74	0.005	0.52
Total score	41.58	12.67	42.09	17.25	31.10	0.001	0.58

Legend: M = Mean; SD = Standard Deviation; F = Fischer; p = Sig. or p-value; ES = Effect Size

4. Discussion

The main aim of this study was to identify the benefits of Pilates exercises on functional fitness and the quality of life in older men and it was fully achieved. The formulated hypothesis was considered in the interpretation of the results and compared with results from the literature review. The key findings of the present study are evidence for significant improvement in balance, strength, flexibility, agility, and quality of life among older males after the Pilates exercise program lasting 36 sessions.

There was an assumption that dynamic balance, strength, flexibility, agility, and quality of life of participants in the Pilates group would improve significantly better compared to the control group. The results showed a significant difference in the post-intervention test in the dynamic balance between groups. This finding was in line with the results of previous studies [8, 12, 19, 20]. Pilates exercises may improve dynamic balance in older men. Balance limitation might be dangerous because older men tend to have problems maintaining balance and face the risk of falling. Thus, doing regular Pilates exercises can decrease this problem among older men [12]. A significant improvement in balance due to Pilates exercises can be obtained due to an improvement in muscle strength and psychological factors. To explain this thesis, it is important to notice that a decrease in muscle strength in the lower body leads to a change in the placement of the center of gravity in front of the ankle joint, which itself causes imbalance and fall risk. Also, improving muscle strength can shift the center of gravity of the ankle and improve balance [8].

This study showed that the Pilates intervention could improve strength in older men. Accordingly, the results confirmed previous findings related to strength outcomes [9, 12], but were inconsistent with the some results [19] and previous systematic review findings [9, 12]. Based on previous studies, it is recommended to use lower body exercises in sport-based interventions for older adults. That is because one of the major impairments in older adults is the injury of the lower body, especially in the pelvic area. Thus, regular Pilates exercises can prevent, and in some cases, treat lower body injuries [12].

Moreover, lower body injuries could depend on limited mobility in joints [21]. Based on our results, we assumed that Pilates exercises would improve flexibility. Accordingly, the present results confirmed this hypothesis, which was consistent with the results of Işık and Başar [12], who showed the effectiveness of Pilates exercises in improving the flexibility of the upper body of older adults. Pilates exercises could have positive and significant effects on improving the flexibility of the upper body of older adults because people at this age, due to changes in their tissues (stiffness), usually have many challenges in changing the range of motion in joints, and sometimes these changes cause serious injuries. Therefore, Pilates exercises can prevent the occurrence of such injuries in older adults [11].

The present finding was inconsistent with results of Cancela et al. [19], who did not observe improvement in flexibility in older people after the Pilates exercise intervention. The reason for this disparity can be found in the type of exercise protocol and the functional test those authors chose to assess flexibility.

Agility is another skill analyzed in this study which improve due to the Pilates intervention. This finding was consistent with previous studies [20, 22].

Finally, as regards the last part of the proposed hypothesis, Pilates exercises would significantly improve quality of life. This result was in line with results in studies by García-Soidán et al. [23], Meikis et al. [9] and de Siqueira Rodrigues [24]. According to this finding and the results of previous studies [24], it could be concluded that Pilates exercises may significantly improve the quality of life and its components among older men. Therefore, the Pilates exercise program can help older people to cope more easily with physical, mental, and social problems. The result of the present study was consistent with Soori et al. [25], who showed that Pilates exercises led to reduced anxiety and improvement in various mental health components. Also, in line with Vécseyné et al. [11], Pilates exercises may improve physical functioning and the quality of life among older adults. It is believed that the mental health-enhancing aspect of Pilates exercises leads to improved mood and self-esteem and decreases the number of depressive symptoms after the intervention [11]. The Pilates exercise program requires the implementation of more aerobic training and challenging movements. Hence, this exercise approach is considered one of the best interventions for enhancing mental health process of older adults.

5. Conclusions

Benefits of the Pilates exercise program in older men include improved functional fitness of the lower body, which leads to a better quality of life and their greater independence. Designing the appropriate Pilates exercise protocol and doing these exercises correctly and regularly by older men may reduce their common everyday mobility problems and the risk of falls. However, future studies are needed to support this hypothesis. Because the Pilates exercise program is low-cost, low-risk, non-invasive, does not need fast movements and is based on the execution of movements in a very controlled and slow manner, it can be used to help older men enhance basic motor skills and improve the quality of life. Thus, it is suggested to do the Pilates exercise program in care and rehabilitation centers for older people.

Limitations and recommendations for future studies

The recruited participants chose to be volunteers for this program, so these people already have a positive attitude towards exercise, which could influence the results. Unfortunately, one could not ascertain whether the experimental group's improvements would be maintained over time. Also, the sample size was rather small, although appropriate calculations were conducted, and there was a focus on the effect size in the interpretation of the results. Considering that the present study was conducted on a limited number of older adults, its results cannot be generalized to a larger population, and consequently, a study of these variables on a larger sample of elderly men and women is suggested. It is also suggested that, in further research, the financial situation and the level

of education of the elderly groups should be additionally investigated, as these can be among the components that affect the quality of life of the different populations.

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Appendix A
The Pilates exercise program in the current study (the intervention).

			Week					
Session number	**Pilates exercise**	**Frequency**	**I**	**II**	**III**	**IV**	**V**	**VI**
1	Neutral Spine	Set	3	3	3	3	3	3
		Repetition	5	5	5	7	7	10
2	The Pelvic Bowl	Set	3	3	3	3	3	3
		Repetition	5	5	5	7	7	10
3	The Knee Fold	Set			3	3	3	3
		Repetition			5	7	7	10
4	The Leg Slide	Set				3	3	3
		Repetition				7	7	10
5	The Cat	Set	3	3	3	3	3	3
		Repetition	5	5	5	7	7	10
6	Bridging	Set		3	3	3	3	3
		Repetition		5	5	7	7	10
7	Rib Cage Arms	Set	3	3	3	3	3	3
		Repetition	5	5	5	7	7	10
8	Exercising the forefoot (clasping with fingers and toes)	Set	3	3	3	3	3	3
		Repetition	5	5	5	7	7	10
9	Exercising the forefoot (instep lifts)	Set		3	3	3	3	3
		Repetition		5	5	7	7	10
10	Exercising the forefoot (instep lifts with toe action)	Set		3	3	3	3	3
		Repetition		5	5	7	7	10
11	Foot and ankle mobilization	Set	3	3	3	3	3	3
		Repetition	5	5	5	7	7	10
12	Standing	Set	3	3	3	3	3	3
		Repetition	5	5	5	7	7	10
13	The Bow	Set		3	3	3	3	3
		Repetition		5	5	7	7	10
14	Spinal rotation with arms	Set			3	3	3	3
		Repetition			5	7	7	10
15	Spinal lateral flexion with arms	Set					3	3
		Repetition					7	10
16	Heel drops overstep	Set					3	3
		Repetition					7	10

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