

# Research Paper: Effect of Pilates Exercise on Fear of Falling in Iranian Elderly Women



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## ABSTRACT

**Objectives:** The aim of this study was to determine the effect of Pilates exercise on Fear of Falling (FOF) among elderly women.

**Methods:** The present study is a clinical trial that was conducted on 44 elderly women aged between 60-80 years. Subjects were recruited through the convenience sampling method and were then randomly divided into two groups of inference viz. pilates exercise group, the members of which underwent Pilates exercise training along with the routine sanatorium exercises and the control group in which members stuck with (routine exercise only. Data was gathered by using demographic questionnaire and Fall Efficacy Scale-International (FES-I). For the intervention group, Pilates training was done for 8 weeks, three times a week (1 hour per session) under the supervision of a trained coach. Data were analyzed by the SPSS software v.16.

**Results:** The findings indicated that the means of FES-I scores in Pilates group improved from 32.90 to 22.18 (MD=10.72) after the intervention. According to the independent t-test, there was a significant difference in the means of post intervention FES-I scores, between the two groups ( $P<0.001$ ). In the Pilates group, the effect size of intervention was much more than the control group ( $ES=0.89$ ).

**Discussion:** Pilates training could decrease the FOF and may thus be implemented as an effective interventional method for fall prevention in elderly women.

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## 1. Introduction

**F**alling is one of the most common and problematic issues among the elderly [1]. On an average, more than a quarter of the elderly population is likely to experience a fall once in a year [2]. Owing to its prevalence and severity, the World Health Organization has categorized falls as the third leading cause of chronic disability [3]. Fear of Falling (FOF) has been categorized as a crucial psychological factor that often leads to falling [4].

Principally, FOF is a psychological state which increases physical weakness and reduces the levels of physical activity in older adults. Furthermore, its prevalence among the elderly population is substantially high. Many studies have reported that an average of 21-85% of the elderly population has FOF [5-8]. The various risk factors that have been identified to be associated with FOF are previous history of falling, impaired gait, imbalance, unsteadiness, muscle weakness and limitation of daily tasks [9, 10]. It is important to consider that presence of FOF in the elderly can reduce their ability to perform daily activities, which further reduces their mobility levels and thus, overall Quality of Life (QoL).

This, in turn, is known to decrease physical strength and robustness and increase the risk of actual falling, depression and isolation [10-12]. The “FOF” problem has been a major concern not only for the elderly, but also for their caretakers, families and health care providers. This can be understood from the fact that a simple psychological fear can lead to the occurrence of a number of health discrepancies and thus necessitate increased dependence on health care services [13, 14].

The present article is centered upon the above mentioned factors as observed in the elderly population of Iran. It has been observed that aging and its implications vary greatly between elderly Iranian women and men. Previous studies indicated that Iranian women follow different strategies to achieve optimal health due to which they are more likely to experience healthy aging in a natural way [15]. Furthermore, it has also been observed that they perceive optimal mental health through physical health. Interestingly, “seeking comfort” is the most basic psycho-social process that they follow to maintain their health [16, 17]. However, the prevalence of FOF in elderly women was observed to be higher than in men [18].

Once medical experts identified FOF as the root cause of most clinical presentations of falls in elderly population, they started studying and finding out possible psy-

chological as well as medical interventions that can help in preventing it. Some of the most commonly adopted interventions for this purpose include, usage of hip protectors, educating the geriatric population regarding the causes and implications of FOF, teaching and encouraging them to follow exercise routines and improve their socialization skills [19-21].

Studies have also already shown that learning different types of sports and balance training viz. Tai Chi, yoga and strength training are helpful in reducing the levels of FOF and thus minimizes the chances of falling [21-25], but others also have no significant relationship [26, 27]. Though it is proposed that sports can imply significant beneficial effects in the elderly population, there is still no agreement on the individualistic impacts of different sports exercises on specific traits of physical abilities of the elderly. Pilates Exercise is one of the very few sporting techniques the effects of which have been studied by sports and rehabilitation researchers [28, 29].

Among the various sports, Pilates exercise is a kind of cognitive and motion training program that can be used as a complementary therapy so as to augment the process of improving strength, concentration, flexibility, muscle control, postural stability and breathing [30-32]. In addition, Pilates exercise has also shown to have beneficial effects in reducing FOF [30, 31, 33-36]. However, exclusive studies that prove the same in the elderly population, especially on the fall and the FOF among older adults are lacking. The present study was thus designed to study the impact of Pilates exercises on FOF in elderly women. The study was conducted with the aim that validation of beneficial effects of Pilates exercises, which are essentially highly safe and low-cost alternative exercise routines, can help in its propagation as a complementary therapeutic method for the treatment of FOF in the elderly community.

## 2. Methods

### Study setting and participants

The present study was a randomized control trial, which investigated the effects of 8-week Pilates training on FOF of elderly women. The study was conducted between September–November, 2016. Participants included 44 elderly women who were chosen out of the 120 elderly women who were referred to the day care center of Kahrizak sanatorium (Alborz Province) via the convenient sampling method. Inclusion criteria were- age between 60 to 80 years, willingness to join the study and signing the consent form, having medical approval that

certifies the person's ability to participate in physical activity and exercise routines, no history of hospitalization in the past 3 months as well as ability and availability to attend at least 80% of the Pilates exercise sessions.

Exclusion criteria were applying mobility-aids, suffering from any physical and mental ailments that can prevent them from continuing the exercise program and attending other concurring coherent exercise programs other than the routine workouts of the sanatorium. The selected participants signed written informed consent at the beginning of the intervention. Participants were allocated randomly into two groups (intervention group and control group) of 22 women each. Both groups continued with their routine exercises of the sanatorium. In addition, the intervention group practiced Pilates exercises (hourly sessions, three times per week for 8 weeks) under the supervision of a trained coach.

### Data collection

Demographic data was collected with the help of a questionnaire that helped in acquiring information regarding the age, marital status, education, height, weight, medical history, medicine intake, history of falling, age of menopause, smoking, past sport activities and presence of pain in different organs. The Fall Efficacy Scale – International (FES-I) was used to evaluate the outcomes of the exercise routine (possibility of falling). This questionnaire consisted of 16 questions that were specifically designed to evaluate the physical, social and functional aspects associated with the concern of falling.

The level of concern was measured on the Likert scale of 1 to 4, where 1=not at all concerned and 4=extremely concerned), with a score that can vary from 16 to 64. This questionnaire has already been validated in several countries as a reliable method of measuring FOF in elderly population [37]. The Persian version of FES-I that has already been approved by Khajavi ( $\alpha=0.98$ ) for its validity and reliability, was used in the current study [38]. Cronbach's alpha of 0.93 in the current research was gained. This Questionnaire was completed in two stages (before and after intervention).

### Intervention

Pilates exercise protocol of this study was derived from the protocol of Pérez [39]. These exercises were performed in the classical way on mattresses, including three parts of warm up with Pilates breathing and stretching exercises followed by the main workout session and finally cooling down. Exercises were divided into two

parts; the first week consisted of primary level pre-Pilates exercises (Table 1), and for the next seven weeks included core interventional exercising. The exercise protocol was further amended by adding new intermediate-level exercises that were decided on the basis of individualistic ability and readiness (Table 2). It was ensured that the participants reported no discomfort throughout the period of intervention. The control group continued routine workouts of the sanatorium (included stretching training) as usual.

### Data analysis

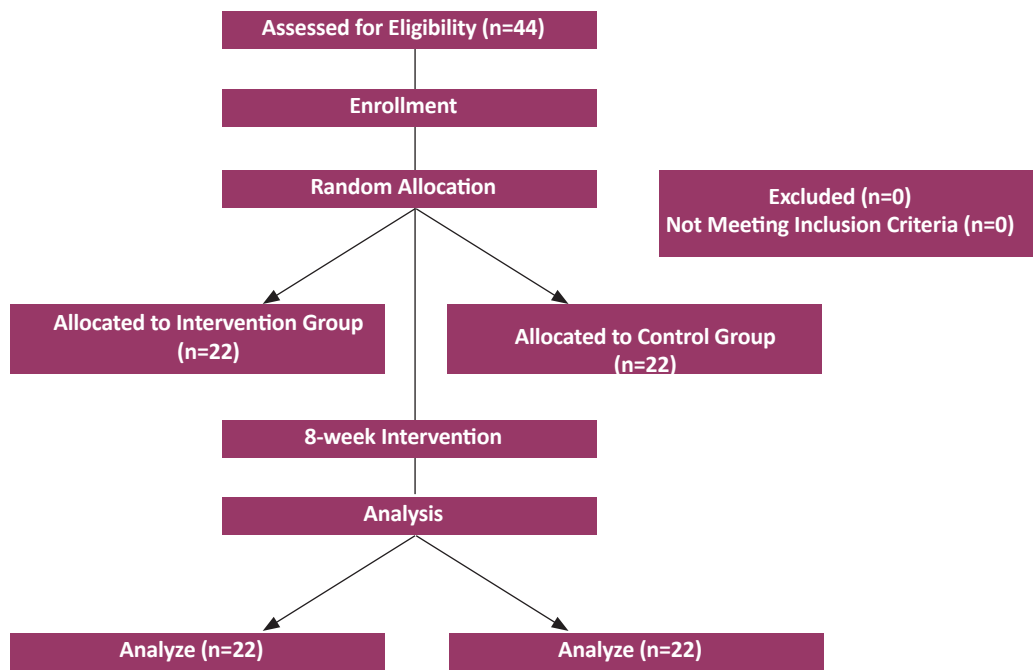
Descriptive Statistics used to summarize the participants' base-line characteristics included mean and Standard Deviation (SD) for continuous variable. Statistical tests, like the independent T-test and Chi-square test, were used for comparing the difference in demographic variables between the intervention and control groups. In order to compare the possible effects of Pilates on Fear of Falling (FOF), independent t-test and Paired samples t-test were used. In addition, Kolmogorov-Smirnov Test was applied to evaluate the normal distribution of variables. ANCOVA was used to assess the impact of the intervention while controlling the co-variant effects of age and the pre-test. Assumptions of normal distribution of scores and homogeneity of variance were evaluated. SPSS version 16 was used for data analysis.

### Ethical approval

The study was approved by the Ethics Committee of the University of Social Welfare and Rehabilitation Sciences (IR.USWR.REC.1395.352) and the Register Center for Clinical Trials of Iran (IRCT: 2017010431767N1). The purpose of the study was fully explained to the participants and it was ensured that all of them provided written personal consent. The consent form also ensured that the collected data of questionnaires will remain confidential.

## 3. Results

Forty-four elderly women who visited the Kahrizak daycare center, Alborz Province, participated in the study. All the participants completed the study protocol (22 allocated to intervention group and 22 to control group) (Figure 1). Their ages ranged between 60 to 80 years, with a mean age of  $68\pm5.9$  for the intervention group and  $71\pm4.1$  for the control group. It was noted that there was a significant difference between them ( $P=0.01$ ). However, both groups were found to be similar in terms of Body Mass Index (BMI). Chi-Square test results showed no significant difference between the two groups in terms



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Figure 1. Diagram of randomized control trial of effect of pilates exercise on fear of falling in elderly women

of education ( $P=0.2$ ), marital status ( $P=0.2$ ), living status ( $P=0.7$ ), past medical history ( $P>0.05$ ), medicine intake ( $P=0.2$ ), presence of pain in the body organs ( $P>0.05$ ), history of falling ( $P=0.5$ ), number of falls during past year ( $P=0.4$ ) and history of past exercises ( $P=0.6$ ) (Table 3).

The results indicated that there was no significant difference between the FES-I scores in the intervention

and control group in the beginning of the intervention ( $P=0.6$ ). However, a significant difference was observed in the values after the completion of the Pilates exercise intervention ( $P<0.001$ ) (Table 4). Also, mean difference of FOF between pre-test and post-test scores in the control group was [1] score while the Pilates group had [10] scores ( $P<0.001$ ) (Table 4).

Table 1. Planning classes in the first weeks: PM for beginner client

Prepilates Exercise (Lying Down)	Prepilates Exercise (Sitting Up)	Beginner Mat	Wall Series	Series With Weight (1 kg)
Exploring the power house	Towering above the hips	The hundred	Arm circle	Arm forward 90
Pushing the navel toward the spine	Lifting the knee	Rolling up	Rolling down	Arm to the side 90
Pushing the column toward the mat	Raising and lowering the shoulders	Leg circle	Sitting on the chair	Flexion of the forearm standing
Stretching the neck-chin leading toward the chest	Shoulder circles from one side to the other	Single leg stretching		
Rolling down	Looking toward the navel	Double leg stretching		
	Bringing the ear to the shoulder	Spine stretching forward		
	Half circle			

Source: Perez et al. (2014) [39]

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Table 2. Planning classes in the next seven weeks of intervention: PM for intermediate client

Level: Intermediate Mat	Repetition
The hundred	10 sets for 10 repetition
Rolling up	3
Leg circle	5 each way
Rolling like a ball	6
Single leg stretching	6
Double leg stretching	5
Single straight leg stretching	5 set
Double straight leg stretching	5
Criss-Crossing	5 set
Spine stretching forward	3
Open leg rocker	6
Corkscrew	3 set
Saw	3 set
Neck circle	1 each way
Single leg kicking	5
Double leg kicking	2 set
Neck pulling	3
Side kicking series: front-behind	5
Side kicking series: up-down	3
Small circle	5
Teaser 1	3
Sealing	6

Source: Perez et al. (2014) [39]

To illustrate the exact effects of the intervention on FOF by controlling age and pre-test score, ANCOVA test was applied. Data presented in Table 5 indicates that Pilates interventions led to a significant difference in FOF levels between the intervention and control group. Considering the pre-test scores and age as a co-variant variable ( $P<0.001$ ) and (Adjusted R Squared=0.89), and the intervention effect size was found to be 0.89 (Table 5). In other words, 89 percent of variance of post-test scores (FOF) was due to the Pilates intervention.

4. Discussion

This study was designed to investigate the possible effect so fan 8-weeks long Pilates exercise program on the levels of FOF among elderly women of Kahrizak sanatorium daycare center. The results showed that adding Pilates exercise to their routine daily workout

sat the sanatorium could significantly decrease FOF. It has already been established that FOF is a major health problem among the elderly living in communities and it is responsible for increasing the risk and chances of actually falling down. Participants receiving the Pilates intervention showed better results than the control group who continued with the routine daily workouts of the Sanitarium only. These findings were aligned with several previously conducted studies on the same topic viz. Arantes (2015), Olsen et al. (2014), Kendrick et al. (2014) [21-23].

Conventionally, decrease in muscle strength, balance, flexibility and gait alteration are associated with an increase in FOF levels. Hence, effectiveness of Pilates exercise in decreasing FOF can be directly linked with improvement in these parameters [9, 10]. Trombetti et al. (2016) showed that declining muscle mass, strength

**Table 3.** Demographic characteristics of participants at baseline for both groups

Variable		Pilates Group	Control Group	P
Age, mean(SD), y		68(5.9)	71(4.1)	0.01
BMI, mean(SD), kg.m <sup>2</sup>		30.63(2.9)	28.68(5.2)	0.1
Age of menopause, mean(SD), y		48(6.61)	45(10.9)	0.1
Falls in the past year, Mean(SD), n		1.54(1.79)	2(2.4)	0.4
Exercise length, mean(SD), y		2.3(0.9)	2.4(1.2)	0.6
Educational status, n (%)	Illiterate	11(50)	11(50)	0.2
	Elementary	5(22.7)	7(31.8)	
	Junior and diploma	6(27.3)	4(18.2)	
Marital status, n (%)	Married	11(50)	10(45.5)	0.1
	Divorced and widowed	11(50)	12(54.5)	
History of falls, n (%)	Yes	15(68.2)	17(77.3)	0.5
	No	7(31.8)	5(22.7)	
Living status, n (%)	With husband	11(50)	9(40.9)	0.7
	Alone	6(27.3)	6(27.3)	
	With children (s)	5(22.7)	7(31.8)	
Medical history, n (%)	Cardiac disorders	4(18.2)	2(9.1)	0.4
	Hypertension	16(72.7)	15(68.2)	0.7
	Muscle-skeletal disorder	17(77.3)	20(90.9)	0.2
	Metabolic disorders	9(40.9)	13(59.1)	0.2
	Respiratory disorders	1(4.5)	2(9.1)	0.5
	Visual-auditory disorder	12(54.5)	15(68.2)	0.3
Drugs intake n (%)	Cardiovascular drugs	18(81.8)	15(68.2)	0.3
	Blood sugar control drugs	8(36.4)	8(36.4)	1
	Analgesia and anti-depression	6(27.3)	4(18.2)	0.4
	Fat controlling drugs	7(31.8)	8(36.4)	0.7
	Thyroid drugs	3(13.6)	1(4.5)	0.2
Presence of Pain in different organs n (%)	Low back	8(36.4)	13(59.1)	0.1
	Knee	16(72.7)	17(77.3)	0.7
	Foot	5(22.7)	5(22.7)	1



Table 4. Outcome variable at baseline and post intervention for both groups

Test		Mean(SD)		df	P
		Pilates Group	Control Group		
FES-I (16-64 point)	Pre-test	32.9(5.6)	33.7(4.2)	42	P=0.6
	Post-test	22.18(2.8)	32.7(3.9)	42	P<0.001
		P<0.001	P<0.001		

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and power can independently contribute towards increasing the Fear of Falling (FOF) [40]. Inherently, muscle strength is known to decrease after the age of 30 years. It has also been proposed that the best solution to improve or at least maintain it, is by exercising [41]. In sports, such as Tai Chi and Pilates, role of stabilizer muscles, moving muscles and retroactive muscles, keep shifting constantly and this shifting helps in improving muscle strength [42]. The information presented in the articles published by Irez et al. (2011), Kao et al. (2015) and Kamali et al. (2016) suggest that Pilates is also one of the best exercises that can help in increasing muscle strength [30, 35, 43].

After muscle strength, Loss of Balance is the next strongest risk factor responsible for FOF. It is known to be related to numerous other factors, like reduced rate of muscle response, strength and depth receptors caused due to aging [44, 45]. Recent studies have shown that Pilates can help in increasing strength and postural stability. Furthermore, the basic principle behind Pilates exercise requires concentrating, coordinating and controlling body movements that are essentially the requirements of depth receptor stimulation. Hence, Pilates exercise is done by bearing one's own weight and focusing on the power center of the body which helps in improving postural stability and balance [46]. In addition, Kaesler et al. (2007) and Kamali et al.(2016) also indicated that Pilates can also be used for improving static and dynamic balance among the elderly [34, 47].

Conversely, Bird et al. (2012) reported no significant differences in static and dynamic balance between the

intervention and control group of similar Pilates exercise based studies [26]. Such anomalous results may also be attributed to low sample size (32 individuals) and method of the study (cross-over). Meanwhile, it should also be considered that reduced muscle strength in lower extremity leads to position the center of gravity in front of the ankle joint that impairs the balance. On the other hand, improved muscle strength could shift the center of gravity to the ankle and improve balance [48].

In the present study, it was observed that adhering to the Pilates exercise principles, such as body center contraction, concentration and Precision during the training, helped in strengthening of the abdominal muscles, improvement of standing up state and postural aspects of the body. These factors altogether result in improved balance and decrease the FOF in elderly women. The results obtained in the present study were found to be in line with the results reported by some of the previous studies which indicated that community based interventions could improve the professional roles of nurses and help in addressing the changes caused due to aging [49, 50].

Hence, it is proposed that nurses, as the member of elderly healthcare team, can play effective roles in improving the overall health status of elderly women, especially in community based service settings [50]. The findings should be particularly emphasized in countries like Iran where the socio-cultural conditions do not approve of acceptance of sports by women due to the supposed limitations of women in accomplishing physical activities. The findings of the present study can help in creating

Table 5. Effect of pilates intervention on fear of falling with controlling age and the pretest scores

Source	Sum of Squares	Mean Square	F	P	Partial Eta Squared
Age	2159.66	4906.88	0.96	0.3	0.02
Pretest scores	361.4	361.4	130.8	<0.001	0.76
Group	901.3	901.3	326.1	<0.001	0.89

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a new attitude towards the possible roles of exercising in decreasing the risk of falling and other related factors in the elderly population, especially elderly women. In addition, health care providers can use this study to formulate similar interventional strategies that can improve the quality of life of the elderly.

Having said all that, it should also be considered that the present study also had some major limitations, one among which is the possibility that the physical and psychological conditions of the participants during completion of questionnaires might have affected their responses. In addition, physiological differences among the selected individuals who participated in the study may have influenced the result. Most importantly these factors are out of the researcher's control and thus cannot be addressed.

## 5. Conclusion

Pilates exercise was found to be an effective solution that can reduce FOF in elderly women, which in turn may help in increasing their self-confidence for performing their daily activities without losing balance. It was found that these positive implications were due to the fact that adoption of the exercise program helped in improving muscle strength, flexibility and balance. Considering the importance of active and successful aging and role of physical activity and lifestyle on that, Pilates can be considered as a proper, non-violent, safe and medicine free intervention for the elderly women that must be taken into consideration by healthcare service providers, especially nurses.

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## Conflict of Interest

The authors declared that there is no conflicts of interest regarding the publication of this article.

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