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Research Paper

Investigation of the effect of clinical pilates on balance, coordination and quality of life in individuals over 65 years old

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Abstract

The aim of this study was to investigate the effect of pilates on balance, coordination, quality of life and fear of falling in the elderly.

The study was conducted through the participation of 55 volunteers all of whom were over 65 years of age. The mean age was 77.09 ± 8.07 years. The individuals were divided into three groups: pilates group (n=19), gait group (n=18) and sedentary group (n=18). The pilates group participated in a 30-minute exercise program for 2 days a week for 3 months, and the gait group participated in a 30-minute brisk walking session 2 days a week for 3 months. SF-36 quality of life scale, Rivermead mobility test, Tinetti balance test and Tampa scale of kinesiophobia were applied to each group at the start of the study and the evaluations were repeated after the 3-months program. Pre- and post-exercise evaluation results of the pilates group demonstrated that there were significant changes in all the sub-parameters of the SF-36 quality of life scale ($p<0.05$). In addition, there was a significant difference in physical role limitation, emotional role limitation, pain and social function scores when compared with the control group ($p<0.05$). Significant differences were found in the pilates group between the pre- and post-exercise Tinetti balance and walking tests ($p<0.05$). Comparing the pilates and control groups, a significant difference was found in the walking test ($p<0.05$), while no significant difference was found in the balance test. However, in the Tampa Scale of Kinesiophobia, there was a significant improvement in the pilates group ($p<0.05$). A significant difference was also observed in the pilates group according to the Rivermead mobility index ($p<0.05$). Consequently, it was concluded that a 12-week Pilates exercise program has the potential to increase the quality of life, balance coordination and mobility while decreasing the fear of falling.

Keywords: pilates, balance, coordination, movement systems, quality of life

INTRODUCTION

Aging is defined as the gradual and irreversible loss of the physiological and psychological strength of individuals. Consequently, biological and psychological losses bring about social losses as well [1]. In the aging process, inactivity is becoming an increasingly important issue among Turks, who, traditionally, do not have high sport participation rates. According to the World Health Organization data, inactivity ranks 4th among the causes of death worldwide. Furthermore, as a result of inactivity, individuals become more dependent on their environment due to a lack of balance coordination and poor quality of life. Exercise is undoubtedly a way to improve this problem. It has been previously shown that exercise improves body composition, reduces the risk of diabetes and coronary artery disease, joint pain and depression, improves quality of life, prolongs life and prevents obesity [2]. One method of exercise is pilates which was developed by Joseph Pilates in the 1920s as a synthesis of balance, breathing and movement systems for the integrity of mind and body [3].

The International Pilates Federation has divided pilates exercises into 3 basic forms-classical or traditional pilates consisting of the original 40 high-load mat exercises of Joseph Pilates, fitness-based enhanced or adapted pilates and clinical pilates designed for disability prevention and rehabilitation. Conversely, the Australian Institute of Physiotherapy and Pilates has divided pilates into two groups- classical or traditional pilates and modified pilates. Additionally, there are authors who divide pilates exercises into two groups called clinical pilates and fitness pilates [4,5] as well as authors who distinguish "traditional" pilates from "Pilates-based" exercises. While traditional pilates trainers use the spring apparatus and a few accessories originally designed by Joseph Pilates to perform exercises with minimal movement, less repetition and speed, physiotherapists have added different non-traditional exercises and accessories to their training programs to benefit their patients.

From this perspective, the study was designed to raise awareness among the elderly living in nursing homes, most of whom are live sedentary lifestyles, about pilates which has become increasingly popular in Turkey and worldwide, ensures that they regularly do pilates as part of their lifestyle. Our hypothesis is that the exercise program will have a positive effect in terms of balance, coordination.

DATA AND METHODOLOGY

The participants in this study included 23 volunteers from the Nazilli Haluk Alıcık Nursing Home, 20 volunteers from the Horsunlu Municipality Nursing Home Elderly Care and Rehabilitation Center as the control group as well as 20 sedentary individuals living in their homes. The criteria that were used to determine whether an individual can participate in the study are given in Table 1.

Participants inclusion in the study was confirmed to be after an analysis of their health status reports archived in the registered nursing homes in conjunction with an assessment by the physician of the relevant nursing home. Participants were initially verbally informed about the application and subsequently, their written consent was obtained.

The pilates group received 30 minutes of pilates exercises, 2 days a week for 3 months. The gait group was given a program that involved 30-minutes of brisk walking, 2 days a week for 3 months.

All evaluations were made individually by the researcher on the first day of the study and 12 weeks after the last exercise day. 4 people from the pilates group were excluded from the group since they discontinued the exercise program for health or other reasons. In addition, 2 people from the gait group left the group voluntarily due to health problems while 2 people from the sedentary group chose to leave the study. As a result of these changes, the study was completed with the pilates group (n=19), gait control group (n=18) and sedentary control group (n=18).

Accordingly, the pilates group was evaluated before and after the 12-week exercise program; the elderly in the first control group were evaluated before and after the 12-week walking program and the sedentary elderly in the second control group were evaluated by allotting 12 weeks between the first measurement and the last measurement. A questionnaire regarding their personal details was given to the volunteers and included questions regarding their gender, age, weight, body mass index, smoking habits, and medication use.

Table 1. Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
Aged over 65 years	A neurological problem preventing exercise
Willing to participate in the program	Orthopedic problems preventing exercise
Stable medical condition	Severe visual impairment
No known systemic disease	Pulmonary disease such as chronic obstructive pulmonary disease causing dyspnea
Adequate mental and cognitive functions	Acute cardio vascular diseases
Not bedridden	Systemic diseases such as dementia or Alzheimer's disease
	Participating in another exercise program

Short-form SF-36 was developed by the Rand Corporation to assess the quality of life [6]. It was translated into Turkish in the reliability and validity study conducted by Koçyiğit et al. [7]. In this process, a physical indicator score is calculated by taking the mean values of physical function, physical role limitation, body pain and general health perception, while a mental indicator score is calculated by taking the mean values of vitality, social function, emotional role limitation and mental health scores. The subscales evaluate health on a scale from 0 to 100 where 0 indicates poor health and 100 indicates good health.

Akın et al. conducted a reliability and validity study of the Turkish version of the Rivermead Mobility Index in 2007 and this questionnaire is used to measure basic mobility status. It consists of 14 questions and 1 observation. 1 point is given for each 'yes' response. The total score is between 0-15. 15 points indicate that there are no mobility problems, whilst 14 and below indicate increasing mobility problems [8].

The Tinetti Balance Test was developed by Mary Tinetti to evaluate patients at high risk of falling. The Turkish reliability and validity study of the Tinetti Balance and Gait Scale was conducted by Duygu Ağırcan [9].

In the test, the first 9 questions evaluate the balance, and the next 7 questions evaluate the gait. In the evaluation made based on observations, 2.1 and 0 points are given according to the level of movement. If the total score of the scale is 18 or less, the risk of falling is high, 19-24 indicates that the risk of falling is moderate and 24 or above indicates that the risk of falling is low [9].

The original Tampa Scale of Kinesiophobia (TKS) was developed in 1991 by Miller, Kopri, and Todd, but was not published at that time. With the permission of the researchers who developed it, Vlaeyen et al. published the original scale consisting of 17 questions in 1995 [10]. The Turkish reliability and validity study of the scale was conducted by Tunca et al. The scale was developed to measure the fear of injury in work-related activities [11].

In the scale, 4-point Likert scoring was done as 1=strongly disagree, 2=disagree, 3=agree, 4=completely agree. 4,8,12 and 16th articles are reversed to calculate the score. On the scale which has a total score between 17-68, increasing scores indicate that kinesiophobia increased.

Timed up and go test is a test for evaluating functional mobility. The participant sits in a chair without armrests and is told to stand up and walk up to the sign 3 meters away and return to the chair. The elapsed time is measured with a stopwatch. In this assessment, the risk of falling is defined as high if the time taken is 14 seconds or more.

The pilates exercises were performed sitting or standing depending

on the patient's condition and a yellow pilates resistance band was added to some exercises after 6 weeks to make the movements more challenging.

STATISTICAL ANALYSIS

For the statistical analysis of the data in this study, IBM SPSS Statistics 16 (IBM SPSS (International Business Machines Statistical Package for the Social Sciences), Turkey) statistical software was used. The results of the analysis were considered within a 95% confidence level and $p<0.05$ was considered statistically significant.

In addition to SF-36 quality of life index, Tampa Scale of Kinesiophobia, Tinetti Balance and Gait Scale, Rivermead Mobility Scale and timed up and go test, the 'Wilcoxon' test was used for in-group evaluation of the pilates, gait and sedentary groups, while 'One Way Anova' test was used to find out whether there was a significant difference among the groups.

FINDINGS

A total of 55 people participated in the study. 19 of the participants constituted the pilates group, 18 the gait control group and the other 18 constituted the sedentary control group. 40% (n=22) of the volunteering participants were female and 60% (n=33) were male.

The mean age of all volunteers was 77.09 ± 8.07 years. The mean age of the pilates group was 76.26 ± 6.88, the mean age of the gait control group was 75.50 ± 7.43, and the mean age of the sedentary control group was 79.55 ± 9.56.

While 80% of the participants were non-smokers (n=44), 20% (n=11) were smokers. 13.6% of the smokers were female (n=3), 24.2% were male (n=8), and 86.4% of the non-smokers were female (n=19) and 75.8% were male (n=25).

The mean Body Mass Index (BMI) of all volunteers was 26.96 ± 3.52, the mean BMI of female volunteers was 27.90 ± 4.00 and the mean BMI of male volunteers was 26.34 ± 3.07. Analyzing the risk of fall before treatment, it was found that 57.9% (n=11) of the pilates group, 38.9% (n=7) of the gait group and 50% (n=9) of the sedentary group did not have a fall risk.

In addition, the pilates group completed the timed up and go test in 14.47 ± 4.29 seconds, the gait group in 15.17 ± 3.99 seconds and the sedentary group in 14.28 ± 3.79 seconds on average. When evaluating the fall risk of all of the patients after treatment, it was observed that 52.6% (n=10) of the pilates group, 44.4% (n=8) of the gait group and 50% (n=9) of the sedentary group had no risk of fall.

Additionally, the pilates group completed the timed up and go test in 13.05 ± 3.85 seconds, the gait group in 14.03 ± 3.65 seconds and the sedentary group in 14.33 ± 4.13 seconds on average after the treatment.

Table 2 shows the intra-group and inter-group comparison of the mean values of the sub-parameters of the Short Form 36 (SF-36)

Table 2. Intra-group and inter-group comparison of short form-36 mean values of the cases

	Pre-treatment Mean ± SD	Post-treatment Mean ± SD	Wilcoxon		One way ANOVA			
			Z	p	F	P	Tukey	
							Group	p*
Physical Function								
Group 1	41.32 ± 26.66	46.84 ± 27.95	-2.091	0.037	8.635	0.001	1-2	0.076
Group 2	44.72 ± 23.48	46.39 ± 22.67					2-3	0.150
Group 3	50.00 ± 12.83	48.33 ± 12.95					1-3	0.000
Physical Role Limitations								
Group 1	31.58 ± 41.53	53.95 ± 39.32	-2.971	0.003	3.848	0.028	1-2	0.441
Group 2	40.28 ± 41.25	51.48 ± 35.87					2-3	0.290
Group 3	29.17 ± 28.76	26.39 ± 29.04					1-3	0.021
Emotional Role Limitations								
Group 1	28.06 ± 40.45	59.66 ± 42.43	-3.527	0.000	4.858	0.002	1-2	0.480
Group 2	40.73 ± 43.62	59.75 ± 39.02					2-3	0.148
Group 3	27.75 ± 26.17	25.90 ± 29,24					1-3	0.009
Body Pain								
Group 1	54.08 ± 28.03	72 ± 24.76	-2.102	0.036	11.989	0.000	1-2	0.001
Group 2	59.28 ± 31.00	59.50 ± 28.57					2-3	0.781
Group 3	54.58 ± 16.12	51.67 ± 15.29					1-3	0.000
General State of Health								
Group 1	32.11 ± 17.66	42.63 ± 21.56	-3.58	0.000	13.09	0.000	1-2	0.021
Group 2	39.17 ± 22.44	42.78 ± 22.44					2-3	0.000
Group 3	48.61 ± 11.48	46.39 ± 13.48					1-3	0.064
Social Function								
Group 1	43.82 ± 25.70	59.47 ± 19.33	-2.393	0.017	7.566	0.001	1-2	0.021
Group 2	47.64 ± 19.30	50.14 ± 22.54					2-3	0.610
Group 3	43.75 ± 15.01	41.67 ± 14.85					1-3	0.001
Mental Health								
Group 1	46.47 ± 17.61	52.32 ± 17.57	-3.700	0.000	12.529	0.000	1-2	0.160
Group 2	56.89 ± 12.84	60.22 ± 11.60					2-3	0.010
Group 3	53.56 ± 15.22	52.44 ± 15.39					1-3	0.000
Vitality								
Group 1	37.26 ± 18.73	47.32 ± 22.69	-3.714	0.000	12.153	0.000	1-2	0.179
Group 2	49.44 ± 23.45	55.28 ± 21.32					2-3	0.010
Group 3	47.78 ± 16.56	46.39 ± 16.87					1-3	0.000

Group 1=Pilates Group; Group 2=Gait Group; Group 3=Sedentary Group
SD: Standard Deviation; CR: Confidence Range; LSD: Least Significant Difference
p*: Significance level is accepted as $p<0.05$

quality of life scale. Intra-group evaluation results showed a statistically significant improvement in physical function sub-parameter (p=0.037). There was also a significant difference in physical function among the groups (p=0.001). Analyzing the difference of the experimental group- the pilates group – from the other two control groups, it was observed that there was a more significant difference in the sedentary group than the gait group (p=0.000 and p=0.076, respectively). A statistically significant improvement was observed in the intra-group sub-parameter of physical role limitation (p=0.003). However, there was no significant improvement in the physical role sub-parameter in inter-group comparison (p=0.028). There was a significant difference between the pilates and the sedentary group only (p=0.021). No significant difference was found between the pilates group and the other control group, the gait group (p>0.05).

There was a statistically significant improvement in intra-group and inter-group emotional role limitation sub-parameter (p=0.000 and p=0.002, respectively). In terms of the emotional role limitation result score, a significant difference was observed between the pilates group and the sedentary control group only (p=0.009). There was no significant difference between the pilates and gait groups (p>0.05).

Intra-group evaluation of the pain sub-parameter demonstrated that there was a statistically significant improvement in pain (p=0.036). Evaluating the inter-group values via the 'One Way Anova' test, it was found that there was a statistically significant improvement in the pain sub-parameter (p=0.000). In terms of statistical data showing the outcome scores of the pain sub-parameter, the pilates group was compared to the gait and sedentary group and the sedentary group was found to have a more significant improvement than the gait group (p=0,000 and p=0.001, respectively). The intra-group evaluation results showed that there was a statistically significant improvement in the general state of health sub-parameter (p=0.000). Significant improvement was also observed in inter-group evaluation of the general state of health (p=0.000). When the pilates group was compared with the other control groups, the gait group showed a higher significant difference compared to the sedentary group (p=0.021 and p=0.064, respectively). However, the difference between the gait and the sedentary group was the most significant (p=0.000).

Intra-group evaluation of social function showed that there was a statistically significant improvement (p=0.017). In the same manner, there was a significant improvement in the social function sub-parameter as a result of the inter-group evaluation (p=0.001). While there was a statistically significant difference between the pilates and the sedentary group only (p=0.001), there was no significant difference between the gait group and the pilates or the sedentary group (p>0.05).

Intra-group mental health sub-parameter evaluation results showed statistically significant improvement (p=0.000). In this regard, there were significant differences among the mental health scores of the groups (p=0.000). A significant difference was found when the pilates and gait groups were compared with the sedentary group (p=0,000 and p=0.010, respectively). On the other hand, there was no significant difference between the pilates and the gait group (p>0.05). There was a statistically significant improvement in intra-group vitality sub-parameter evaluation results (p=0.000). In addition, significant differences were found in inter-group vitality assessments (p=0.000). As a result of the comparison of the pilates and the gait group with the sedentary group, the difference in the pilates group was more significant than the gait group (p=0,000 and p=0.010, respectively). Nevertheless, no significant difference was found between the gait and pilates groups (p>0.05).

Table 3 shows the intra- and inter-group comparison of the Tinetti Balance and Gait Test mean values of the cases. There was a statistically significant improvement in the Tinetti Balance Score in the intra-group comparison results (p=0.000). When the inter-group values were evaluated with 'One way ANOVA' (Analysis of variance) test, a significant improvement was found in the Tinetti Balance parameter (p=0.000). A significant result was found in the comparison of the pilates group with the gait and sedentary groups. However, the results of the comparison with the sedentary group were more significant than the gait group (p=0.000 and p=0.011, respectively). There was a statistically significant improvement in the Tinetti gait score in the intra-group evaluations (p=0.000). When the inter-group values were evaluated via the 'One way ANOVA' test, however, a statistically significant improvement was also observed in the Tinetti gait parameter (p=0.002). A significant difference was observed in a comparison of the pilates and gait groups to the sedentary group in terms of changes in the Tinetti gait result score (p=0.003 and p=0.015). However, there was no significant difference between the pilates and gait groups (p=0.792).

Table 4 shows the intra- and inter-group comparison of the Tampa Scale of Kinesiophobia mean values of the cases. There was a statistically significant improvement in the intra-group evaluation results (p=0.000). Similarly, there was a statistically significant improvement in the inter-group evaluation results as well (p=0.000). When the pilates group was compared to gait and sedentary groups, there was a significant difference in the sedentary group compared to the gait group (p=0.002 and p=0.000, respectively).

Table 5 shows the intra- and inter-group comparison of the Rivermead Mobility Index mean values of the cases. There was a statistically significant improvement in intra-group evaluation results (p=0.001). Similarly, there was a statistically significant improvement in the inter-group evaluation results (p=0.023). Moreover, a significant improvement was observed in the comparison of the pilates and sedentary groups only (p=0.018).

Table 3. Intra-group and inter-group comparison of Tinetti Balance and Gait Test mean values of the cases

	Pre-treatment Mean ± SD	Post-treatment Mean ± SD	Wilcoxon		One way ANOVA			
			Z	p	F	p	Tukey	
							Group	p*
Balance								
Group 1	16.05 ± 7.26	17.26 ± 6.84	-3.519	0.000	9.192	0,000	1-2	0.011
Group 2	16.72 ± 6.96	17.06 ± 6.83					2-3	0.504
Group 3	14.00 ± 4.45	14.00 ± 4.54					1-3	0.000
Gait								
Group 1	6.68 ± 2.65	7.26 ± 2.00	-3.581	0.000	6.946	0.002	1-2	0.792
Group 2	6.50 ± 2.18	7.22 ± 1.83					2-3	0.003
Group 3	5.67 ± 1.37	5.61 ± 1.42					1-3	0.015

Group 1=Pilates Group; Group 2=Gait Group; Group 3=Sedentary Group
SD: Standard Deviation; CR: Confidence Range; LSD: Least Significant Difference
p*: Significance level is accepted as p<0.05

Table 4. Intra-Group and Inter-Group Comparison of Tampa Scale of Kinesiophobia mean values of the cases

	Pre-treatment Mean ± SD	Post-treatment Mean ± SD	Wilcoxon		One way ANOVA			
			Z	p	F	p	Tukey	
							Group	p*
Group 1	42.21 ± 13.85	36.37 ± 11.73	-4.766	0.000	15.587	0.000	1-2	0.002
Group 2	38.44 ± 11.12	36.28 ± 9.98					2-3	0.146
Group 3	40.89 ± 10.67	40.72 ± 10.54					1-3	0.000
Group 1= Pilates Group; Group 2=Gait Group; Group 3=Sedentary Group SD: Standard Deviation; CR: Confidence Range; LSD: Least Significant Difference p*: Significance level is accepted as p<0.05								

Table 5. Intra-group and inter-group comparison of **rivermead mobility index** mean values of the cases

	Pre-treatment Mean ± SD	Post-treatment Mean ± SD	Wilcoxon		One way ANOVA			
			Z	p	F	p	Tukey	
							Group	p*
sBalance								
Group 1	10.68 ± 4,56	11.21 ± 4.25	-3,234	0.001	4.052	0.023	1-2	0.559
Group 2	10.50 ± 3,60	10.83 ± 3.37					2-3	0.192
Group 3	9.56 ± 3,01	9.56 ± 2.87					1-3	0.018
Group 1=Pilates Group; Group 2=Gait Group; Group 3=Sedentary Group SD: Standard Deviation; CR: Confidence Range; LSD: Least Significant Difference p*: Significance level is accepted as p<0.05								

DISCUSSION

Literature review in this regard demonstrates that our study is compliant with other studies in general in terms of age distribution and mean age. [12]. According to the evaluation results, there were statistically significant differences in the physical function, the general state of health, social function, physical health and mental health sub-parameters of the SF-36 quality of life scale, while there was no statistically significant difference in the other variables. In our study, in addition to these parameters, significant differences were also found in the physical role limitation, emotional role limitation and pain parameters of the same scale. It is important to note that the duration of the exercise program and the type of exercises performed in our study were similar to those of Kılınç et al. [1].

Since a sedentary lifestyle in conjunction with a lack of sport participation is quite common in Turkey for individuals of all ages and particularly the elder population, the risk of falls and imbalance is considered to be higher particularly for the older community. Hence, in our study, the mean duration of timed up and go test was determined to be 14.64 ± 3.97.

In the study of Kılınç et al., Babayiğit et al., Mokhtari et al. and the specialization study of İrez Babayiğit, the exercise group received sessions 3 days a week for 12 weeks. In our study, the relevant groups applied exercise sessions 2 days a week for 12 weeks in order to ensure continuity [1,12,13].

In the literature, pilates exercises are mostly found in studies related to balance, fall frequency and depression in the elderly. In a study by Bird et al., the effect of Pilates exercise on static and dynamic balance was investigated in 27 participants with a mean age of 67.3 ± 6.5 years; and after a 5-week exercise program, a positive increase in balance was observed in the pilates group, however, no significant results were obtained when compared with the control group [14]. In a study by Mokhtari et al. [13], 12 weeks of pilates exercise was applied to individuals in the age range 62-80 years (n-15), all of whom with a tendency to fall in order to investigate whether pilates had an effect on balance and depression. According to the results, depression decreased, and balance improved after undertaking pilates exercises.

In the present study, both mental and emotional and physiological improvements were observed in the elderly according to the pre- and post- clinical pilates training evaluations. Pilates has also been found to improve balance, reduce the fear of injury or movement, and generally increase mobility within or outside the living area.

CONCLUSION

It can be concluded, as a result of the pre- and post-treatment evaluations of pilates exercises, that pilates does not have a positive effect in reducing the risk of falling, however, it has positive physical, mental and sensory effects- which form the quality of life- improves balance and coordination, reduces the fear of movement and increases the capacity of mobility.

It is observed that exercise and particularly clinical pilates, which was analyzed in this study, has a role both in the psychological and physical activities of the elderly. When elderly people do this type of exercise, their self-confidence increases, and they start to communicate with other elderly people living in the same nursing home and are less likely to become inactive individuals.

In conclusion, the strengths of the study include the use of inter-group measurements, the age range of the cases was at an optimum level, and the reliability and validity of the measurement methods are available. However, the weaknesses of the study included limited participation because we trained only a specific population, and therefore, the number of samples was low, there was a lack of detailed grouping for measurements, the responses of the participants were variable, there was no suitable location for bed-based exercises, and the diversity of the exercise program was limited. This study is expected to be a source of inspiration for future studies in this field.

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