



## Research Article

# Pilates-Based Training for Postural Stability in Patients with Schizophrenia

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## ABSTRACT

**Objectives:** Impairment in postural stability is prevalent in schizophrenia patients and this poses potential hazards. This study was planned to investigate whether the Pilates-based training improve the postural stability of patients with schizophrenia.

**Methods:** Outpatients with schizophrenia were allocated to either Pilates exercise group (n=10), or control group (n=10) receiving no exercise. Pilates exercise group participated in supervised Pilates mat exercise program twice per week for six weeks, while the control group participated in no regular physical activity during study. Biodex Balance System was used to assess the participants' postural stability at the baseline and after six weeks.

**Results:** Statistical analysis revealed that Pilates exercise group showed significant improvement in terms of overall and medial/lateral postural stability scores in static condition ( $p < 0.05$ ). Also, overall and anterior/posterior index scores on left leg, overall and medial/lateral index scores on right leg decreased after training ( $p < 0.05$ ). Postural stability scores in dynamic condition, medial/lateral index score on left leg and anterior/posterior index score on right leg did not change in the Pilates exercise group ( $p > 0.05$ ).

**Conclusions:** Our results showed that Pilates-based training benefit and suggest potential particular benefits in terms of postural stability in patients with schizophrenia. Pilates exercise can be added to the rehabilitation program of schizophrenia patients as a safe and effective method. Future research should include comparative exercise groups in order to determine any particular advantage to Pilates-based training in schizophrenia.

## INTRODUCTION

Motor dysfunction, postural control disorders, balance and gait abnormalities are prevalent in schizophrenia due to the nature of the disease, intensive antipsychotic drug and/or alcohol use [1,2]. Dysfunction of motor, cerebellar and sensory integration causes deterioration in postural stability, and postural instability may adversely affect daily living activities, increase the risk of falls, cause serious injuries, aggravate cognitive symptoms, and prolong hospitalization [2-4].

Some previous studies reported that postural sway was

related with increased symptom severity while others stated this condition was independent of clinical characteristics in patients with schizophrenia [4-6]. Additionally, since postural instability which is common in patients with schizophrenia is expected to affect their physical function and daily living adversely, it is clinically important to regard and to improve postural control and balance mechanisms in this population [1,2].

Heretofore the knowledge obtained about schizophrenia patients point out holistic approaches such as exercise should be included to the treatment for the management of the symptoms in this complicated disease [7,8]. Researchers showed that mental and functional symptoms can be reduced with exercise and physical activity in patients with schizophrenia [9-11]. However, only one study investigated the effect of an exercise method on postural stability of schizophrenia patients in the literature, despite potential promise of exercise therapy to improve postural stability.

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That study investigating the effect of yoga therapy on postural stability in schizophrenia patients showed that yoga therapy had positive effects on postural stability, but these effects were transient [12].

Pilates exercises have an increasing popularity among the general population in the last decades [13]. It has also been used by clinicians and researchers to improve the individuals' physical fitness, posture, muscle strength and functional performance. Previous studies have reported that the holistic approach of Pilates-based training can provide positive influence in the management of various diseases [14-16]. In addition, there are studies in the literature showing that Pilates exercises increase balance and postural stability in elderly individuals, dancers and athletes [17-20]. However, there are almost no studies or reports in terms of the effects of Pilates-based training on postural stability in schizophrenia patients.

Literature reported that prospective exercise intervention would be worthy of investigation to enhance postural stability in an effort to prevent falls in patients with schizophrenia-spectrum disorders [2]. The current study aimed to investigate the effects of Pilates-based exercise training on the postural stability of schizophrenia patients. Our hypothesis was that Pilates-based training would improve the postural stability in outpatients with schizophrenia.

## METHODS

### Experimental approach to the problem

This single-blind, controlled, experimental study was conducted with the patients who were diagnosed with schizophrenia according to The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) [21]. Inclusion criteria were having symptoms of schizophrenia for at least six months, not to change the type of antipsychotic medication prescribed for at least six weeks prior to study (although dosage may change) and willingness to participate in groups [22]. Exclusion criteria were any additional neurological or medical diseases, or any other condition that impairs postural stability. Patients with a severe physical disability or a physical condition that makes their participation impossible or potentially harmful (such as serious musculoskeletal or neurological disabilities) were also excluded from the study [23, 24]. Twenty-five individuals were assessed for eligibility, 2 were excluded, and 23 were enrolled into the study. On receipt of a completed consent form, individuals were assigned to the Pilates-based exercise group (PEG) or the control group (CG) based on their willingness. The PEG participated in 6-week supervised Pilates-based exercise training twice a week; while the CG participated in a routine non-specific activity program in Community Mental Health Center. Finally, 10 individuals with schizophrenia from each group completed the study (Figure 1).

Ethical approval for this study was obtained from the Clinical Research Ethics Committee of Zonguldak Bülent Ecevit University (Protocol no: 2015-84-21/10). All the

individuals volunteered to participate in this research and signed the informed consent form.

### Procedure

Both groups received the similar medication (atypical antipsychotic drugs) during the study. Antipsychotics were described in cumulative dosage (clozapine, 40 : 1; olanzapine, 2.5 : 1; risperidone, 1 : 1; aripiprazole, 3.75 : 1). CG had no additional intervention to pharmacological treatment. They maintained their normal sedentary activities for six weeks. PEG participated in a supervised Pilates-based training program twice per week for six weeks (totally 12 sessions). Previous research demonstrated that 6 to 8 weeks of Pilates training improves physical and psychological health [25, 26]. Besides, six-week Pilates exercise protocol, which consists of two sessions per week, was revealed to contribute to physical and psychological well-being in healthy individuals [13]. Based on these results, we established the same protocol (twice per week for six weeks) in the current study. Outcomes of the participants were measured at the baseline and after six weeks.

Exercises were performed as group training and supervised by an experienced physiotherapist. They trained 50 minutes duration via a Pilates-based training protocol including a warm-up period, main exercises period, and a cool-down period. Pilates-based training protocol focused on core stabilization and alignment, included breath control (Appendix). Individual limitations were respected, and exercises were modified according to the subjects' capability. Therapist demonstrated each activity using verbal and visual instructions. All the exercises were performed coordinated in the group.

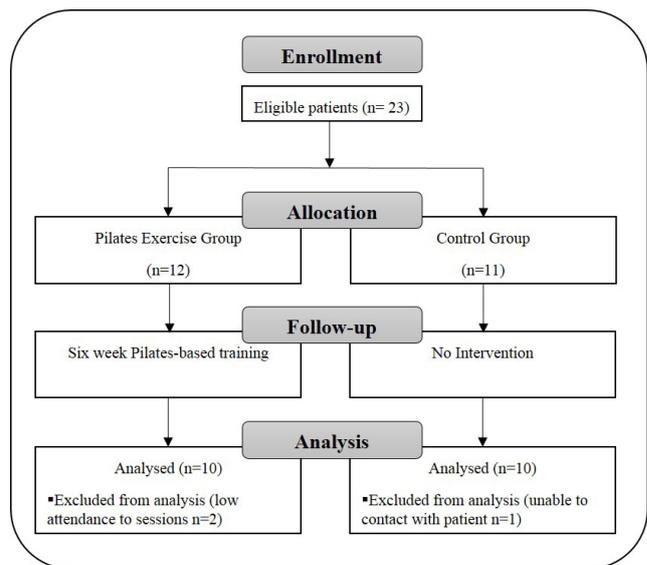


Figure 1. Flow diagram

**Outcome measures**

Demographic features including gender, age, weight, and height of the patients were recorded. Postural stability was assessed by Biodex Balance System (Biodex® Medical Systems, Shirley, NY, USA) which was indicated as a reliable balance device [27]. Biodex Balance System has a circular movable platform that allows up to 20° of surface tilt in all directions (Figure 2). Participants were evaluated in static (on stable platform), dynamic (on moving platform) and single leg (on each left and right legs) conditions. Overall (OA), anterior/posterior (AP), and medial/lateral (ML) stability scores were obtained from Biodex software (Version 3.1, Biodex Medical Systems). Higher stability scores indicate poor balance.

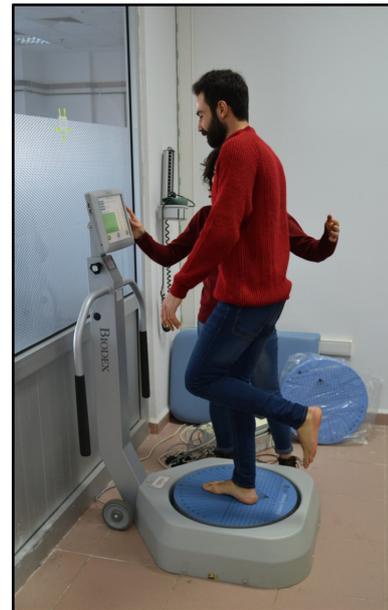
**Statistical analysis**

Data was evaluated using the Statistical Package for Social Science 18 (SPSS Inc., Chicago, IL, USA) program for Windows. The significance level was set to  $p < 0.05$ . Normality tests (visual and analytical) were conducted. Mann Whitney U test was used to compare age, height, weight, BMI (Body Mass Index) which were not normally distributed between groups. Chi-square test was used to compare sex ratio between two groups. Initial outcomes were compared between the groups using Mann-Whitney U test. Wilcoxon signed-rank test was used comparing intra-group analysis. Post-hoc power analysis was performed using G\* Power (Version 3.0.10 University of Dusseldorf, Germany).

**RESULTS**

Twenty-five individuals were assessed for eligibility, two were excluded, and 23 were enrolled into the study and allocated to either the PEG (n=12) or the CG (n=11). Finally, 10 individuals with schizophrenia from each group completed the study.

Demographic features of the participants including age, weight, BMI, and gender were similar in the both of the groups ( $p > 0.05$ ) (Table 1). Baseline assessments including postural stability scores were also similar in the both of the groups ( $p > 0.05$ ) except ML index score on right leg ( $p < 0.05$ ) (Table 2).



**Figure 2.** Postural stability assessment with Biodex Balance System

Statistical analysis revealed that PEG showed significant improvement in terms of OA and ML postural stability scores in static condition ( $p < 0.05$ ). Also, OA and AP index scores on left leg, OA and ML index scores on right leg decreased after training ( $p < 0.05$ ). Postural stability scores in dynamic condition, ML index score on left leg and AP index score on right leg did not change in the Pilates exercise group ( $p > 0.05$ ). Postural stability outcomes did not change in the CG ( $p > 0.05$ ), except OA index score in static condition and OA index score on left leg ( $p < 0.05$ ) (Table 3).

**DISCUSSION**

Present study was conducted to determine the influences of a six-week Pilates-based training on postural stability of schizophrenia patients. According to our results, Pilates-based training improves postural stability in terms of static and single-leg conditions in patients with schizophrenia.

Increased postural sway in schizophrenia patients is thought to be primarily depending on cerebellar abnormalities [4,28,29]. As another possible reason,

**Table 1.** Demographic features of the participants

	CG (n=10) Mean±SD	PEG (n=10) Mean±SD	P
Age (year)	39.13±6.69	40.40±8.40	0.573
Weight (kg)	86.00±19.46	73.44±8.69	0.190
Height (cm)	168.38±7.96	163.40±8.73	0.203
BMI (kg/m <sup>2</sup> )	29.79±5.61	27.42±3.28	0.364
Gender (f/m) <sup>a</sup>	3/5	5/5	0.596

Mann Whitney U test, <sup>a</sup>Chi-square test

CG: Control group, PEG: Pilates-based exercise group, SD: Standard deviation, BMI: Body mass index

**Table 2. Intra-group comparison of initial postural stability scores of the participants**

	CG (n=10) Mean±SD	PEG (n=10) Mean±SD	P
PSS-Static OA	1.79±1.82	1.85±1.42	0.762
PSS -Static AP Index	1.30±1.84	1.05±0.85	0.897
PSS-Static ML Index	0.81±0.79	1.23±1.38	0.762
PSS-Dynamic OA	2.61±1.38	2.27±1.04	0.887
PSS-Dynamic AP Index	1.74±1.05	1.43±0.58	0.813
PSS-Dynamic ML Index	1.56±0.87	1.39±0.99	0.740
PSS-Single Leg OA (L)	3.05±2.00	3.63±2.56	0.829
PSS-Single Leg AP Index (L)	2.20±1.88	2.63±2.27	0.829
PSS-Single Leg ML Index (L)	1.56±0.90	2.03±1.65	0.696
PSS-Single Leg OA (R)	2.21±1.55	3.05±1.09	0.109
PSS-Single Leg AP Index (R)	1.70±1.62	1.66±1.23	0.740
PSS-Single Leg ML Index (R)	1.03±0.40	2.04±1.10	0.043*

Mann Whitney U test, \*p<0.05

CG: Control group, PEG: Pilates-based exercise group, SD: Standard deviation, PSS: Postural stability score, OP: Overall, AP: Anterior/posterior, ML: Medial/lateral, L: Left, R: Right

**Table 3. Inter-group comparison of postural stability outcomes of the participants**

	CG (n=10)			PEG (n=10)		
	Baseline Mean±SD	Final Mean±SD	P	Baseline Mean±SD	Final Mean±SD	P
PSS-Static OA	1.79±1.82	0.98±0.71	0.034	1.85±1.42	0.68±0.39	0.037
PSS -Static AP Index	1.30±1.84	0.59±0.33	0.236	1.05±0.85	0.48±0.34	0.109
PSS-Static ML Index	0.81±0.79	0.61±0.59	0.058	1.23±1.38	0.36±0.22	0.041
PSS-Dynamic OA	2.61±1.38	2.28±0.88	0.279	2.27±1.04	1.65±0.60	0.066
PSS-Dynamic AP Index	1.74±1.05	1.40±0.72	0.138	1.43±0.58	1.06±0.47	0.155
PSS-Dynamic ML Index	1.56±0.87	1.50±0.65	1.00	1.39±0.99	1.05±0.51	0.674
PSS-Single Leg OA (L)	3.05±2.00	2.49±2.22	0.046	3.63±2.56	1.62±0.70	0.019
PSS-Single Leg AP Index (L)	2.20±1.88	1.85±1.99	0.092	2.63±2.27	1.02±0.60	0.005
PSS-Single Leg ML Index (L)	1.56±0.90	1.21±0.90	0.138	2.03±1.65	1.04±0.52	0.110
PSS-Single Leg OA (R)	2.21±1.55	2.71±2.22	0.752	3.05±1.09	1.62±1.11	0.028
PSS-Single Leg AP Index (R)	1.70±1.62	1.64±1.34	0.292	1.66±1.23	1.24±1.12	0.313
PSS-Single Leg ML Index (R)	1.03±0.40	1.89±1.67	0.249	2.04±1.10	0.76±0.49	0.007

Wilcoxon Signed Ranks Test

CG: Control group, PEG: Pilates-based exercise group, SD: Standard deviation, PSS: Postural stability score, OP: Overall, AP: Anterior/posterior, ML: Medial/lateral, L: Left, R: Right

balance deficiency might arise as a side effect of the atypical antipsychotic drug use [4]. In the literature, the majority of the exercise interventions in schizophrenia are standard steady-state aerobic exercises; coupled with progressive resistance and body relaxation and only one of these studies investigated the effectiveness of exercise therapy on postural stability [10,11,30-32]. Our results are consistent with the previous study investigating the effects of yoga therapy on postural stability in patients with schizophrenia-spectrum disorders in terms of providing positive influences on postural stability. According to the results of the study, a total length of trunk motion, the Romberg ratio, and ante-

flexion in standing of the participants were significantly improved in the yoga group at week eight [10]. In our study postural stability analysis indicated that OA and ML index scores in static condition and on right leg. Also, OA and AP index scores on left leg decreased while none of dynamic postural stability scores change after training. However, since the evaluation tool used in the previous study (Clinical Stabilometric Platform) was different from that in our study and the assessments of different parameters of postural stability, it is difficult to clearly demonstrate the consistency of the results.

The effectiveness of Pilates exercises was investigated

in the elderly population in which balance and postural stability problems are common. Although balance and postural stability problems in elderly individuals are not exactly same to those of schizophrenic individuals, previous studies showed that Pilates based exercise program may be effective in improving balance, mobility and postural stability to decrease fall risk in older adults [17,18].

Pilates as a mind-body integrity exercise method focuses on strength, core stability, flexibility, muscle control, posture and breathing [33]. In our study, the mechanisms explaining the improvement in postural stability were not investigated. However according to the results of a previous study, Pilates core stability training enhances motor performance skills by increasing lower extremity muscle strength and improving postural stability and can prevent musculoskeletal disorders and improve quality of life [34].

This study is unique in terms of investigating the effects of Pilates-based training on postural stability in patients with schizophrenia. But the small amount of sample size limits the exact outcomes indeed. Yet considering the characteristics of this disease such as problems in social interaction, concentration, and motivation, it is admissible even this study performed with a small number of participants and groups is valuable as an evidence-based trial.

## CONCLUSIONS

Postural instability is a common problem in schizophrenia and it is important to improve postural stability to protect patients from potential injuries. According to the results of the present study, a six-week Pilates-based training improves postural stability of patients with schizophrenia in terms of static and single leg conditions. Pilates exercise method can be added to the rehabilitation program of schizophrenia patients as a safe and effective method to improve postural stability.

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## Conflicts of Interest

The authors declare no conflict of interest.

## Supplementary Materials

Supplementary materials related to this article can be found at <https://doi.org/10.26644/em.2019.005>

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