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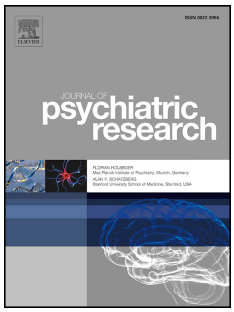

Effects of chair yoga therapy on physical fitness in patients with psychiatric disorders: A 12-week single-blind randomized controlled trial

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Effects of Chair Yoga Therapy on Physical Fitness in Patients with Psychiatric Disorders: A 12-Week Single-Blind Randomized Controlled Trial

Abbreviated Title: ***Chair Yoga for Physical Fitness***

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Abstract

***Introduction*:** Since falls may lead to fractures and have serious, potentially fatal outcomes, prevention of falls is an urgent public health issue. We examined the effects of chair yoga therapy on physical fitness among psychiatric patients in order to reduce the risk of falls, which has not been previously reported in the literature.

Methods: In this 12-week single-blind randomized controlled trial with a 6-week follow-up, inpatients with mixed psychiatric diagnoses were randomly assigned to either chair yoga therapy in addition to ongoing treatment, or treatment-as-usual. Chair yoga therapy was conducted as twice-weekly 20-minute sessions over 12 weeks. Assessments included anteflexion in sitting, degree of muscle strength, and Modified Falls Efficacy Scale (MFES) as well as QOL, psychopathology and functioning.

Results: Fifty-six inpatients participated in this study (36 men; mean±SD age, 55.3±13.7 years; schizophrenia 87.5%). In the chair yoga group, significant improvements were observed in flexibility, hand-grip, lower limb muscle endurance, and MFES at week 12 (mean±SD: 55.1±16.6 to 67.2±14.0 cm, 23.6±10.6 to 26.8±9.7 kg, 4.9±4.0 to 7.0±3.9 kg, and 114.9±29.2 to 134.1±11.6, respectively). Additionally, these improvements were observable six weeks after the intervention was over. The

QOL-VAS improved in the intervention group while no differences were noted in psychopathology and functioning between the groups. The intervention appeared to be highly tolerable without any notable adverse effects.

Conclusions: The results indicated sustainable effects of 20-minute, 12-week, 24-session chair yoga therapy on physical fitness. Chair yoga therapy may contribute to reduce the risk of falls and their unwanted consequences in psychiatric patients.

Key words: chair yoga therapy, fear of fall, flexibility, muscle strength, physical fitness

1. Introduction

A high incidence of falls has been reported in elderly patients who have been prescribed psychotropic medications (Bloch et al., 2011; Hill and Wee, 2012; Woolcott et al., 2009). In older individuals with psychiatric disorders, the chance of a fall that results in injuries is reported to be 1.5-4.5 times greater than in healthy controls (Finkelstein et al., 2007). The negative psychological experiences of falls are expected to result in a fear of recurrence, likely to reduce ADL, which in turn could impair QOL (Deshpande et al., 2008b). Therefore, it is highly desirable to prevent falls and to minimize any associated fears in this frail population in particular and thereby foster the potential for a better quality of life for these individuals.

Physical activity is typically recommended for seniors, and it has been identified to be an effective approach in preventing falls as has been shown in a recent meta-analysis (Stubbs et al., 2015a). This effectiveness is realized because enhanced physical activity is reported to reduce the severity of symptoms, and to derive multiple health benefits in anthropometric measures, aerobic capacity, QOL (Rosenbaum et al., 2014), cognitive

function (Firth et al., 2016), and depressive symptoms (Schuch et al., 2016) among patients with psychiatric disorders. It should be noted that skeletal muscle strength has an impact on postural stability and flexibility (Micheo et al., 2012; Rubini et al., 2007). Furthermore, postural stability and flexibility were found to represent separate constructs of physical fitness in patients taking antipsychotics (Ikai et al., 2016). In addition, a greater reduction in flexibility may be associated with an increase in negative symptoms in these patients (Ikai et al., 2016). A series of studies have underscored that there are high levels of sedentary behavior in people with psychiatric disorders. Consequently, there is a serious need for physical activity in such populations to promote and improve general health (Schuch et al., 2017; Stubbs et al., 2016; Vancampfort et al., 2016). However, depression, stress (Firth et al., 2016), aging, and a higher BMI (Vancampfort et al., 2016) are reported to be potential barriers against engaging in exercise in these patients. In this context, methods that may be useful for the general population may not be appropriate to derive clinical benefits, and specific strategies may be necessary as an effective intervention of falls in this particular patient population (Ikai et al., 2016).

Yoga consists of a wide variety of aspects that include an ethical lifestyle, spiritual practice, physical exercise, and the practice of meditation (Iyengar, 1996). In particular, Hatha yoga, a physically-oriented yoga style, contains an exercise component, involving postures that predominately strengthen and stretch the musculature. This might be an option for patients with chronic schizophrenia because of its feasibility of practice. Randomized controlled trials of yoga therapy in addition to ongoing antipsychotic treatment have found to be beneficial to mental state, social functioning, and quality of life in patients with chronic schizophrenia (Duraiswamy et al., 2007; Jayaram et al., 2013; Visceglia and Lewis, 2011; Xie J et al., 2006) although the data remain inconclusive (Broderick et al., 2015; Cramer et al., 2013b). However, there has been only one clinical trial that focused on the effects of yoga therapy on physical parameters (Ikai et al., 2013).

Chair yoga therapy is practiced by sitting in a chair, or standing while holding the chair for support. This practice seems promising, especially for older patients, since those who are unable to participate in the ordinal standing yoga, or exercise, can practice it

safely and conveniently (Galantino et al., 2012). In fact, previous studies have demonstrated the feasibility of chair yoga therapy (Galantino et al., 2012) as well as its beneficial effects on the fear of falls in seniors (Furtado et al., 2016). In light of the positive effects of yoga therapy on postural balance (Ikai et al., 2013), we hypothesized that chair yoga therapy should also be beneficial for patients with psychiatric disorders. To our knowledge, this has not been addressed in the literature.

In this 12-week single-blind randomized controlled trial, we evaluated the effects of 24 sessions of adjunctive chair yoga therapy on physical parameters, including flexibility, muscle strength and body balance, in inpatients with chronic psychiatric disorders. We also performed a 6-week follow-up assessment after the intervention to examine whether the effects of the intervention were persistent or transient.

2. Methods

2.1. Study Design

In this single-site, single-blind randomized controlled trial, twice weekly sessions of chair yoga therapy were added to the ongoing regular psychopharmacological treatment for a period of 12 weeks. A 6-week follow-up assessment to examine the sustainability of the effects was done as well. The study was conducted at the Minami-Hanno Hospital, Saitama, Japan between December 2014 and February 2016. This study was approved by the hospital's institutional ethics board. Written informed consent was obtained from all participants after a full description of the study was provided. The study was registered at the University Medical Information Network Clinical Trial Registry (Identifier : UMIN000015711). This study is reported according to the standard CONSORT guidelines.

2.2. Participants

Study participants were recruited via a flyer posted in the inpatient units of the hospital. In the present study, the following inclusion criteria were adopted: (1) 20 years, or older,

(2) inpatients, (3) ICD-10 diagnosis of psychiatric disorders (F0 - F9 according to the International Classification of Diseases, the 10th edition) (World Health Organization, 1992), (4) receiving treatment with the same antipsychotics for the previous 8 weeks before entry, and (5) the capability of providing voluntary informed consent. Participants with active alcohol abuse, or other psychiatric comorbidities were excluded. In this study, no other exclusion criteria were applied to ensure representativeness of the sample in the real-world clinical setting. Medications were kept constant by the participants' treating psychiatrists throughout the study period unless a change was clinically indicated.

2.3. Intervention

The participants were randomly assigned to either of the following two groups: chair yoga therapy group, or treatment-as-usual group. Randomization was stratified for sex and age, and was performed using computers by a research assistant (Ms. Ai Ohtani Gounaridis) at Keio University who was otherwise not involved in this study. Participants who were assigned to the chair yoga group received a 20-minute chair yoga

session, based on Hatha yoga, twice a week for 12 weeks, amounting to a total of 24 sessions. Each session consisted of chair yoga stretches and simple movements in coordination with breathing (gentle movements of major muscle groups), and asana: modified seated poses on chair, twisting poses on chair, supported standing poses on chair, etc. These are detailed in Supplementary Table 1. These sessions were provided as an adjunctive to routine treatment by a yoga instructor (S.I.), who was qualified as a Hatha yoga therapist, and were supported by two occupational therapists in the hospital. After the completion of the 12-week intervention, those in the intervention group received treatment as usual but did not receive any chair yoga therapy until the follow-up assessment was performed at 18 weeks after entry into the study. The participants in the control group were instructed to spend their time freely for twenty minutes (e.g. walking, reading, or chatting) each time. Following the completion of the 12-week observation, the participants in the control group were provided an opportunity to attend chair yoga sessions when they wished. The participants were receiving the same psychotropics, including antipsychotics, for the entire study period unless a change was clinically indicated. This was done since the reported negative

consequences of medications such as postural instability (Koreki et al., 2011) and reduced bone mineral density (De Hert et al., 2016; Takahashi et al., 2013) would not affect the results of this study.

2.4. Outcomes Measures

One of the outcome measures in this study was postural sway, which was measured using the Clinical Stabilometric Platform (CSP) (ANIMA® GS-7, Tokyo, Japan) between at baseline, week 12 and week 18. Postural sway is used to measure the range of the trunk motion by evaluating the resistance applied to the platform for 30 seconds with eyes closed, feet together, and arms down at the sides. The position of the center of pressure (COP) as the participants stand on the platform is calculated from forces and moments. The outcome parameter also includes the measure of COP sway area surrounded by an outer line, which is automatically calculated by this device and shown in cm^2; a smaller value indicates a better stability. The Romberg ratio is defined as a ratio of sway areas obtained with eyes open and eyes closed. Anteflexion in sitting is the flexibility of the lower extremities (lower back and hamstring); it is measured using the

long seat type body anteflexion measurement device (TOEI LIGHT®, Tokyo, Japan) at baseline, week 12, and week 18. This body anteflexion measuring device is able to measure flexibility easily and safely with the legs being stretched. For this test, each participant leaned forward as much as possible, pushing the measuring gauge away from their bodies with the tips of their fingers. Upper extremities were assessed using a grip dynamometer while lower extremities, and lower limb muscle endurance were assessed by using strength testing with a portable dynamometer (ANIMA® μTas-F-100, Tokyo, Japan) between the hours of 13:00 and 17:00 at baseline, week 12, and week 18, respectively. We also considered the intra-class correlations for this trial; in addition, two trails were individually recorded with the average value utilized for analysis.

The following clinical assessments were performed at baseline and week 12 by experienced investigators who were blind to subjects' allocations and were not involved in the sessions. The participants received the clinical assessments of psychopathology with the Positive and Negative Syndrome Scale (PANSS) (Kay et al., 1987) for schizophrenia, the Montgomery-Åsberg Depression Rating Scale (MADRS)

(Montgomery and Asberg, 1979), and the Young Mania Rating Scale (YMRS) (Young et al., 1978) for mood disorders, and the Mini Mental State Examination (MMSE) for dementia. For the assessment of extrapyramidal symptoms, the Drug Induced Extrapyramidal Symptoms Scale (DIEPSS) (Inada, 1996) was used. The functioning level of each person was assessed with the Targeted Inventory on Problems in Schizophrenia (TIP-Sz) (Suzuki et al., 2008) for schizophrenia, the Functional Assessment Staging (FAST) (Sclan and Reisberg, 1992) for dementia, and the Global Assessment of Functioning (GAF) (Jones et al., 1995) for all diagnoses. The following self-administered scales were conducted at baseline, and weeks 12 and 18. QOL was evaluated with the EQ-5D (Brooks, 1996). It consists of two parts: a health state description (index) and Visual Analogue Scale (VAS). Participants assessed their health on a 3-point Likert scale ranging from ‘0=no problem’ to ‘2=great problem’. The VAS provides a quantitative measure of health as judged by the individual respondents, which ranges from 0 to 100; a greater score represents better subjective health conditions. With regard to the fear of falls, the Modified Falls Efficacy Scale (MFES) in Japanese (Hill et al., 1996) was used. This self-assessment scale examines a degree of

perceived self-efficacy at avoiding a fall during basic activities from 0 (not at all confident) to 10 (completely confident) on 14 items (Hill et al., 1996). In addition to sex, age, height (cm), weight (kg), duration of illness (years after the diagnosis was determined), length of stay (years, or days), the number of falls in the past 12 months, physical comorbidity, waist circumference (cm), and psychotropic medication regimen, chlorpromazine equivalent dose of antipsychotics (Inagaki and Inada, 2008; Inagaki et al., 1999), the use of benzodiazepines, lithium, and anticonvulsants were examined as possible predictors of falls in an inpatient psychiatric population (Lavsa et al., 2010).

2.5. Statistical Analyses

For the primary efficacy measure of physical fitness, 25 participants in each group were required for a power of 80% at a two-side alpha of 0.05 to detect a treatment difference of 20% with a 25% standard deviation. Assuming a dropout rate of 10%, a total of 28 patients in each group were required. Statistical analyses were carried out, using the IBM SPSS Statistics Version 23 (IBM Corporation Armonk, NY). Subjects' baseline characteristics were compared between the two groups, using the chi-square test, or the

independent t-test. The Mann-Whitney U test was used for onset of illness, length of stay, falls in the past 12 months, GAF, EQ-5D, total length of the trunk motion, range of the trunk motion, Romberg ratio, lower limb muscle endurance, knee flexion strength to body weight ratio, and MFES since they were not distributed normally (by the Shapiro-Wilk test of normality). The mixed-effects model for repeated measures was used to compare the continuous outcomes between the chair yoga therapy group and the control group. Group and time main effects were included in the main analysis. Analyses were performed on an intent-to-treat basis. Where appropriate, post-hoc analyses were performed with Bonferroni correction. All tests were two-tailed and a *P*-value of <0.05 was considered statistically significant.

3. Results

3.1. Characteristics of Participants

Sixty-four patients were approached; of these, four patients did not agree to participate in this study because of little interest in any physical activities. Thus, 60 patients agreed to participate in this study. Among them, four participants were discharged from the hospital before the randomization. Consequently, a total of 56 participants entered the intervention phase. These participants were allocated to either the chair yoga therapy group (n=28), or the control group (n=28). Characteristics and disposition of participants are shown in Table 1, and Figure 1, respectively; there were no significant differences in all variables at baseline between the two groups. Forty-nine participants (87.5%) were diagnosed with schizophrenia, 3 with mood disorder (5.3%), 2 with dementia (3.6%), and 2 with chronic alcohol dependence (3.6%). Physical comorbidities were: constipation (33.9%, n=19), hypertension (18.6%, n=10), hyperlipidemia (16.0%, n=9), diabetes mellitus (8.9%, n=5), anemia (3.6%, n=2), low back pain (3.6%, n=2), seizure (1.8%, n=1), hepatitis C (1.8%, n=1), angina (1.8%,

n=1), and polyneuritis (1.8%, n=1). The most frequently used antipsychotic drug at baseline was haloperidol (30.8%, n=16), followed by risperidone (17.3%, n=9), olanzapine (13.5%, n=7), quetiapine (13.5%, n=7), aripiprazole (7.7%, n=4), perospirone (3.8%, n=2), and fluphenazine (3.8%, n=2). Twenty-three patients (41.1%) were receiving two or three antipsychotics. Use rates of benzodiazepine, lithium, and anticonvulsants are described in Table 1. Medication adherence was acceptable judging from participants' nursing medical records for both groups. Ten participants (5 participants in each group) experienced a minor change in their medication regimen during the 12 weeks.

3.2. Treatment Outcomes at week 12

Two participants (7.1%) in the yoga therapy group and 3 participants (10.7%) in the control group prematurely withdrew from the study, respectively. The reasons for withdrawal were: discharge from the hospital (2 participants in the yoga group), relapse (1 participant in the control group), and transfer to another hospital (2 participants in the control group). The mean total number of participation in the chair yoga intervention

was 20.0 sessions (max. 24). No side effects were reported by either of the groups.

The mixed-effects model for repeated measures demonstrated significant differences between the two groups (Table 2). Participants in the chair yoga intervention showed greater improvements in the anteflexion, hand grip, lower limb muscle strength, EQ-5D VAS, and MFES at week 12 compared to those in the control group. In the subgroup of schizophrenia patients that constituted 87.5% of the study population, improvements were not observed in the PANSS, DIEPSS, and TIP-Sz (Table 3). Moreover, no improvements were found in psychopathology and functioning level in those with mood disorder or dementia (data available on request).

3.3. Follow-up Assessment at Week 18

As shown in Table 4, the improvements in the flexibility, muscle strength, fear of falls, and QOL noted at week 12 were still apparent 6 weeks later at week 18 in the chair yoga group by the mixed-effects model for repeated measures.

4. Discussion

4.1. Main Findings

To the best of our knowledge, this is the first study to evaluate the effects of chair yoga therapy on physical fitness in inpatients with chronic psychiatric disorders. We found that a total of 24 sessions of chair yoga intervention over 12 weeks improved the flexibility, degree of muscle strength, fear of falls, and QOL at week 12 compared to the control group. In addition, these improvements were sustained for another 6 weeks after the intervention was over. These findings suggest the potential utility of chair yoga therapy to enhance physical fitness and to mitigate the fear of falls; therefore, this form of yoga therapy may aid in the reduction of falls and subsequently a reduction of fractures in patients with chronic psychiatric disorders.

4.2. Chair Yoga Therapy and Physical Activity

Yoga includes a variety of movements and poses that focus on the pivot of the body, which is practiced in coordination with breath control, meditation, and lifestyle changes

(Iyengar, 1996). Previous clinical trials have demonstrated the effectiveness of yoga therapy in gait, balance, and flexibility of the body among elderly people (Jeter et al., 2014; Roland et al., 2011; Schmid et al., 2010; Zettergren et al., 2011), and in postural stability among patients with schizophrenia (Ikai et al., 2013). Thus, yoga therapy has been considered as a means to improve the parameters of physical fitness in patients with psychiatric disorders as well. A point of interest, a pilot study in healthy people also showed that chair yoga therapy is a feasible and safe intervention for seniors (Furtado et al., 2016; Galantino et al., 2012). The results of the present study have demonstrated the potential of chair yoga therapy for positive effects on the parameters of physical fitness in people with psychiatric disorders.

4.3. Yoga Therapy and the Fear of Falls

The fear of falls has been reported to be associated with physical and psychological negative consequences (Deshpande et al., 2008a), and as a predictor of falls (Ersoy et al., 2009). Although exercise intervention reduces the fear of falls in the community-dwelling elderly, the effects do not seem to be sustainable after the

intervention (Kendrick et al., 2014). The average age of this study group, 55 years old, may not appear to qualify as an elderly group; however, given that patients with schizophrenia have, on average, a life expectancy that is 22.5 years shorter than the general population along with a higher risk of cardiovascular diseases (Tiihonen et al., 2009; Correll et al., 2017), the mean age of 55 years in our sample may be considered to be relatively old.

In the present study, a significant improvement in the MFES by approximately 15% was observed in patients with chronic psychiatric disorders, following the 12-week chair yoga therapy. These clinical gains were sustained for another 6 weeks after the intervention. Given that patients with chronic psychiatric disorders generally need to receive antipsychotics for years, and since these medications may render patients susceptible to falls as a side effect, the topic addressed herein represents a serious clinical issue. Actual long-term outcomes regarding prevalence of falls were not the focus of this study, which remains a critical issue to be addressed in the future.

4.4. Yoga Therapy and Prevention of Falls in Patients with Psychiatric Disorders

In addition to the reported high incidence of falls (Bloch et al., 2011; Hill and Wee, 2012; Woolcott et al., 2009), it should be noted that reduced bone mineral density could result from antipsychotic treatment. This may lead to severe fractures, which can have life-threating consequences if falls happen at all, where hyperprolactinemia and postural instability greatly matter (Gomez et al., 2016; Stubbs et al., 2014; Stubbs et al., 2015b; Takahashi et al., 2013; De Hert et al., 2016; Koreki et al., 2011). However, in clinical settings, some older patients are unable, or unwilling to participate in the ordinal standing exercises; depression, stress (Firth et al., 2016), aging, and higher BMI (Vancampfort et al., 2015) may hamper their engagement in exercises that require standing. In this context, simpler strategies might be appropriate as an effective intervention of falls in specific patient populations (Ikai et al., 2016). This topic is highly pertinent since as our society continues to age, there will be a subsequent increase in the numbers of chronic or elderly psychiatric patients, making prevention of falls a clinical priority.

Physical activities as well as individually tailored multifactorial interventions are recommended for the prevention of falls in the elderly (Stubbs et al., 2015a). Yoga

1 therapy has also been proven to enhance body awareness, where practitioners are
2 instructed to maintain sitting yoga positions with the eyes either opened or closed
3 (Cramer et al., 2013a). Therefore, a series of such brief poses in chair yoga therapy may
4 facilitate better muscle strength, and greater body flexibility, which are both expected to
5 exert protective effects against falls.
6
7 In the real world clinical settings, sedentariness, difficulties in attention, and
8 demotivation are considered to be obstacles to regular physical activities (Aubin et al.,
9 2009). However, it is critically important to point out that people with psychotic
10 disorders do like exercise, but they simply need help to engage in exercise (Soundy et
11 al., 2014). Continued reinforcement would be necessary to help patients maintain
12 motivation. Another consideration relates to neuroleptic-induced deficit syndrome
13 (NIDS) that causes sedation, sleepiness, and dysphoria in patients receiving
14 antipsychotics (Lewander, 1994). We previously showed that a 8-week standard yoga
15 session was insufficient to derive clinical benefits of resilience and metabolic markers
16 (Ikai et al., 2014), and to maintain the benefit of postural stability (Ikai et al., 2013).

Considering the obstacle of negative or deficit symptoms, a relatively user-friendly, less strenuous manner of intervention, as was adopted herein, may be useful in light of the limited feasibility of continuation of more rigorous forms of interventions.

4.5. Clinical implications

A twice-a-week 20-minute chair yoga intervention is relatively concise compared to conventional exercise interventions in terms of duration and intensity (Firth et al., 2017; Rosenbaum et al., 2014). The high completion rate in the present study would imply the feasibility and potential utility of chair yoga therapy in patients with chronic psychiatric disorders. To further optimize the chair yoga therapy, intensity, frequency, and duration of sessions warrant further investigations since our protocol has been insufficient to improve postural stability in our participants. Lastly, the postures and practices of chair yoga therapy may need to be individually tailored for each population in light of the physical strength and comorbidities of each participant.

4.6. Limitations

Apart from the issues discussed above, there are several limitations to be noted. First, this study was limited by the small sample size (n=56), and included various psychiatric diagnoses, potentially limiting the power to detect possible differentials between the groups. Second, the results should be interpreted in a context of type, duration, and intensity of chair yoga intervention coordinated by one author (S.I.): the optimal mode of delivery of yoga therapy (e.g. intensity and duration) is still unknown. Third, due to the single-blind study design, expectation bias among the participants in the yoga group remains a possibility although a number of objective measures were adopted, and it would have been technically challenging to conduct a double-blind RCT of chair yoga therapy. Fourth, our inability to control for the contribution of different antipsychotics on the parameter of physical fitness was another limitation. In fact, the effects of medications on postural stability may differ among medications (Koreki et al., 2011). Fifth, the sustainability of the effects of chair yoga therapy is not known beyond 6 weeks. Sixth, the actual physical activity level of participants outside of yoga therapy was not evaluated in this study. Although the participants in the chair yoga group did not receive any formal chair yoga therapy after the 12-week intervention, we cannot

entirely reject a possibility that they practiced chair yoga on their own. Finally, the mechanisms on how yoga induces beneficial physical effects remain to be elucidated, calling for further studies on this clinically relevant topic.

In conclusion, the first study to focus on the effect of chair yoga therapy on physical activities in patients with psychiatric disorders was positive. These findings suggest the clinical utility of chair yoga intervention to enhance physical fitness and to potentially reduce the risk of falls and fractures in patients with psychiatric disorders. Furthermore, the therapeutic effects of the 12-week chair yoga therapy with a total of 24 sessions seemed sustainable for at least 6 weeks after the intervention. Since the impacts of physical fitness are amenable to improvements throughout a person's life, comprehensive strategies for the prevention of falls are urgently needed. In light of the limited evidence to date, our results emphasize the need for further investigations on the potential benefits of chair yoga therapy in patients with psychiatric disorders.

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Table 1. Demographic and Clinical Characteristics of Participants (N=56)

Variables	Yoga group (n=28)	Control group (n=28)	*P*-value
Age, years	55.5±11.4	55.0±15.8	0.89
Male, n (%)	18 (64.3)	18 (64.3)	0.61
Onset of illness, years	32.0±17.7	30.1±14.0	0.81
Duration of illness, years	23.4±14.4	28.9±14.8	0.17
Length of stay, months	155.3±139.8	102.0±104.5	0.82
Body mass index	22.7±4.2	24.5±4.8	0.15
Waist circumference, cm	89.1±10.9	87.5±11.4	0.59
Dose of antipsychotics, CPZE mg/d	546.1±385.5	569.9±362.0	0.89
Use of benzodiazepines, n (%)	16 (57.1)	15 (53.6)	0.79
Use of lithium, n (%)	5 (17.9)	4 (14.3)	0.72
Use of anticonvulsants, n (%)	6 (21.4)	8 (28.6)	0.54
Falls in past 12 months	0.4±1.0	1.1±2.0	0.13
Anteflexion in sitting, cm	55.1±16.6	54.2±16.9	0.84
Postural sway			
Total length of the trunk motion, cm	60.9±26.2	61.4±27.1	0.83
Range of the trunk motion, cm2	5.7±4.1	5.0±3.8	0.46
Romberg ratio	1.155±0.637	1.224±0.948	0.70
Muscle strength			
Hand grip, kg	23.6±10.6	25.7±11.8	0.47
Lower limb muscle endurance	4.9±4.0	5.5±5.0	0.83
Knee flexion strength to body weight ratio	0.079±0.056	0.083±0.067	0.82
MFES	114.9±29.2	122.1±31.0	0.24

Group differences were compared using chi-square test, independent t-test, or the Mann-Whitney test. Values are shown as mean±SD.

Abbreviations: CPZE, chlorpromazine equivalent; MFES, Modified Falls Efficacy Scale in Japanese; SD, standard deviation.

Table 2. Mixed-effects Model in Anteflexion, Postural Sway, Muscle Strength, EQ-5D, GAF, and MFES at Baseline and Week 12

	Yoga group (n=28)		Control group (n=28)		
Variables	Baseline	Week 12	Baseline	Week 12	*P*-value of interaction
Anteflexion in sitting, cm	55.1±16.6	67.2±14.0[a]	54.2±16.9	59.0±13.7	**0.029**
Postural sway					
Total length of the trunk motion, cm	60.9±26.2	57.1±24.3	61.4±27.1	63.4±30.8	0.42
Range of the trunk motion, cm^2	5.7±4.1	4.6±4.1	5.0±3.8	5.0±2.8	0.50
Romberg ratio	1.155±0.637	1.305±0.773	1.224±0.948	1.376±0.957	0.89
Muscle strength					
Hand grip, kg	23.6±10.6	26.8±9.7[a]	25.7±11.8	25.2±12.1	**0.001**
Lower limb muscle endurance, kg	4.9±4.0	7.0±3.9[a]	5.5±5.0	5.2±4.6	**0.004**
Knee flexion strength to body weight ratio	0.079±0.056	0.115±0.061[a]	0.083±0.067	0.079±0.060	**0.002**
EQ-5D index	0.653±0.354	0.898±0.129	0.620±0.417	0.680±0.289	0.14
EQ-5D VAS	58.9±25.0	73.4±20.2[a]	62.4±29.6	56.4±23.4	**0.002**
GAF	27.9±9.4	31.7±9.7	28.0±9.3	29.0±10.5	0.05
MFES	114.9±29.2	134.1±11.6[a]	122.1±31.0	120.0±33.3	**0.03**

Group differences were compared using mixed-effects model for repeated measures (two-way).

Values are shown as mean±SD, using a last-observation-carried-forward method.

Abbreviations: EQ-5D, the EuroQol 5 dimensions; GAF, Global Assessment of Functioning; MFES, Modified Falls Efficacy Scale in Japanese; SD,

standard deviation; VAS, Visual Analogue Scale.

[a] *P*-value for time effects of <0.05.

P-values of <0.05 are shown in bold.

Table 3. Mixed-Effects Model in Symptoms at Baseline and Week 12 in the Subgroup of Schizophrenia

	Yoga group (n=24)		Control group (n=25)		
Variables	Baseline	Week 12	Baseline	Week 12	*P*-value of interaction
PANSS					
Total	90.0±16.5	85.5±16.1	83.9±24.8	80.2±20.3	0.31
Positive symptoms	18.3±6.2	17.8±6.3	18.3±6.9	17.2±6.2	0.79
Negative symptoms	27.5±6.9	26.0±6.7	24.6±9.3	23.7±8.2	0.24
General psychopathology	43.8±7.6	41.8±7.3	41.0±12.0	39.3±9.6	0.31
DIEPSS	6.2±3.1	5.7±3.4	4.5±3.8	3.7±2.7	0.10
TIP-Sz	45.9±10.5	51.2±10.3	49.0±15.6	51.2±14.9	0.70

Group differences were compared using mixed-effects model for repeated measures (two-way).

Values are shown as mean±SD, using a last-observation-carried-forward method.

Abbreviations: DIEPSS, Drug Induced Extrapyramidal Symptoms Scale; PANSS, Positive and Negative Syndrome Scale; SD, standard deviation; TIP-Sz, Targeted Inventory on Problems in Schizophrenia.

Table 4. Mixed-Effects Model in the Yoga Group at Baseline, Week 12, and Week 18

	Yoga group (n=28)			
Variables	Baseline	Week 12	Week 18	*P*-value
Anteflexion in sitting, cm	55.1±16.6	67.2±14.0[a]	68.8±14.2[b]	**<0.001**
Postural sway				
Total length of the trunk motion, cm	60.9±26.2	57.1±24.3	52.2±23.1	0.23
Range of the trunk motion, cm^2	5.7±4.1	4.6±4.1	3.9±2.3	0.16
Romberg ratio	1.155±0.637	1.305±0.773	1.179±0.907	0.71
Muscle strength				
Hand grip, kg	23.6±10.6	26.8±9.7[c]	26.7±9.9[d]	**<0.001**
Lower limb muscle endurance, kg	4.9±4.0	7.0±3.9[e]	7.3±3.9[f]	**<0.001**
Knee flexion strength to body weight ratio	0.079±0.056	0.115±0.061[g]	0.118±0.060[h]	**<0.001**
EQ-5D index	0.653±0.354	0.898±0.129[i]	0.843±0.168[j]	**<0.001**
EQ-5D VAS	58.9±25.0	73.4±20.2[k]	70.6±18.7[l]	**<0.001**
MFES	114.9±29.2	134.1±11.6[m]	138.0±6.5[n]	**<0.001**

[a] *P*-value of <0.001 after Bonferroni correction, compared with baseline.

[b] *P*-value of <0.001 after Bonferroni correction, compared with baseline.

[c] *P*-value of <0.001 after Bonferroni correction, compared with baseline.

[d] *P*-value of <0.001 after Bonferroni correction, compared with baseline.

[e] *P*-value of 0.001 after Bonferroni correction, compared with baseline.

[f] *P*-value of <0.001 after Bonferroni correction, compared with baseline.

[g] *P*-value of <0.001 after Bonferroni correction, compared with baseline.

[h] *P*-value of <0.001 after Bonferroni correction, compared with baseline.

[i] *P*-value of <0.001 after Bonferroni correction, compared with baseline.

[j] *P*-value of 0.001 after Bonferroni correction, compared with baseline.

[k] *P*-value of 0.008 after Bonferroni correction, compared with baseline.

[l] *P*-value of 0.034 after Bonferroni correction, compared with baseline.

[m] *P*-value of <0.001 after Bonferroni correction, compared with baseline.

[n] *P*-value of <0.001 after Bonferroni correction, compared with baseline.

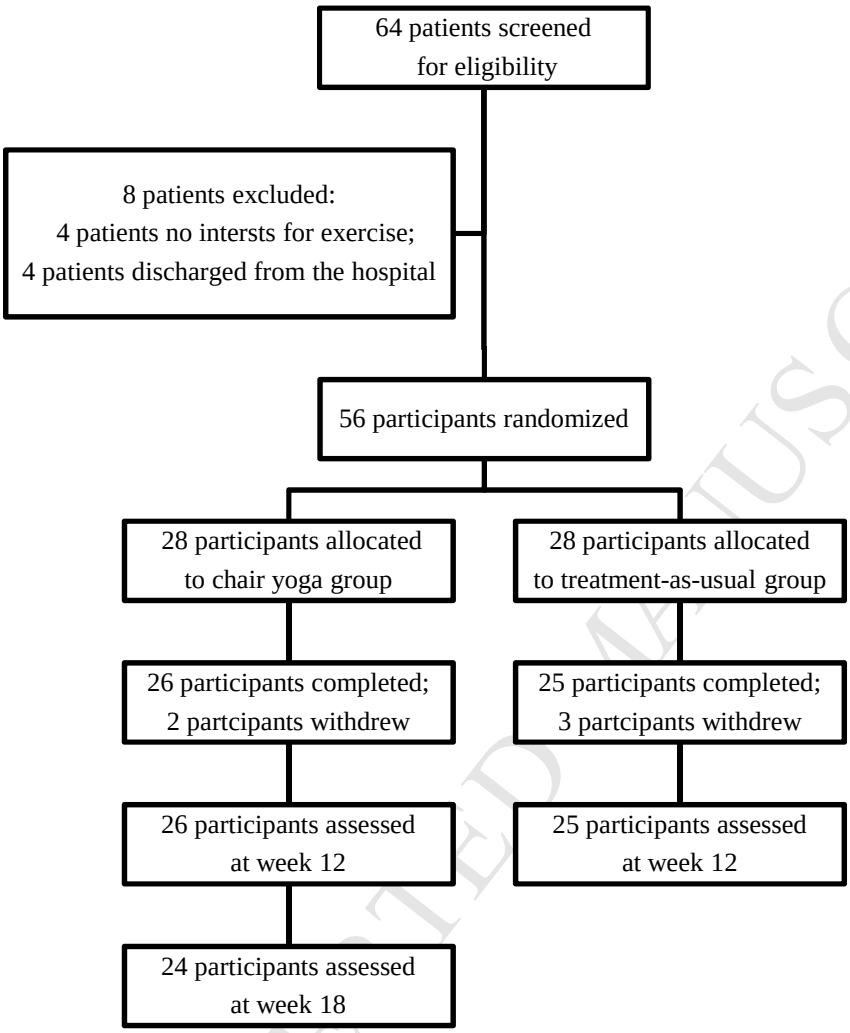
The differences were compared using mixed-effects model for repeated measures (one-way).

Values are shown as mean±SD using a last-observation-carried-forward method (one-way).

Abbreviations: EQ-5D, the EuroQol 5 dimensions; GAF, Global Assessment of Functioning; MFES, Modified Falls Efficacy Scale in Japanese; SD, standard deviation; VAS, Visual Analogue Scale.

P-values of <0.05 are shown in bold.

Figure 1. Flow of the Participants



Highlights:

-12-week chair yoga therapy improved physical fitness and fear of falls among psychiatric patients.

-These improvements were sustained for 6 weeks after the intervention was over.

- A total of 24 session of chair yoga therapy was well tolerated.

-Chair yoga therapy may contribute to reduce the risk of falls in psychiatric patients.