Effect of Intensive Balance Training on Balance in Hospitalized Older Adults with Schizophrenia: A Randomized Controlled Trial Post-Print

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Abstract

Background The incidence of falls among hospitalized elderly patients with mental disorders is increasing, with insufficient physical activity and sedentary lifestyles becoming prevalent in this population. Although balance training has been proven effective in reducing falls, its implementation in psychiatric settings remains limited. Objective To investigate the effects of intensive balance training on balance ability in hospitalized elderly patients with schizophrenia. Methods Seventy-two elderly inpatients with schizophrenia from the geriatric department of a tertiary Grade A psychiatric hospital in Jiangxi Province in 2023 were enrolled and randomly divided into an experimental group (n=36) and a control group (n=36) using a random number table method. The control group received conventional rehabilitation training, while the experimental group received an intensive balance training protocol in addition to conventional rehabilitation. Both groups were assessed before intervention and after 4 and 12 weeks using the Berg Balance Scale (BBS), Chinese version of the Barthel Index (BI), and International Fall Efficacy Scale (FES-I). Results Sixty-two patients completed the training (experimental group: n=30; control group: n=32). Two-way repeated measures ANOVA revealed a significant group × time interaction for BBS and BI scores ($P<0.05$). The main effect of group was significant for BBS scores ($P<0.05$) but not for BI scores ($P>0.05$). The main effect of time was significant for both BBS and BI scores ($P<0.05$). After 12 weeks of intervention, BBS and BI scores in the experimental group were significantly higher than those in the control group ($P<0.05$). Within-group comparisons showed that BBS and BI scores in the experimental group at 4 weeks were higher than baseline, and scores at 12 weeks were higher than both baseline and 4 weeks ($P<0.05$). A significant group × time interaction was observed for total FES-I scores and both indoor and outdoor activity subscales ($P<0.05$). The main effect of group was significant for indoor activity scores ($P<0.05$) but not for total FES-I scores or outdoor activity scores ($P>0.05$). The main

effect of time was significant for total FES-I scores and both indoor and outdoor activity scores (P<0.05). After 12 weeks, the experimental group showed higher total FES-I scores and indoor and outdoor activity scores compared to the control group (P<0.05). Within-group comparisons demonstrated that the experimental group's total FES-I scores and indoor and outdoor activity scores at 4 weeks were higher than baseline, and scores at 12 weeks were higher than both baseline and 4 weeks (P<0.05). Conclusion The intensive balance training protocol can effectively improve balance ability, activities of daily living, and fall self-efficacy in hospitalized elderly patients with schizophrenia, thereby reducing fall risk.

Full Text

Effects of Balance-Strengthening Training on Balance Ability in Elderly Inpatients with Schizophrenia: A Randomized Controlled Trial

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Abstract

Background The incidence of falls among elderly inpatients with psychiatric disorders is on the rise. A lack of adequate physical activity and sedentary lifestyle have become prevalent among hospitalized elderly patients. While balance training has been demonstrated to be efficacious in reducing falls, its application within psychiatric care remains limited.

Objective To explore the effect of balance-strengthening training on balance ability in hospitalized elderly patients with schizophrenia.

Methods Seventy-two elderly inpatients with schizophrenia from a tertiary psychiatric hospital in Jiangxi Province were selected as study participants in 2023. Participants were randomly assigned into an experimental group (n=36) and a control group (n=36) using a random number table. The control group received standard rehabilitation training, whereas the experimental group received a balance-strengthening training program in addition to the standard regimen. The Berg Balance Scale (BBS), Chinese version of the Barthel Index (BI), and International Falls Efficacy Scale (FES-I) were utilized to assess

patients at baseline and after 4 and 12 weeks of intervention.

Results A total of 62 patients completed the study, with 30 in the experimental group and 32 in the control group. Two-factor repeated measures ANOVA showed significant interaction effects between group and time on BBS and BI scores ($P<0.05$). Group had a significant main effect on BBS scores ($P<0.05$) but not on BI scores ($P>0.05$). Time had significant main effects on both BBS and BI scores ($P<0.05$). After 12 weeks of intervention, the experimental group showed higher BBS and BI scores than the control group ($P<0.05$). Intra-group comparison revealed that the experimental group's BBS and BI scores at 4 weeks were higher than baseline, and scores at 12 weeks were higher than both baseline and 4 weeks ($P<0.05$). Group and time also showed interaction effects on FES-I total score and indoor/outdoor activity scores ($P<0.05$). The main effect of group was significant for FES-I indoor activity score ($P<0.05$) but not for total score or outdoor activity score ($P>0.05$). Time had significant main effects on FES-I total score and both indoor and outdoor activity scores ($P<0.05$). After 12 weeks, the experimental group's FES-I total score and indoor/outdoor activity scores were higher than the control group's ($P<0.05$). Intra-group comparison showed that the experimental group's FES-I scores at 4 weeks were higher than baseline, and scores at 12 weeks were higher than both baseline and 4 weeks ($P<0.05$).

Conclusion A balance-strengthening training program can effectively improve balance ability, self-care capacity, and fall self-efficacy in elderly inpatients with schizophrenia, thereby reducing fall risk.

Keywords schizophrenia; elderly; balance-strengthening training; balance ability; falls; randomized controlled trial

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1. Methods

1.1 Study Participants

Elderly inpatients with schizophrenia from the geriatrics department of a tertiary psychiatric hospital in Jiangxi Province were selected as study participants in 2023. **Inclusion criteria** were: (1) age $ $60 years; (2) diagnosis of schizophrenia according to ICD-10 criteria; (3) stable psychiatric symptoms while receiving medication; and (4) signed informed consent and voluntary participation. **Exclusion criteria** were: (1) inability to bear weight on lower limbs; (2) comorbid other psychiatric disorders; (3) severe cardiovascular, metabolic, or renal diseases; and (4) severe cognitive impairment. **Withdrawal criteria** were: (1) occurrence of serious adverse events; (2) inability to complete the entire training cycle; and (3) revocation of informed consent by patient/guardian.

Sample size was calculated using G*Power 3.1.9.2 software, with significance level α set at 0.05, test power at 0.85, and medium effect size of 0.25. Accounting for a 15% attrition rate, the total sample size was determined to be

72 cases. This study was approved by the Ethics Review Committee of Jiangxi Mental Health Center [Approval No.: (2022) Medical Research Ethics Review No. (022)].

1.2 Grouping and Intervention Methods

Patients were randomly divided into an experimental group (n=36) and a control group (n=36) using a random number table. A multidisciplinary training team was established, consisting of 1 chief psychiatrist, 1 rehabilitation therapist, 1 psychotherapist, 2 co-chief superintendent nurses, and 4 charge nurses (2 with master's degrees and 7 with bachelor's degrees). The researcher was responsible for study design and, together with the rehabilitation therapist and psychiatrist, constructed the balance-strengthening training protocol. The psychiatrist and psychotherapist assessed patient conditions and provided medication management and psychological counseling, the rehabilitation therapist supervised exercise training and guidance, and nurses implemented the exercise training for eligible patients.

Training Protocol Development: (1) **Control group**: Followed the daily rehabilitation activity plan in the ward, including 4 minutes of broadcast calisthenics (8th set), finger exercises (1 minute daily), and weekly activities such as karaoke, origami, and reminiscence therapy (40 minutes each). (2) **Experimental group**: A literature search was conducted using keywords including "schizophrenia," "balance-training/balance exercise," "balance ability/balance function," "falls," "falling," "elderly," "aged" in both English and Chinese across PubMed, Web of Science, Cochrane Library, CNKI, Wanfang, VIP, and SinoMed databases. Based on literature review and expert consultation, an exercise training plan was developed, gradually adjusting exercise type, intensity, frequency, and duration to achieve optimal dosing for patients. After pilot testing for feasibility, a personalized balance-strengthening training protocol was constructed for elderly patients with schizophrenia. Training movements were filmed with background music for instructional purposes, and nurses and rehabilitation therapists jointly conducted the balance-strengthening training in the ward activity room.

Implementation: The balance-strengthening training program consisted of three phases, conducted 3 times per week for 45 minutes per session over 12 weeks. Exercise intensity was monitored using the Rating of Perceived Exertion (RPE) scale (score range 6-20, with higher scores indicating greater exertion). (1) **Initial phase (Weeks 1-4)**: Supported completion of knee bends, heel raises, single-leg side-back swings, arm curls, lateral wall walking, and heel-to-toe walking. Each exercise was performed for 10-12 repetitions or 20 steps per side, repeated for 3-5 sets with 2-minute rest intervals. (2) **Progression phase (Weeks 5-8)**: Unsupported completion of knee bends, heel raises, single-leg side-back swings, weighted arm curls, lateral walking, and simplified side cross-steps. Same repetitions/sets with 1-minute rest intervals. (3) **Intensification phase (Weeks 9-12)**: Unweighted squats, single-leg standing, single-leg side-

back swings, weighted arm curls, simplified side cross-steps, and stair climbing. Same repetitions/sets with 1-minute rest intervals.

Precautions: (1) Begin by adding 2-3 movement groups weekly, with repeated reinforcement and gradual progression to moderate intensity, following the principle of gradual advancement. (2) Each 4-week phase progressively reduced support base; patients advanced to higher difficulty levels upon successful completion of current movements, following the principle of progressive difficulty. (3) Progression sequence: supported → unsupported → walking while looking sideways; double-leg → single-leg → eyes-closed standing; weight progression from 500mL to 750mL to 1000mL water bottles. (4) All movements were performed slowly and with control; exercise intensity maintained at RPE 10-14 or target heart rate = (220-0.7×age-resting heart rate)×(40%-60%) + resting heart rate. (5) 5-10 minutes of warm-up before each session and fascial release after training to promote recovery and reduce injury. (6) Group training was supervised by nurses and rehabilitation therapists, with background music and video demonstrations to teach proper technique. (7) Maximum absence of 2 sessions per training cycle was permitted. See Table 1 .

1.3 Assessment Tools

1.3.1 General Patient Information Questionnaire: A self-designed questionnaire collected demographic data including gender, age, education level, marital status, schizophrenia course, BMI, comorbidities, and medication use.

1.3.2 Berg Balance Scale (BBS): Developed by Berg et al. in 1989, the BBS is the most widely used balance assessment tool, comprising 14 items including sit-to-stand, standing unsupported, eyes-closed standing, forward reach, 360° turn, alternating foot taps, and single-leg standing. Each item is scored 0-4, with a total score of 56. Higher scores indicate better balance ability and lower fall risk. The scale's Cronbach's α coefficient is 0.97.

1.3.3 Barthel Index (BI): The Chinese version of BI was used to assess activities of daily living. Originally developed by Mahoney and Barthel, it includes 10 items: feeding, bathing, grooming, dressing, bowel control, bladder control, toileting, bed-chair transfer, ambulation, and stair climbing. Items are scored across 2-4 levels, with total scores ranging from 0-100. Dependency levels are: $ $40 (severe), 41-60 (moderate), 61-99 (mild), and 100 (independent). Higher scores indicate stronger self-care ability. The Chinese version's Cronbach's α coefficient is >0.92.

1.3.4 Falls Efficacy Scale-International (FES-I): The Chinese version was translated by Guo Qiyun et al. in 2015. It measures concern about falling during simple or complex physical activities, comprising 10 indoor and 6 outdoor items scored on a 1-4 scale ("no confidence at all" to "very confident"). Total scores range from 16-64, with higher scores indicating stronger fall efficacy and confidence. The scale's Cronbach's α coefficient is 0.921.

1.4 Statistical Methods

SPSS 23.0 software was used for analysis. Normally distributed continuous data were expressed as ($\bar{x}\pm s$) and compared between groups using independent samples t-tests. Categorical data were described using relative frequencies and compared using ^{2} tests. Repeated measures ANOVA was used for longitudinal data. If interaction effects were significant, simple effects analysis was conducted. $P<0.05$ indicated statistical significance.

2 Results

2.1 Patient Baseline Data

Six patients in the experimental group and four in the control group withdrew due to discharge or physical illness, leaving 30 and 32 patients respectively who completed the study (total n=62). There were no statistically significant differences between groups in gender, age, education level, marital status, schizophrenia course, BMI, comorbidities, or medication use ($P>0.05$). See Table 2 .

2.2 BBS and BI Scores at Baseline, 4 Weeks, and 12 Weeks

Significant interaction effects between group and time were found for BBS and BI scores ($P<0.05$). Group had a significant main effect on BBS scores ($P<0.05$) but not on BI scores ($P>0.05$). Time had significant main effects on both BBS and BI scores ($P<0.05$).

At baseline and 4 weeks, no significant differences existed between groups in BBS or BI scores ($P>0.05$). At 12 weeks, the experimental group showed significantly higher BBS and BI scores than the control group ($P<0.05$). Intra-group comparisons revealed that the experimental group's BBS and BI scores at 4 weeks were higher than baseline, and scores at 12 weeks were higher than both baseline and 4 weeks ($P<0.05$). The control group showed no significant differences across time points ($P>0.05$). See Table 3 .

2.3 FES-I Scores at Baseline, 4 Weeks, and 12 Weeks

Significant interaction effects between group and time were found for FES-I total score and indoor/outdoor activity scores ($P<0.05$). Group had a significant main effect on indoor activity score ($P<0.05$) but not on total score or outdoor activity score ($P>0.05$). Time had significant main effects on total score and both indoor and outdoor activity scores ($P<0.05$).

At baseline and 4 weeks, no significant differences existed between groups in FES-I total or subscale scores ($P>0.05$). At 12 weeks, the experimental group showed significantly higher total and indoor/outdoor activity scores than the control group ($P<0.05$). Intra-group comparisons revealed that the experimental group's scores at 4 weeks were higher than baseline ($P<0.05$), and scores at 12 weeks were higher than both baseline and 4 weeks ($P<0.05$). The control

group showed no significant differences across time points (P>0.05). See Table 4 .

3 Discussion

3.1 Feasibility of the Balance-Strengthening Training Protocol in Geriatric Psychiatric Wards

Balance ability is crucial for maintaining standing, walking, and coordinating various movements. Research has confirmed that declining balance is a primary cause of falls in older adults. Our study participants were elderly schizophrenia patients with an average disease course exceeding 30 years, long-term antipsychotic medication use, residual psychiatric symptoms, and medication side effects, resulting in widespread cognitive impairment, lack of will, anhedonia, and social withdrawal. The closed inpatient environment further contributed to sedentary behavior, with elderly schizophrenia patients sitting approximately 12.5 hours daily during non-sleep time, leading to decreased fall resistance.

Given these unique characteristics of elderly schizophrenia patients, we developed a personalized balance-strengthening training protocol through literature analysis and expert consultation. This low-cost intervention strategy is feasible for psychiatric inpatients with limited mobility and exercise conditions. Nurse- and therapist-supervised group training promoted stable long-term exercise behavior, ensured effectiveness and safety, facilitated interpersonal interaction, reduced pathological experiences, and increased adherence through peer support. Soundy et al. demonstrated that exercise can improve confidence and promote physical and mental health in schizophrenia patients.

3.2 Balance-Strengthening Training Improves Balance and Self-Care Ability

Balance ability depends on coordination between sensory and motor functions under central nervous system control. With aging, information transmission and motor responses slow, making balance maintenance more difficult. Our study showed that after 12 weeks of balance-strengthening training, the experimental group achieved significantly higher BBS and BI scores than the control group (P<0.05), indicating improved balance and daily living abilities. These findings align with existing research but provide specificity for elderly schizophrenia patients.

The protocol followed progressive principles, combining strength and balance training while gradually reducing support. Exercises such as heel raises, weighted arm curls, and unweighted squats targeted major muscle groups in the feet, neck/back, and sacroiliac regions. Muscle stretching increased joint range of motion and flexibility while activating sensorimotor connections from bottom-up, improving reaction speed, postural control, center-of-gravity transfer, and coordinated balance. Enhanced physical tolerance also alleviated

antipsychotic side effects, reducing fall incidence. Improved balance function enhanced patients' ability to manage daily activities and improved quality of life.

3.3 Balance-Strengthening Training Improves Fall Efficacy

Fall efficacy reflects confidence in performing daily activities without falling and negatively correlates with fear of falling. Our study showed that over time, the balance-strengthening group achieved higher total FES-I scores and indoor/outdoor subscale scores than the control group ($P<0.05$), confirming that the training improved fall efficacy and reduced fear of falling. This likely resulted from improved muscle strength and balance increasing activity capacity. Enhanced postural stability boosted confidence in activity participation, reducing sedentary behavior. Conversely, falls reduce confidence, leading to avoidance behavior, muscle weakness, impaired balance, and increased fall risk—a vicious cycle exacerbating anxiety and fear.

The 2022 World Guidelines emphasize addressing older adults' perspectives and concerns about falling. While domestic fall efficacy research has focused on community and institutionalized elderly, studies on psychiatric patients are lacking. Schizophrenia patients' cognitive biases may affect fall efficacy assessment, requiring nurses to guide them in evaluating fall risks, addressing unnecessary anxiety and fear, and building confidence. Exercise effectively overcomes fear of falling, consistent with Halvarsson et al.'s findings that balance training improves physical function and fall-related self-efficacy.

Study Limitations: The sample size limited our ability to analyze correlations between schizophrenia course, medication dosage/type, and balance ability. Future studies should expand sample size for further validation.

4 Conclusion

Appropriate balance-strengthening exercise training can improve balance ability, fall self-efficacy, and self-care capacity in elderly schizophrenia patients, thereby reducing fall risk and improving quality of life. In the context of increasingly serious population aging, this represents an effective fall prevention measure. Our findings provide reference and evidence for developing exercise prescriptions for elderly schizophrenia patients.

Author Contributions: Qin Wei developed the research concept and protocol and wrote the manuscript. Tu Gangying and Wan Xiaomei implemented the study, collected and analyzed data, and created figures/tables. Qin Wei and Wang Fang were responsible for quality control and manuscript review.

Conflict of Interest: None declared.

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Note: Figure translations are in progress. See original paper for figures.