Improving Physical Performance and Fall Risk in the Elderly Through Structured Tai Chi: A Quasi-Experimental Investigation in an Indonesian Nursing Home

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Article Info	Abstract
Keywords: Balance, Elderly, Fall Prevention, Physical Performance, Tai Chi. **Corresponding Author**: Shinta Silaswati Hermina Health Institute **Email**: shintha16@gmail.com	**Background:** Falls are a major cause of injury and disability among older adults. Tai Chi, with its slow and controlled movements, is a promising intervention for improving balance and reducing fall risk. **Purpose:** This study evaluated the effect of a structured two-week Tai Chi program on physical performance and fall risk among elderly nursing home residents in East Jakarta, Indonesia. **Methods:** A quasi-experimental one-group pre-post design was used with 20 participants (mean age 66.4±4.2 years; 85% female). Fall risk was assessed using the Short Physical Performance Battery (SPPB) before and after a 10-session Tai Chi program. Data were analyzed using the Wilcoxon signed-rank test. **Results:** Pre-intervention SPPB scores indicated high fall risk (Mean=7.8±1.1). Post-intervention scores improved significantly (Mean=9.6±1.0; p=0.046). The proportion of participants classified as "stable" (SPPB 10-12) increased from 0% to 20%. **Conclusion:** A short-term Tai Chi program significantly improved physical performance and reduced fall risk in institutionalized elderly, supporting its integration into nursing home fall prevention strategies.

Background

Increasing life expectancy has led to a continuous rise in the global elderly population. The number of individuals aged 60 years and older is projected to reach 2.1 billion by 2050, bringing with it a significant burden of falls, as 20–30% of older adults experience one or more falls annually (WHO, 2023). In long-term care facilities, the incidence of falls is approximately three times higher compared to community-dwelling older adults, posing a global challenge for health systems and gerontological nursing services (Sadaqa et al., 2025). Falls not only cause physical injury but also increase healthcare utilization, disability, and long-term dependency. This situation demands effective, structured, and easily integrable fall prevention interventions within nursing home settings (Pillay et al., 2024).

In Indonesia, demographic transition is accelerating the growth of the elderly population, many of whom live with functional limitations and a high risk of falls both in the community and in nursing homes (*Panti Wredha*) (Kemenkes RI, 2023). Nursing home residents experience a more rapid decline in mobility, muscle strength, and balance, leading to a greater prevalence of falls compared to elders living with family (Oberholster et al., 2024; Tanaka et al., 2023). However, evidence-based structured physical exercise programs, particularly those focusing on balance training and fall prevention in Indonesian nursing homes, remain limited. This gap

between the burden of the problem and the availability of standardized interventions underscores the need for context-specific gerontological nursing research (Andas et al., 2022, 2025; Mortin Andas et al., 2025).

Falls in the elderly are associated with increased morbidity, fractures, hospitalization, loss of independence, and significant decline in quality of life (Rikkonen et al., 2023). Approximately half of fall incidents result in moderate to severe injury, some requiring medical consultation or hospitalization, including fractures that increase mortality risk and long-term care needs (Rikkonen et al., 2023). Beyond physical impact, fear of falling and reduced physical activity exacerbate a vicious cycle of functional decline, increasing the risk of subsequent falls, depression, and limitations in daily activities (Savvakis et al., 2024; Tsai et al., 2024). This creates a substantial economic and social burden for families and elderly care institutions, including nursing homes (Pillay et al., 2024; Rikkonen et al., 2023).

Fall risk factors in the elderly are multifactorial, encompassing sarcopenia, decreased muscle strength and function, impaired balance, gait disturbances, cognitive decline, depression, and low physical activity (Sadaqa et al., 2025; Savvakis et al., 2024). Studies in Taiwan indicate that the combination of fear of falling and low physical activity doubles the risk of falling, highlighting the importance of interventions targeting both physical and psychological aspects (Tsai et al., 2024). Recent meta-analyses confirm that exercise programs combining strength, balance, and mind-body activities can reduce fall risk indices and improve functional physical performance in older adults (Marcos-Pardo et al., 2023; Zhou et al., 2025). These findings support the development of comprehensive exercise programs in gerontological care settings.

Tai Chi, as a mind-body exercise, has been widely reported to improve balance, lower extremity strength, postural stability, and reduce both fall risk and fear of falling in older adults and populations with gait disorders (Freiberger et al., 2024; Jia et al., 2024). Systematic reviews indicate that various Tai Chi stylesparticularly Yang style with a duration of 12 weeks, frequency of 2–3 times per week, and 30–60 minutes per sessioneffectively enhance dynamic balance, mobility, and fall risk indicators (Freiberger et al., 2024; Jia et al., 2024). Tai Chi exercise is also identified as a group intervention with moderate evidence for reducing fall incidence in community-dwelling older adults (Pillay et al., 2024) and is associated with a "younger" functional profile in long-term practitioners(Ma et al., 2024; Meredith et al., 2023).

Despite international evidence supporting Tai Chi's effectiveness, a research gap exists regarding the implementation of structured Tai Chi programs in nursing homes, particularly in middle-income countries like Indonesia, with cultures, resources, and resident characteristics differing from studies in foreign communities or hospitals (Ma et al., 2024; Meredith et al., 2023). Most research focuses on community-dwelling elders or patients with specific diseases, and few have employed quasi-experimental designs in nursing homes to comprehensively evaluate the impact of Tai Chi on physical performance and fall risk. Furthermore, implementation aspects within gerontological nursing settingssuch as exercise regularity, participant acceptance, and program sustainabilityremain underexplored (Loewenthal et al., 2024; Meredith et al., 2023). Therefore, this study aims to analyze the effect of a structured Tai Chi program on physical performance and fall risk among elderly nursing home residents in Indonesia using a quasi-experimental design, contributing to the development of evidence-based gerontological nursing interventions at the national level.

Method

Study Design

This study employed a quantitative research approach with a quasi-experimental, one-group pretest-posttest design. The design was chosen to evaluate the effects of a structured Tai Chi intervention on physical performance and fall risk within a single nursing home setting, where randomization and the use of a control group were not feasible due to practical and ethical constraints related to equitable care provision. Measurements were taken at two time points: before the intervention (T1) and immediately after the completion of the two-week intervention (T2).

Population and Sample

The study population consisted of all elderly residents at the STW Ria Pembangunan Nursing Home in East Jakarta, Indonesia. A total sampling method was used to recruit participants who met the inclusion criteria. The sample size was 20 participants, which represented all eligible residents during the study period. Inclusion criteria were: (1) age 60 years or older, (2) ability to ambulate independently or with a cane, (3) a baseline Short Physical Performance Battery (SPPB) score between 7 and 10 (indicating moderate to high fall risk), (4) medically stable condition without acute illness, and (5) willingness to provide written informed consent. Exclusion criteria included: (1) severe cognitive impairment (as determined by nursing staff assessment), (2) acute medical conditions that contraindicated physical activity, (3) participation in other structured exercise programs during the study period, and (4) inability to comprehend basic instructions.

Intervention Protocol

The intervention was a structured Tai Chi program adapted from the evidence-based "Tai Chi for Arthritis and Fall Prevention" program. The program was conducted over two consecutive weeks, comprising a total of 10 sessions (one session per day, five days per week). Each 30-minute session was led by a certified Tai Chi instructor (author JS) and assisted by a nurse. Sessions were held in a spacious, well-lit common room within the nursing home to ensure safety.

Each session followed a standardized structure:1) **Warm-up (5 minutes):** Gentle stretching and breathing exercises to prepare the body and mind. 2) **Core Tai Chi Practice (20 minutes):** Instruction and group practice of eight fundamental Tai Chi forms (e.g., "Commencement Form," "Parting the Wild Horse's Mane," "Wave Hands Like Clouds"). Emphasis was placed on slow, continuous, and controlled movements, proper weight shifting, knee alignment, and coordination with diaphragmatic breathing. 3) **Cool-down (5 minutes):** Gentle movements and relaxation techniques to conclude the session. Adherence was monitored via a session attendance log. All participants completed 100% of the scheduled sessions.

Instrument and Data Collection

The primary outcome was fall risk, operationalized and measured using the **Short Physical Performance Battery (SPPB)**. The SPPB is a well-validated, reliable, and objective tool for assessing lower extremity function in older adults (Guralnik et al., 1994). It consists of three

timed tests: 1) **Balance tests:** Side-by-side, semi-tandem, and tandem stands (0-4 points). 2) **Gait speed test:** Time to walk 4 meters at usual pace (0-4 points). 3) **Chair stand test:** Time to complete five repeated chair rises (0-4 points). The scores from each component are summed to produce a total score ranging from 0 (worst performance) to 12 (best performance). A score below 10 is widely used as a cutoff indicating increased fall risk. Data collection was performed by two research assistants who were trained in SPPB administration and were blinded to the study's specific hypotheses to reduce assessment bias. Pre-test (T1) data were collected one day before the intervention began. Post-test (T2) data were collected one day after the final Tai Chi session.

Ethical Considerations

This study received ethical approval from the Health Research Ethics Committee of Hermina Health Institute. The study was conducted in accordance with the principles of the Declaration of Helsinki. All potential participants received a complete explanation of the study's purpose, procedures, potential benefits, and risks. Written informed consent was obtained from each participant prior to enrollment. Confidentiality of all participant data was strictly maintained, and participants were informed of their right to withdraw from the study at any time without consequence.

Data Analysis

Collected data were processed and analyzed using IBM SPSS Statistics software (Version 25.0). Descriptive statistics (frequency, percentage, mean, and standard deviation) were used to summarize the demographic characteristics of the participants and the SPPB scores. The normality of the SPPB score distribution was assessed using the Shapiro-Wilk test, which indicated a non-normal distribution ($p < 0.05$). Therefore, the non-parametric **Wilcoxon Signed-Rank Test** was used to compare the pre-intervention and post-intervention SPPB scores. The level of statistical significance was set at $p < 0.05$. Results are presented with medians, interquartile ranges (IQR), and exact p-values where applicable.

Results

Participant Characteristics

The first objective of this study was to describe the demographic characteristics of the participants. See tabel below:

Table 1. Demographic and Baseline Characteristics of Participants (N=20)

Characteristic	n	%	Mean (SD)
Age (years)			66.4 (4.2)
60-69	17	85%	
≥70	3	15%	
Gender			
Female	17	85%	

Male	3	15%
Education Level		
Elementary School	2	10%
Junior High School	4	20%
Senior High School	11	55%
Higher Education	3	15%
Baseline SPPB Score	7.8 (1.1)	

A total of 20 elderly nursing home residents were enrolled in the study, and all participants (100%) completed the entire two-week Tai Chi intervention without any dropouts or adverse events. The demographic characteristics of the participants are presented in Table 1. The mean age of the participants was 66.4 years (SD = 4.2), with the majority (85%) belonging to the "young-old" category (60-69 years). Female participants constituted 85% of the sample. In terms of educational background, more than half (55%) had completed senior high school.

Tai Chi vs Fall Risk

This table 2 presents the results of the Short Physical Performance Battery (SPPB) screening conducted to evaluate the effect of Tai Chi exercise on reducing fall risk among elderly residents at East Jakarta Nursing Home. The data compare pre-intervention and post-intervention scores, highlighting changes in physical stability following the implementation of Tai Chi. See table below:

Tabel 2: The Effect of Tai Chi Exercise on Reducing Fall Risk through SPPB Screening at East Jakarta Nursing Home

SPPB Scores	Pra Intervention		Post Intervention		Z Score	p-value
	N	Percentage	N	Percentage		
Instability (< 10)	20	100%	16	80%	-2,000	< 0,05
Stabil (10-12)	0	0%	4	20%		

Pre-intervention measurements using the Short Physical Performance Battery (SPPB) revealed that 16 participants (80%) were classified as having a high risk of falling, while only 4 participants (20%) demonstrated lower risk. The mean baseline SPPB score was 7.8 (SD = 1.1), indicating limited balance and mobility among the majority of respondents. This result confirmed the hypothesis that institutionalized elderly residents are at elevated risk of falls.

Following two weeks of structured Tai Chi sessions, post-intervention assessments showed a marked improvement in balance and mobility. All participants (n=20, 100%) demonstrated higher SPPB scores compared to baseline. The mean post-intervention SPPB score increased to 9.6 (SD = 1.0), reflecting significant enhancement in physical performance. These findings

suggest that Tai Chi exercise contributed to measurable improvements in functional mobility among the study population.

Statistical analysis using the Wilcoxon signed-rank test indicated a significant difference between pretest and posttest scores ($Z = –2.000$, $p < 0.05$). The mean difference between baseline and post-intervention SPPB scores was 1.8 points (SD = 0.6). This result supports the hypothesis that Tai Chi exercise has a positive effect on reducing fall risk among elderly residents in nursing homes.

Finally, the overall findings demonstrate that Tai Chi exercise enhances postural stability, lower extremity strength, and confidence in movement. Improvements were observed across all participants, with no adverse events reported during the intervention. The results confirm that Tai Chi is a safe, accessible, and effective intervention for fall prevention in institutionalized elderly populations. These outcomes highlight the potential of integrating Tai Chi into routine health promotion programs in elderly care facilities to reduce fall risk and improve quality of life.

Discussion

The findings of this quasi-experimental study indicate that a structured two-week Tai Chi intervention significantly improved physical performance, as measured by the Short Physical Performance Battery (SPPB), among elderly residents in an Indonesian nursing home. The demographic profile of our sample, predominantly comprising younger-old females (mean age 66.4 years), provides important context for interpreting these results. This cohort may possess a greater physiological capacity for adaptation to exercise compared to older or more frail populations, potentially enhancing the observed responsiveness to the intervention (Windham et al., 2023). The significant post-intervention increase in mean SPPB score from 7.8 to 9.6, alongside a shift of 20% of participants into the "stable" classification, demonstrates a meaningful change in functional mobility. This aligns with evidence that structured mind-body exercises can effectively enhance lower extremity strength and dynamic balance in older adults (Zhu et al., 2025).

However, the clinical interpretation of improved SPPB scores requires careful consideration. While the SPPB is a validated and sensitive tool for measuring functional capacity, its direct predictive power for actual fall incidence has been questioned (Knell et al., 2025; Li et al., 2024; Zhou et al., 2025). Recent longitudinal data suggest that although lower SPPB scores correlate with fall risk, the SPPB may not be a significant independent predictor of injurious falls after adjusting for key demographic and clinical confounders (Freiberger et al., 2024). Therefore, while our results show a clear improvement in physical performance a crucial component of fall prevention they should be viewed as an indicator of enhanced functional capacity rather than a definitive guarantee of reduced fall rates. This underscores the necessity of a multifactorial fall prevention approach that integrates exercise with environmental modifications, medication review, and visual assessment.

The role of cognitive function and baseline independence as effect modifiers must also be acknowledged. Research indicates that higher admission cognitive scores and greater independence in activities of daily living are positive predictors of functional improvement

following rehabilitation (Butera et al., 2024). Although not formally assessed in our study, the participants' ability to learn and adhere to the Tai Chi sequences suggests a baseline level of cognitive engagement that likely contributed to the positive outcomes (Adliah et al., 2025; Sturnieks et al., 2024; Wu & Zhang, 2025). Future iterations of such programs would benefit from standardized cognitive screening to tailor instruction and better understand the interplay between cognitive status and physical training benefits (Ángel García et al., 2025; Vaidya et al., 2024).

Furthermore, the presence of frailty is a critical independent predictor of mobility outcomes. Studies in acute geriatric care settings identify frailty as a strong negative predictor of improvements in mobility metrics, including SPPB scores (Rikkonen et al., 2023; Werner et al., 2023). The relatively young age of our sample suggests a lower probable prevalence of severe frailty, which may have created a more conducive environment for observing positive effects from a short-term intervention. For broader application in nursing homes, which often house frailer individuals, Tai Chi programs may need to be adapted in intensity and paired with comprehensive geriatric assessments and nutritional support to optimize efficacy.

Acknowledgement

LIMITATIONS

This study has several limitations that must be considered when interpreting the findings. First, the quasi-experimental, single-group pre-post design lacks a control group, which limits the ability to establish causality and control for confounding variables such as concurrent care, social interaction, or the natural progression of physical function. Second, the small sample size (N=20) and homogeneous demographic profile (predominantly female, younger-old residents from a single nursing home) restrict the generalizability of the results to broader elderly populations, particularly older males or those with higher frailty. Third, the short duration of the intervention (two weeks) and the absence of a long-term follow-up assessment preclude conclusions about the sustainability of the observed improvements in physical performance. Fourth, the primary outcome was a performance-based measure (SPPB) rather than the actual incidence of falls; therefore, the direct impact of Tai Chi on fall reduction remains inferential. Finally, potential moderating factors such as baseline cognitive status,

nutritional state, and specific comorbidities were not systematically assessed, which could influence both the response to the intervention and the overall fall risk profile.

CONCLUSION

In conclusion, this study provides evidence that a structured, two-week Tai Chi program is a feasible and effective intervention for improving physical performance, as measured by the SPPB, among elderly nursing home residents in Indonesia. The significant post-intervention improvement in functional mobility supports the integration of Tai Chi as a valuable, low-risk component of multifactorial fall prevention strategies in institutional care settings. However, given the study's methodological limitations, these findings should be considered preliminary. Future research employing randomized controlled trials with larger, more diverse samples, longer intervention and follow-up periods, and direct measurement of fall incidence is essential to confirm the efficacy of Tai Chi and to evaluate its long-term role in promoting safe mobility and preventing falls in the vulnerable elderly population.

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