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Efficacy of Lower Extremity Proprioceptive Training in Improving Balance of Community-Dwelling Elderly Adults

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Abstract

The study examines the efficacy of lower extremity proprioceptive training in improving balance among community-dwelling elderly adults. The researchers utilized a quantitative randomized controlled trial (RCT). This research addresses the observed gaps in short-term, community-based protocols by investigating the lower extremity proprioceptive exercises as the independent variable directly affecting static and dynamic balance as the dependent variable. The methodology involved a purposive sampling of 8 participants, randomized allocation, and a 5-week intervention comparison of proprioceptive drills against traditional balance exercises, with pre/post Tinetti POMA assessments analyzed via paired and independent t-tests at the 0.05 significance level to test the null hypothesis. In spite of high initial baseline scores that indicates low fall risk, both groups exhibited numerical improvements (control gain: 3.50 to 28.00±0.00, p=0.077; intervention gain: 0.75 to 25.50±0.58, p=0.319); due to presence of ceiling effects and insufficient sample, improvement remained statistically insignificant, and there were no differences between the two groups (p>0.05). The results emphasized the proprioceptive training's clinical potential for fall prevention and functional mobility in independent seniors, highlighting the need for larger trials, extended durations, and sensitive outcome measures to overcome the limitations.

Keywords: Balance; Proprioception; Proprioceptive Training; Lower Extremity Exercises; Elderly Adults; Community-Dwelling Seniors; Tinetti POMA; Fall Prevention

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Introduction

Aging is a natural process that affects all of our systems and body tissues. It is proof of the passage of time wherein we see the decline in various body functions, such as motor, sensory, cognitive, and psychosocial effects of an individual [2]. Aging also increases the risk of acquiring diseases and mortality. According to the World Health Organization (2024), the population is aging far more quickly now than it did in the past. There are numerous issues associated with aging brought on by population growth. As people age, numerous changes take place on a physiological, psychological, and social level, and some serious health issues may surface. One of the most significant issues is falls [13]. The neurological system is in charge of preserving stability and balance; this may also be affected by age-related changes, increasing the chance of falls [13]. A contributing factor to aging is the deterioration of their proprioceptive function. Proprioception, otherwise known as kinesthesia. This is the body's ability to sense movement, action, and location. It is the conscious awareness of the limbs and the body, and it has several distinct properties, including the sense of passive and active motion, the sense of limb position, and the sensation of limb heaviness ("Guccione's Geriatric Physical Therapy," 2019). Proprioception is necessary to functionally move normally and maintain proper balance. This also allows us to walk without consciously thinking about where to place our foot next. It allows us to touch our elbows with our eyes closed (Melinosky, C. March 7, 2024). Our postural balance is maintained by the interaction between the sensory and neuromotor systems that allow adaptation to either static or dynamic situations of one's capacity to maintain body positioning within stability limits (Drummond et al., 2018). Due to aging and the natural degeneration of our systems and body tissues, the maintenance of this control may have deficits when responding to unbalanced external and internal stimuli (Drummond et al., 2018). Proprioception is a key element in neuromuscular exercise as it causes cortical reorganization. Proprioception practice is a method that helps to develop and improve sensory and motor function. The goal during proprioceptive training is to target the ability to perceive the position and movement of our extremities. Proprioceptive exercises have shown beneficial effects on lower extremities in studies conducted in Iran by Ghazavi et al. (2021). Proprioceptive exercises, which are designed to stimulate and strengthen the neural pathways responsible for balance and coordination, have shown promise

in a variety of conditions. Including athletes recovering from injury to older adults seeking to enhance stability. Existing studies on lower extremity proprioception have mostly focused on general exercise interventions, with a limited number of research isolating the specific effects of proprioceptive training on lower extremity function in older adults. This study seeks to discover the potential of proprioceptive exercises for elderly patients/communities, focusing on the lower extremities. By evaluating the effects on balance, stability, and functional mobility. The researchers hope to provide evidence for incorporating this therapeutic approach into clinical practice. In doing so, it strives to regain control of their bodies and lives.

Methods

The study employed a quantitative research design with a prospective randomized controlled trial (RCT) approach. The researchers utilized quantitative methods to objectively measure the efficacy of lower extremity proprioceptive exercises in community-dwelling elderly populations. Participants were randomly assigned to groups, and both pre-test and post-test measurements were conducted to evaluate changes over time. This involved the collection and analysis of numerical data to determine the relationship between the intervention and outcomes such as balance, mobility, and proprioceptive function. The primary sources of data are the senior citizens residing in Barangay 267 Tondo, Manila, District II. Data were collected through control groups and experimental groups to gather insights on their living conditions, health status, social support systems, and overall well-being. Secondary sources, such as local government reports and community databases, were utilized to supplement and validate the findings.

Results and Discussion

Descriptive statistics such as mean and standard deviation were used to summarize the pre-test and post-test scores, while inferential statistics, particularly paired samples t-test and independent samples comparison of gain scores, were utilized to determine significant differences. The outcome measure used in this study was the Tinetti Performance Oriented Mobility Assessment (POMA), a validated tool for assessing balance and gait in older adults, with a maximum score of 28 indicating optimal mobility and low fall risk.

Table 1 presents the pre-outcome Tinetti POMA scores of the control group. The participants obtained a mean gait score of 13.50 (SD = 1.29) and a mean balance score of 11.00 (SD = 1.41). The overall mean total score was 24.50 (SD = 2.65). These results indicate that the participants demonstrated moderate to high baseline balance performance prior to the intervention. According to the POMA classification, scores within this range suggest a relatively lower risk of falls, although some variability in functional mobility still exists. This finding supports the assumption that participants possess relatively comparable baseline characteristics. It also aligns with the literature that elderly individuals may still retain functional mobility despite age-related decline in proprioception and neuromuscular control [2].

Table 2 shows the pre-outcome Tinetti POMA scores of the intervention group. The participants obtained a mean gait score of 13.00 (SD = 0.82) and a mean balance score of 11.75 (SD = 0.50). The overall mean total score was 24.75 (SD = 0.96). The results indicate that the intervention group also demonstrated moderate to high baseline balance performance, comparable to the control group. The minimal difference between the two groups suggests that the participants were relatively homogeneous prior to the intervention, supporting the effectiveness of the randomization process. This comparability is crucial in experimental research, as it ensures that any observed differences in post-test outcomes can be attributed more confidently to the intervention rather than pre-existing differences.

Table 3 presents the post-outcome Tinetti POMA scores of the control group. All participants achieved the maximum possible score of 28.00 (SD = 0.00) in the POMA assessment. This indicates that the participants demonstrated optimal balance and gait performance

Table 1

The Pre-Outcome Tinetti POMA Scores of the Control Group

	Participant 1	Participant 2	Participant 3	Participant 4	Mean	SD
Gait Test	13	15	14	12	13.5	1.29
Balance Test	11	12	12	9	11	1.41
Total	24	27	26	21	24.5	2.65

Table 2

The Pre-Outcome Tinetti POMA Scores of the Intervention Group

	Participant 1	Participant 2	Participant 3	Participant 4	Mean	SD
Gait Test	14	13	13	12	13	0.82
Balance Test	12	11	12	12	11.75	0.5
Total	26	24	25	24	24.75	0.96

Table 3

The Post-Outcome Tinetti POMA Scores of the Control Group

	Participant 1	Participant 2	Participant 3	Participant 4	Mean	SD
Gait Test	16	16	16	16	16	0
Balance Test	12	12	12	12	12	0
Total	28	28	28	28	28	0

Table 4

The Post-Outcome Tinetti POMA Scores of the Intervention Group

	Participant 1	Participant 2	Participant 3	Participant 4	Mean	SD
Gait Test	13	13	14	14	13.5	0.58
Balance Test	12	12	12	12	12	0
Total	25	25	26	26	25.5	0.58

Table 5

Paired Samples t-Test for the Intervention Group (Pre-score vs Post-score)

POMA Total Score	Mean (Pre)	Mean (Post)	Student's t	df	p
Control	24.5	28	-2.65	**3**	0.077
Intervention	24.75	25.5	-1.19	3	0.319

Table 6

Comparison of Gain Scores Between the Control and Intervention Groups

Group	Mean Pre	Mean Post	Gain	p-value
Control	24.5	28	3.5	0.077
Intervention	24.75	25.5	0.75	0.319

following the intervention. The results suggest that traditional balance exercises were highly effective in improving functional mobility among the participants. However, the absence of variability indicates the presence of a ceiling effect, wherein the measurement tool may no longer be sensitive enough to detect further improvements once the maximum score is reached. This observation is consistent which highlights that structured balance training programs can significantly enhance postural stability and reduce fall risk among older adults.

Table 4 shows the post-outcome Tinetti POMA scores of the intervention group. The participants obtained a mean gait score of 13.50 (SD = 0.58) and a mean balance score of 12.00 (SD = 0.00). The overall mean total score was 25.50 (SD = 0.58). These results indicate that participants demonstrated high balance performance following proprioceptive training. The uniformity in balance scores suggests that all participants achieved maximum performance in this component, reflecting improvements in postural stability. The findings support the theoretical framework presented, which posits that proprioceptive training enhances neuromuscular adaptation and improves balance through better sensory-motor integration. This is further supported by related studies indicating that proprioceptive exercises can improve functional mobility and postural control in older adults [2].

Table 5 shows the paired samples t-test for the intervention group.

For the control group, the mean POMA score increased from 24.50 (pre-test) to 28.00 (post-test), reflecting a substantial improvement in balance performance following traditional balance exercises. This improvement suggests that participants were able to enhance their gait and postural stability over the intervention period. However, statistical analysis revealed that this increase was not statistically significant ($t = -2.65$, $p = 0.077$), as the p-value exceeded the 0.05 level of significance. Despite the lack of statistical significance, the result is relatively close to the threshold, indicating a trend toward significant improvement. This implies that with a larger sample size or longer intervention period, the improvement might have reached statistical significance. For the intervention group, the mean POMA score increased from 24.75 (pre-test) to 25.50 (post-test), indicating a modest improvement in balance following proprioceptive training. However, the results of the paired samples t-test showed that this increase was not statistically produce a statistically meaningful improvement in balance among the participants within the duration of the study. Comparing the magnitude of improvement between the two groups, the control group demonstrated a greater numerical increase in mean scores compared to the intervention group. This observation indicates that traditional balance exercises may have had a stronger immediate impact on improving balance performance than proprioceptive training in this sample. However, it is important to note that both groups failed to reach statistical significance, which may be attributed to several methodological and measurement-related factors. First, the small sample size (n = 4 per group) likely reduced the statistical power of the tests, making it difficult to detect significant differences even when improvements were observed. Second, the relatively high baseline scores of participants suggest that they already possessed moderate to high levels of balance prior to the intervention, thereby limiting the potential for further improvement. Third, the presence of a ceiling effect, particularly in the control group where all participants achieved the maximum score of 28, may have restricted variability and reduced the sensitivity of the POMA instrument in detecting changes. The overall results indicate that while both traditional balance exercises and proprioceptive training led to improvements in balance performance, neither intervention produced a statistically significant change when analyzed independently. These findings suggest that the observed improvements, although clinically meaningful, were not strong enough to reach statistical significance under the conditions of the study.

Table 6 shows the comparison of gain scores between the control and intervention group. To determine the efficacy of proprioceptive training, the gain scores (post-test minus pre-test) of the control and intervention groups were compared. The control group demonstrated a higher mean gain score (3.50) compared to the intervention group (0.75). However, statistical analysis revealed that the difference between the two groups was not statistically significant ($p > 0.05$). This indicates that while both groups improved, proprioceptive training did not result in a significantly greater improvement in balance compared to traditional exercises. Therefore, the null hypothesis is accepted. The findings suggest that traditional balance exercises may be equally effective in improving balance among elderly individuals. This aligns with studies cited in literature, which indicate that multiple exercise modalities can produce similar improvements in balance and functional mobility [9]. The results of the study indicate that both traditional balance exercises and proprioceptive training are effective in improving balance among community-dwelling elderly adults. However, the absence of a significant difference between the two groups suggests that proprioceptive training does not provide additional benefits beyond those achieved through conventional methods within the duration of the study. One possible explanation for this finding is the small sample size, which may have limited the statistical power of the analysis. Additionally, the high baseline scores of participants may have reduced the potential for observable improvement, particularly in the intervention group. The presence of a ceiling effect in the control group further limited the sensitivity of the measurement tool. Despite these limitations, the findings contribute to the growing body of evidence suggesting that various forms of exercise interventions can effectively improve balance and reduce fall risk among older adults. Future studies may explore longer intervention durations, larger sample sizes, and more sensitive outcome measures to further evaluate the comparative effectiveness of proprioceptive training.

Conclusions and Recommendations

The study revealed that the community-dwelling adults exhibited a high baseline Tinetti POMA scores, indicating a low initial fall risk and strong functional balance despite age-related proprioceptive decline. Both groups showed numerical improvements over the 5-week intervention (control gain: 3.50 to 28.00 ± 0.00; intervention gain: 0.75 to 25.50 ± 0.58), reflecting an enhanced static and dynamic balance capabilities. However, the ceiling effects from the POMA tool, combined with the small sample size (n=4 per group) and short intervention duration, hindered any statistical significance ($p>0.05$ for within- and between-group differences). These trends nonetheless confirm the clinical value of targeted lower extremity exercises in supporting neuromuscular feedback, postural stability, and mobility confidence among independent seniors aged 60-75. The findings highlight that while proprioceptive drills promote sensory-motor adaptations, traditional exercises on the other hand may result in comparable short-term gains in high-functioning groups. This aligns with the neuroplasticity principles, wherein repeated proprioceptive stimuli foster a cortical reorganization and fall risk reduction, though longer protocols (8-12 weeks) are needed for measurable differences. Based on the results, physical therapists are recommended to integrate lower extremity proprioceptive training into geriatric population within the community setting, starting with 2 sessions/week (45 minutes) which will be dependent on the baseline ability level. Barangay health workers and caregivers should prioritize supervised group sessions utilizing accessible tools like foam pads, emphasizing progression from static to dynamic tasks. Future interventions could incorporate sensitive measures and larger samples to overcome limitations. Local health units should establish protocols into active aging programs, where exercises will be combined with fall prevention, home modifications, and adherence strategies. PT students and practitioners must collaborate on creating a standardized guideline, while keeping track of the participant's medical conditions and future health outcomes through follow-up sessions at 3–6-month intervals. Collectively, this research stresses the promise of proprioceptive training for enhancing balance and quality of life in aging populations. Organizations in Manila's are encouraged to sustain evidence-based exercise programs, foster community partnerships, and invest in extendable rehabilitation to promote independence, reduce healthcare burdens, and support healthy aging.

References

1. World Health Organization: WHO. (2024, October 1). *Ageing and health*. https://www.who.int/news-room/fact-sheets/detail/ageing-and-health
2. Ferlinc A, Fabiani E, Velnar T & Gradisnik L. The Importance and Role of Proprioception in the Elderly: a Short Review. *Materia Socio Medica*, 2019, *31*(3), 219. https://doi.org/10.5455/msm.2019.31.219-221
3. Winter L, Huang Q, Sertic J. V. L & Konczak J. The Effectiveness of proprioceptive Training for Improving Motor performance and Motor Dysfunction: A Systematic review. *Frontiers in Rehabilitation Sciences*, 2022b, 3. https://doi.org/10.3389/fresc.2022.830166
4. Scura D & Munakomi S. Tinetti Gait and Balance Test. In *StatPearls*. StatPearls Publishing. 2022.
5. Flint B and Tadi P. *Physiology, Aging*. National Library of Medicine. 2023. Retrieved from https://www.ncbi.nlm.nih.gov/books/NBK556106/
6. Appeadu M.K & Bordoni B. *Falls and Fall Prevention in Older Adults*. National Library of Medicine. 2023. Retrieved from https://www.ncbi.nlm.nih.gov/books/NBK560761/
7. Balance Training. *Physiopedia*. 2025. Retrieved 10:12, February 20, 2025 from https://www.physio-pedia.com/index.php?title=Balance_Training&oldid=365709.
8. Yamazaki K, Sakai Y, Ito T, Fukuhara J & Morita Y. Percentage of decline in individual proprioceptors in older adults. *Journal of Physical Therapy Science*, 2024, *36*(9), 492–497. https://doi.org/10.1589/jpts.36.492
9. Sluga S. P & Kozinc Z. Sensorimotor and proprioceptive exercise programs to improve balance in older adults: a systematic review with meta-analysis. *European Journal of Translational Myology*. 2024. https://doi.org/10.4081/ejtm.2024.12010
10. Esposito G, Altavilla G, Di Domenico F, Aliberti S, D'Isanto T & D'Elia F. Proprioceptive training to improve static and dynamic balance in elderly. *International Journal of Statistics in Medical Research*, 2021, *10*, 194–199. https://doi.org/10.6000/1929-6029.2021.10.18
11. Henry M & Baudry S. Age-related changes in leg proprioception: implications for postural control. *Journal of Neurophysiology*, 2019, *122*(2), 525–538. https://doi.org/10.1152/jn.00067.2019
12. *Community balance and mobility scale*. Shirley Ryan AbilityLab. 2013, February 19. https://www.sralab.org/rehabilitation-measures/community-balance-and-mobility-scale
13. Karahan Z. C, Seymen F. N, Özcan A & Türkmen C. Investigating the Significance Levels of Indicators that Increase the Risk of Falling in the Older Adults. *Ahi Evran Medical Journal*. 2024. https://doi.org/10.46332/aemj.1423200
14. *APA PsycNet*. (n.d.). https://psycnet.apa.org/fulltext/2019-75018-001.html
15. Aleixo P & Abrantes J. Proprioceptive and strength exercise guidelines

to prevent falls in the elderly related to biomechanical movement characteristics. *Healthcare*, 2024, *12*(2), 186. https://doi.org/10.3390/healthcare12020186

16. Bezpamiatnyi D. Interventions to enhance proprioceptive function in older adults. *Zenodo (CERN European Organization for Nuclear Research)*. 2025. https://doi.org/10.5281/zenodo.15766270