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The Effect of Resistance Band Exercise on Dynamic Balance among Older Adults in Gresik, Indonesia

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Abstract

Background: Decreased dynamic balance in the elderly may lead to injury and reduced independence. Resistance band exercise can improve muscle strength and postural stability. **Aims:** To determine the effect of resistance band exercise on the dynamic balance level of elderly residents at Panti Jompo Lestari, Gresik Regency. **Methods:** This study used a pre-experimental design with a one-group pre-test and post-test approach. The sample consisted of 26 elderly participants selected using the total sampling technique. Dynamic balance was measured using the Timed Up and Go Test (TUG). The intervention was conducted for four weeks with a total of eight sessions of resistance band exercise. Data were analyzed using the Wilcoxon test with a significance level of $\alpha \leq 0.05$. **Results:** The results showed that before the intervention, the majority of respondents (92.3%) were in the moderate decline dynamic balance category. After the intervention, most respondents (84.6%) were categorized as having mild decline in dynamic balance. The Wilcoxon test result showed $p < 0.001$ and a correlation coefficient of 0.917, indicating a significant effect of resistance band exercise on improving dynamic balance in the elderly. **Conclusions:** Resistance band exercise has a significant effect on improving dynamic balance among elderly residents at Panti Jompo Lestari, Gresik Regency.

Keywords: dynamic balance, elderly, resistance band exercise, timed up and go test

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Introduction

Population aging has become a major global demographic phenomenon characterized by a growing proportion of individuals aged 60 years and older. This transition poses substantial challenges for health systems by increasing the demand for healthcare services and requiring reforms to address the complex medical needs of older adults. Physiological decline associated with aging generally begins around age 45 years and becomes more pronounced after age 60, resulting in reduced functional capacity and increased susceptibility to chronic conditions such as cardiovascular diseases, diabetes mellitus, and neurological disorders (Balachandran et al., 2024; Cai et al., 2022). Globally, the proportion of people aged 65 years and above increased from 6.1% in 1990 to 8.8% in 2017, contributing to an estimated 12 million additional deaths attributable to population aging, particularly from ischemic heart disease and stroke (Cheng et al., 2020). Moreover, women are expected to account for approximately 60% of individuals aged 80 years and older by 2030, yet they experience unique health challenges resulting from persistent gender inequalities and inadequate health data systems (Morgan et al., 2024). Therefore, addressing these disparities through evidence-based and equitable health interventions is essential to promote healthy aging and meet the diverse needs of older adults worldwide (Li et al., 2019; Morgan et al., 2024).

Indonesia officially entered the aging population era in 2000 and is projected to experience a substantial increase in its elderly population, reaching 33.69 million by 2025 and 48.19 million by 2035 (Basrowi et al., 2021). The proportion of older adults is expected to increase from approximately 5% in 2010 to 11% in 2035, reflecting the broader global trend in which nearly 20% of the world's population will be aged 65 years or older by 2050 (Dogra et al., 2022). Although this demographic transition reflects improvements in life expectancy and public health, it also presents significant challenges related to age-associated disability, declining functional independence, and increasing healthcare demands (Puspitasari et al., 2023). These challenges are further exacerbated by socioeconomic factors, including poverty, inadequate pension coverage, and limited access to health insurance, underscoring the need for comprehensive social protection systems and age-friendly environments (Faharuddin, 2025). Consequently, integrated health policies and community-based support are essential to improve the quality of life and functional well-being of Indonesia's aging population (Basrowi et al., 2021; Faharuddin, 2025).

One of the most significant consequences of aging is the progressive deterioration of the musculoskeletal and neuromuscular systems, leading to declines in muscle strength, joint flexibility, proprioception, and neuromuscular coordination. These changes negatively affect both static and dynamic balance, with dynamic balance being particularly important for everyday functional activities such as walking, turning, and transitioning between sitting and standing positions (Lin et al., 2024; Hernández-Sánchez et al., 2026). Impairment in dynamic balance substantially increases the risk of falls among older adults. Previous studies have demonstrated that structured physical exercise effectively improves both static and dynamic balance while reducing fall incidence (Papalia et al., 2020). In particular, interventions targeting trunk stability have been shown to enhance dynamic balance and functional mobility (Hernández-Sánchez et al., 2026), whereas digitally delivered exercise programs such as the Otago Exercise Program have produced significant improvements in balance and lower-limb muscle strength (He et al., 2025). Collectively, these findings highlight the importance of early and targeted exercise interventions to preserve balance and functional independence in later life.

Falls are among the most serious health consequences associated with impaired balance in older adults and represent a major public health concern worldwide. Approximately 28–35% of individuals aged 65 years and older experience at least one fall annually, with the prevalence increasing to 32–42% among those aged over 70 years (Lewis et al., 2024; Cameron et al., 2024). In Indonesia, fall-related injuries affect up to 49.4% of older adults aged over 55 years, while data from East Java indicate that 9.12% of the population experiences injuries associated with balance disorders (Lewis et al., 2024).

Furthermore, a study conducted at Lestari Nursing Home in Gresik reported that 47.5% of residents aged over 60 years exhibited impaired balance, emphasizing the urgent need for effective fall-prevention strategies in institutional settings (Leung et al., 2024). Evidence suggests that multicomponent interventions combining exercise, environmental modification, and individualized risk management significantly reduce fall incidence, particularly among high-risk older adults (Cameron et al., 2024). However, successful implementation requires sustained community engagement, institutional support, and long-term adherence to intervention programs (Cameron et al., 2024; Leung et al., 2024).

Among exercise-based interventions, resistance band exercise has emerged as a practical, low-cost, and accessible strategy to improve lower-limb muscle strength, balance, and mobility, thereby reducing fall risk in older adults. A systematic review reported that elastic band resistance training (EBT) significantly improved lower-extremity strength and balance performance, including leg extension and chair stand outcomes, with clinically meaningful effect sizes (Meng et al., 2025). Similarly, community-based exercise programs emphasizing lower-limb strengthening have demonstrated significant improvements in functional performance and reductions in fall-related injuries (Sadaqa et al., 2023). Consistent resistance band exercise, performed for approximately 15 minutes three times per week, has also been shown to improve balance and mobility, including among older adults with diabetic peripheral neuropathy (Armat et al., 2024). These findings support resistance band exercise as an effective, feasible, and economical intervention for fall prevention in the elderly (Su et al., 2022).

Despite the growing evidence supporting resistance band exercise, research specifically investigating its effects on dynamic balance among institutionalized older adults remains limited, particularly in Indonesia. Existing studies have predominantly involved community-dwelling older adults or evaluated multicomponent exercise interventions, making it difficult to isolate the specific contribution of resistance band training. A systematic review suggested that resistance band exercise may reduce frailty and depression among older adults, indicating potential benefits for nursing home residents (Saragih et al., 2021). Furthermore, elastic band resistance training has consistently demonstrated improvements in lower-limb strength, balance, and mobility across diverse older populations (Meng et al., 2025). Nevertheless, institutionalized older adults often present distinct physiological characteristics, higher levels of frailty, and more sedentary lifestyles, requiring exercise protocols specifically tailored to their needs. Current exercise guidelines remain insufficiently specific regarding resistance band exercise prescriptions for this population (Ribeiro et al., 2020). Therefore, further research is warranted to develop and validate a standardized, low-cost, and easily replicable resistance band exercise protocol for institutionalized older adults (Freire & Seixas, 2024; Bulow et al., 2025).

Based on these considerations, this study aims to analyze the effect of Resistance Band Exercise on dynamic balance among older adults residing at Lestari Nursing Home, Gresik Regency. The findings are expected to provide evidence supporting the development of practical, evidence-based, and cost-effective exercise interventions to improve dynamic balance and reduce fall risk among institutionalized older adults.

Methods

Study Design and Participants

This study employed a pre-experimental design with a one-group pretest–posttest approach. The study population consisted of 28 elderly individuals residing at Lestari Nursing Home, Gresik Regency. Using the Slovin formula with a 5% margin of error, a total sample of 26 participants was obtained. The samples were selected using a simple random sampling technique. The inclusion criteria were elderly individuals with a Timed Up and Go (TUG) score of more than 10 seconds, having a compos mentis level of consciousness, and actively participating in scheduled morning exercise programs. The

exclusion criteria included elderly individuals who refused to participate or were uncooperative, those with mental disorders, individuals experiencing chest pain at rest, those with a history of myocardial infarction within the last six months, individuals who experienced syncope or loss of consciousness within the last six months, those with fractures within the past month, and individuals experiencing shortness of breath during physical activity.

Instruments

1) Timed Up and Go (TUG) Test

This instrument is widely utilized to evaluate dynamic balance and assess fall risk in older adults (Podsiadlo & Richardson, 1991). The test quantifies the duration (in seconds) a participant takes to rise from a seated position, walk a distance of three meters, turn around, walk back, and return to the seat. The baseline results are categorized into four levels of functional interpretation: normal (<10 seconds), mild impairment (10–19 seconds), moderate impairment (20–30 seconds), and severe impairment (>30 seconds). To ensure psychometric robustness, the TUG test exhibits excellent reliability and validity. Seminal validation research indicates outstanding test-retest and inter-rater reliability, with Intraclass Correlation Coefficient (ICC) values ranging from 0.98 to 0.99 (Podsiadlo & Richardson, 1991; Shumway-Cook et al., 2000). Furthermore, a widely cited follow-up study by Shumway-Cook et al. (2000) confirmed that the TUG test is exceptionally accurate for screening fall risk among community-dwelling elderly populations, yielding a sensitivity of 87% and a specificity of 87% to 100%. Within this clinical context, a cut-off score of ≥13.5 seconds (often rounded to 14 seconds) serves as the critical threshold confirming a high risk of falls in elderly individuals.

2) Resistance Band Exercise Standard Operating Procedure (SOP)

The intervention in this study followed a standardized Resistance Band Exercise protocol designed to improve lower limb strength and dynamic balance. The procedure included structured movements using elastic resistance bands (Therabands), performed in a controlled manner according to established guidelines. The exercise sessions were conducted regularly based on a predetermined schedule to ensure consistency and safety for all participants. Data Collection.

Data collection was conducted from September 28 to October 22, 2025, involving 26 elderly participants at Lestari Nursing Home, Gresik Regency. After obtaining research approval and informed consent from all participants, researchers collected data through direct observation using the Timed Up and Go (TUG) test. Demographic data, including age and gender, were systematically recorded using a standardized demographic form. These variables were collected to describe the study population and to control for potential confounding factors in the analysis. To ensure accuracy and minimize observation bias, researchers provided standardized instructions for the TUG test and monitored participants individually, ensuring their safety throughout the assessment. Participants were informed that their participation was voluntary and that the results would be used solely for research purposes without affecting their daily care or exercise routines. The intervention consisted of a structured Resistance Band Exercise program aimed at improving lower limb strength and dynamic balance. The exercise sessions were conducted over a period of four weeks, with two sessions per week. Each session followed a standardized protocol, including warm-up, targeted resistance band exercises, and cool-down phases. Participants were closely supervised to ensure proper technique, safety, and adherence to the program.

Ethical Considerations

This study received ethical approval from the Health Research Ethics Institute of the Institute of Health Science Nahdlatul Ulama Tuban (Approval No. 184.0084223523/LEPK.IIKNU/IX/2025). All participants provided written informed consent prior to participation. The principles of anonymity,

confidentiality, and voluntary participation were upheld throughout the research process, and the study protocol was approved through an expedited review.

Data Analysis

Data were analyzed using SPSS version 25. Descriptive statistics were employed to summarize participant characteristics and dynamic balance scores before and after the intervention. The Wilcoxon signed-rank test was used to examine the effect of Resistance Band Exercise on dynamic balance, with a significance level set at $p < 0.05$

Results

The study involved 26 respondents. The majority of respondents were in the age group of 55–65 years, comprising 80.8% (n=21), followed by 66–74 years at 15.4% (n=4), and 75–90 years at 3.8% (n=1). Gender distribution showed more males (61.5%, n=16) than females (38.5%, n=10). Assessment of dynamic balance before the intervention (pre-test) showed that the majority of respondents had moderate impairment at 92.3% (n=24), while 7.7% (n=2) experienced mild impairment. No respondents were categorized as having normal balance or severe impairment. After the intervention (post-test), the distribution of dynamic balance improved, with the majority of respondents experiencing mild impairment at 84.6% (n=22), followed by moderate impairment at 15.4% (n=4). No respondents were categorized as having normal balance or severe impairment.

Table 1. Characteristics of respondents (n=26)

Characteristis	Category	Frekuency	Percentage (%)
Age	55-65 years old (elderly)	21	80,8%
	66-74 years old (young old)	4	15,4%
	75-90 years old (old)	1	3,8%
Gender	Male	16	61,5%
	Female	10	38,5%
Dynamic Balance (Pre)	Normal (<10 seconds)	0	0%
	Mild impairment (10-19 seconds)	2	7,7%
	Moderate impairment (20-30 seconds)	24	92,3%
	Severe impairment (>30 seconds)	0	0%
Dynamic Balance (Post)	Normal (<10 seconds)	0	0%
	Mild impairment (10-19 seconds)	22	84,6%
	Moderate impairment (20-30 seconds)	4	15,4%
	Severe impairment (>30 seconds)	0	0%

Based on Table 2, the level of dynamic balance among older adults prior to the implementation of resistance band exercises at Panti Jompo Lestari, Gresik Regency, indicated that the majority of respondents, totaling 24 individuals (92.3%), experienced a moderate decline in dynamic balance. After the implementation of resistance band exercises, the findings showed that most respondents, totaling 22 individuals (84.6%), demonstrated an improvement in dynamic balance, shifting from the moderate category to the mild category. Therefore, the results of this study indicate that respondents with a moderate decline in dynamic balance were more prevalent in the pre-test group, while those in the mild decline category were more prevalent in the post-test group.

Table 2. Analysis of the Effect of Resistance Band Exercise on the Level of Dynamic Balance (n=26)

Resistance band exercise	Dynamic Balance Level				p-value
	Normal	Mild impairment	Moderate impairment	Severe impairment	
Pre-Test	0 (0%)	2 (7,7%)	24 (92,3%)	0 (0%)	0,001
Post-Test	0 (0%)	22 (84,6%)	4 (15,4%)	0 (0%)	

Discussion

This study demonstrated that resistance band exercise significantly improved dynamic balance among older adults. The reduction in Timed Up and Go (TUG) scores after the intervention indicates enhanced functional mobility and postural control. These findings are consistent with current evidence demonstrating that resistance-based exercise effectively improves balance and reduces fall risk in older adults, while providing additional evidence from an Indonesian elderly population.

1. Dynamic Balance Before Resistance Band Exercise Intervention

The present study found that most participants exhibited moderate impairment in dynamic balance prior to the intervention. This finding is consistent with previous studies showing that aging is accompanied by progressive declines in balance and functional mobility due to physiological deterioration across multiple systems. Age-related reductions in visual, vestibular, and proprioceptive function, together with decreased lower-extremity muscle strength and delayed neuromuscular responses, contribute substantially to impaired postural control and increased fall risk (Hernández-Sánchez et al., 2026; Gerhardy et al., 2019). The Timed Up and Go (TUG) test is widely recognized as a valid and reliable measure of dynamic balance and functional mobility in older adults. Previous studies have demonstrated that poorer TUG performance is associated with deficits in sensory integration and is a strong predictor of future falls (Gerhardy et al., 2019; Yu et al., 2021). Consequently, early identification of balance impairment through TUG assessment is essential to facilitate timely interventions aimed at preventing falls and maintaining functional independence (Murphy et al., 2023; Hernández-Sánchez et al., 2026).

Although aging generally results in declining balance performance, individual variability was observed in this study. Some participants aged 55–65 years demonstrated better dynamic balance despite belonging to the older age group. This finding may be explained by differences in habitual physical activity. Older adults who regularly engage in light-to-moderate physical activities, such as walking, tend to preserve muscle function, postural control, and neuromuscular coordination more effectively than sedentary individuals. These findings support the concept of neuroplasticity, whereby continuous physical activity promotes adaptive changes in the neuromuscular system that help maintain functional performance during aging (Rodrigues et al., 2023; Hernández-Sánchez et al., 2026). Furthermore, interventions targeting trunk stability, neurofeedback, and somatosensory training have also demonstrated positive effects on dynamic balance and mobility, highlighting the importance of maintaining an active lifestyle throughout older adulthood (Darijani et al., 2024).

Besides age, several individual characteristics may also influence dynamic balance. Previous studies suggest that men often experience greater balance decline than women, partly due to differences in body height, body mass, and center of gravity, which affect postural stability (Puszczałowska-Lizis et al., 2018). Conversely, women may experience greater balance limitations under certain clinical conditions, such as following total hip replacement (Queen & Schmitt, 2021). Body composition also contributes to balance performance, with reduced lean muscle mass in men and increased fat mass in women being associated with a higher risk of falls (Waters et al., 2019). Therefore, interventions

designed to improve balance should consider individual characteristics, including age, sex, body composition, and baseline physical function, to maximize rehabilitation outcomes (Carral et al., 2019; Lin et al., 2024).

2. Dynamic Balance After Resistance Band Exercise Intervention

Following the resistance band exercise program, participants demonstrated significant improvements in dynamic balance, as reflected by lower TUG scores. These findings are consistent with systematic review evidence indicating that elastic resistance training effectively improves lower-extremity muscle strength, balance performance, and functional mobility among older adults (Meng et al., 2025). The observed improvements are likely attributable to neuromuscular adaptations, including increased muscle strength, enhanced motor unit recruitment, and improved intermuscular coordination, all of which contribute to greater stability during movement (Schaun et al., 2022).

Participants aged 55–65 years appeared to experience greater improvements than older participants, which may reflect better physiological adaptability and greater responsiveness to exercise. Nevertheless, positive changes were observed across all age groups, suggesting that resistance band exercise remains beneficial even in advanced age (Chen et al., 2026). Similar findings have been reported in studies comparing different exercise modalities, where resistance training consistently improved balance and reduced fall risk, with neuromuscular training producing particularly favorable effects on dynamic balance (Zhong et al., 2025; Zhang et al., 2025).

The present findings also agree with previous studies demonstrating that resistance band exercise improves functional mobility in both older men and women. A systematic review reported significant improvements in lower-limb strength, TUG performance, and chair stand test outcomes following elastic resistance training (Meng et al., 2025). Likewise, long-term strength training performed on stable and unstable surfaces has been shown to significantly improve balance and mobility in older adults (Pirauá et al., 2019). Despite these improvements, some participants remained within the moderate balance category after the intervention. This may reflect individual differences in baseline physical capacity, exercise adherence, health conditions, or age-related physiological limitations, which are known to influence responsiveness to exercise interventions (Fielding, 2024). Therefore, individualized exercise prescription may optimize functional improvements while addressing both physical and psychological aspects of mobility (Ladlow et al., 2023; Schaun et al., 2022).

3. Effect of Resistance Band Exercise on Dynamic Balance in Older Adults

The present study demonstrated that resistance band exercise significantly improved dynamic balance among older adults, as evidenced by a reduction in the mean TUG score from 21.70 seconds before the intervention to 18.04 seconds afterward. This improvement supports previous evidence showing that resistance training effectively enhances muscle strength, balance, and functional mobility in older populations (Meng et al., 2025; Nj et al., 2023). The beneficial effects of resistance band exercise are primarily explained by neuromuscular adaptations. Progressive resistance exercise increases lower-extremity muscle strength while improving motor control, proprioception, and postural stability, all of which contribute to enhanced dynamic balance during functional activities (Rodrigues et al., 2023; Hamed et al., 2018). Improved lower-body strength has consistently been associated with better balance performance and reduced fall risk, emphasizing the importance of maintaining muscle function throughout the aging process (Fielding, 2024; Hamed et al., 2018).

These findings are further supported by systematic reviews and meta-analyses demonstrating that elastic resistance training significantly improves lower-limb strength, chair stand performance, and TUG outcomes in older adults (Meng et al., 2025). Moreover, resistance-based exercise interventions have been shown to improve functional fitness, mobility, and balance, with muscle strength gains ranging from approximately 20% to 40% depending on exercise intensity and program duration (Chen et al., 2026). Multi-component exercise programs that combine resistance training with balance and

functional exercises also provide substantial reductions in fall risk and should be considered as part of comprehensive fall prevention strategies (Xu et al., 2025). Although individual responses vary according to age, baseline fitness, and health status, the overall evidence consistently supports resistance training as a safe, feasible, and effective intervention for preserving independence and improving quality of life among older adults (Fielding, 2024; Miller et al., 2022). Overall, the findings of this study reinforce current evidence that resistance band exercise is an effective, low-cost, and practical intervention for improving dynamic balance in older adults. Given its simplicity, safety, and minimal equipment requirements, resistance band exercise can be readily incorporated into routine physical activity programs in community and residential elderly care settings to enhance functional mobility, reduce fall risk, and promote healthy aging.

Study Limitations and Future Research Recommendations

This study has several limitations; however, they do not affect the main objective of the research. First, the researcher required considerable time to ensure the elderly participants were cooperative in determining the schedule for the intervention sessions. Second, some participants had limited understanding in following the exercise movements, which required continuous assistance and supervision from the researcher during the intervention process. For future research, it is recommended to involve a larger sample size and include multiple research sites to improve the generalizability of the findings. Additionally, future studies may consider incorporating longer intervention periods and follow-up assessments to evaluate the long-term effects of resistance band exercise on dynamic balance. Providing clearer instructional methods, such as visual aids or structured training guidance, may also help improve participant understanding and independence during exercise sessions.

Conclusion

This study concludes that resistance band exercise has a positive and statistically significant effect on improving dynamic balance among older adults residing at Lestari Nursing Home, Gresik Regency. The results of the Timed Up and Go (TUG) test demonstrated a significant reduction in the mean completion time, decreasing from 21.70 seconds before the intervention to 18.04 seconds after the intervention. This improvement was further reflected in the participants' balance status, with the majority of older adults who initially exhibited a moderate level of balance impairment (92.3%) improving to a mild level of balance impairment (84.6%) following the intervention. These findings demonstrate that resistance band exercise is a practical, safe, and cost-effective intervention for strengthening lower-extremity muscles and enhancing functional mobility among older adults in long-term care facilities. From a practical perspective, nursing homes are encouraged to incorporate resistance band exercises into their routine daily activities to reduce the risk of falls and promote healthy aging.

Conflicts of Interest

The authors declare no conflicts of interest in this study. All authors have completed the ICMJE uniform disclosure form and report no financial relationships with any organizations that might have an interest in the submitted work.

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Author's Contribution

All authors made significant contributions to the development of this manuscript, including the study conception, manuscript preparation, critical revisions, and approval of the final version for publication. Each author reviewed and approved the manuscript prior to its submission.

Data Availability Statement

The data generated and analyzed during the present study are available from the corresponding author upon reasonable request.

Declaration of Use of AI in Academic Writing

The author utilized ChatGPT and Grammarly during the manuscript preparation process to enhance language clarity and correct grammatical issues. Nevertheless, the author assumes full responsibility for the accuracy, integrity, and content of the manuscript.

References

Armat, M. R., Mortazavi, H., Akbari, H., & Baghizade, S. (2024). The effect of resistance exercises using an elastic band on balance and fear of falling in older adults with diabetic peripheral neuropathy: A 16-week randomized controlled trial. Archives of Physical Medicine and Rehabilitation. https://doi.org/10.1016/j.apmr.2023.11.017

Balachandran, A., Pei, H., Kothari, M., Dominigue, B., Furuya, A., & Belsky, D. W. (2024). Quantifying pace of aging among older adults: an analysis with health and retirement study. Innovation in Aging, 8(Supplement_1), 687–688. https://doi.org/10.1093/geroni/igae098.2246

Basrowi, R. W., Rahayu, E. M., Khoe, L. C., Wasito, E., & Sundjaya, T. (2021). The Road to Healthy Ageing: What Has Indonesia Achieved So Far? Nutrients, 13(10), 3441. https://doi.org/10.3390/NU13103441

Bulow, A., Oates, A., Olarinde, F., Singer, J. C., Van Ooteghem, K., & Sibley, K. M. (2025). Psychometric properties of instrumented tools and outcome measures to assess dynamic, anticipatory and reactive balance in older adults: A scoping review. Gait & Posture, 124, 110054. https://doi.org/10.1016/j.gaitpost.2025.110054

Cai, Y., Song, W., Li, J., Jing, Y., Liang, C., Zhang, L., Zhang, X., Zhang, W., Liu, B., An, Y., Li, J., Tang, B., Pei, S., Wu, X.-M., Liu, Y., Zhuang, C.-L., Ying, Y., Dou, X., Chen, Y., … Han, J.-D. J. (2022). The landscape of aging. Science China-Life Sciences, 65(12), 2354–2454. https://doi.org/10.1007/s11427-022-2161-3

Cameron, I. D., Kurrle, S., & Sherrington, C. (2024). Preventing falls and fall-related injuries in older people. The Medical Journal of Australia. https://doi.org/10.5694/mja2.52374

Cancela Carral, J. M., Ayán, C., Sturzinger, L., & Gonzalez, G. (2019). Relationships Between Body Mass Index and Static and Dynamic Balance in Active and Inactive Older Adults. Journal of Geriatric Physical Therapy, 42(4). https://doi.org/10.1519/JPT.0000000000000195

Chen, C., Freire, C., Teixeira, I., Adegas, M., Gomes, R., Rabaçal, R., Malheiro, A., Leite, L. B., Reis, A.,

Monteiro, A. M., Yang, J., Yao, X., & Forte, P. (2026). Impact of physical exercise interventions on functional fitness in older adults. Frontiers in Medicine. https://doi.org/10.3389/fmed.2025.1732129

Cheng, X., Yang, Y., Schwebel, D. C., Liu, Z., Li, L., Cheng, P., Ning, P., & Hu, G. (2020). Population ageing and mortality during 1990-2017: A global decomposition analysis. PLOS Medicine, 17(6). https://doi.org/10.1371/JOURNAL.PMED.1003138

Clemson L, Stark S, Pighills AC, Fairhall NJ, Lamb SE, Ali J, Sherrington C. Environmental interventions for preventing falls in older people living in the community. Cochrane Database of Systematic Reviews 2023, Issue 3. Art. No.: CD013258. DOI: 10.1002/14651858.CD013258.pub2. Accessed 23 July 2026.

Faharuddin, F. (2025). Poverty Among Elderly in Indonesia: Extent, Determinants, and Policy Implications. Poverty & Public Policy, 17(3). https://doi.org/10.1002/pop4.70025

Fielding, R. A. (2024). Resistance training exercise for the rehabilitation of older adults: a function promoting therapy with robust treatment response heterogeneity. Innovation in Aging, 8(Supplement_1), 288. https://doi.org/10.1093/geroni/igae098.0939

Freire, I., & Seixas, A. (2024). Effectiveness of a sensorimotor exercise program on proprioception, balance, muscle strength, functional mobility and risk of falls in older people. Frontiers in Physiology. https://doi.org/10.3389/fphys.2024.1309161

Gerhardy, T., Gordt, K., Jansen, C.-P., & Schwenk, M. (2019). Towards Using the Instrumented Timed Up-and-Go Test for Screening of Sensory System Performance for Balance Control in Older Adults. Sensors, 19(3), 622. https://doi.org/10.3390/S19030622

Hamed, A., Hamed, A., Bohm, S., Mersmann, F., & Arampatzis, A. (2018). Exercises of dynamic stability under unstable conditions increase muscle strength and balance ability in the elderly. Scandinavian Journal of Medicine & Science in Sports, 28(3), 961–971. https://doi.org/10.1111/SMS.13019

He, Z., Hua, W., Zhao, G., Zhang, Y., Li, C., Xing, Y., Xu, A., Yang, J., & Wang, R. (2025). The effectiveness of digital technology-based Otago Exercise Program on balance ability, muscle strength and fall efficacy in the elderly: a systematic review and meta-analysis. BMC Public Health, 25(1). https://doi.org/10.1186/s12889-024-21251-9

Hernández-Sánchez, S., De Los Ríos-Calonge, J., Juan-Recio, C., Prat-Luri, A., Vera-Garcia, F., & Barbado, D. (2026). Understanding the effects of aging on whole-body dynamic balance, trunk stability, functional mobility, and hip strength. Dental Science Reports. https://doi.org/10.1038/s41598-026-35724-x

Ladlow, P., Western, M. J., Greaves, C., Thompson, J. L., Withall, J., De Koning, J., Bollen, J., Moorlock, S. J., Guralnik, J. M., Fox, K. R., & Stathi, A. (2023). The REtirement in ACTion exercise programme and its effects on elements of long term functionality in older adults. Frontiers in Public Health, 11. https://doi.org/10.3389/fpubh.2023.1151035

Leung, P., Alexander, J. T., & Ouchida, K. (2024). Falls Prevention for Older Adults. JAMA. https://doi.org/10.1001/jama.2023.26942

Lewis, S. R., McGarrigle, L., Pritchard, M. W., Bosco, A., Yang, Y., Gluchowski, A., Sremanakova, J., Boulton, E. R., Gittins, M., Spinks, A., Rapp, K., MacIntyre, D. E., McClure, R. J., & Todd, C. (2024). Population-based interventions for preventing falls and fall-related injuries in older people. Cochrane Database of Systematic Reviews, 2024. https://doi.org/10.1002/14651858.cd013789.pub2

Li, J., Han, X., Zhang, X., & Wang, S. (2019). Spatiotemporal evolution of global population ageing from 1960 to 2017. BMC Public Health, 19(1), 127. https://doi.org/10.1186/S12889-019-6465-2

Lin, T.-T., Cheng, L.-Y., Chen, C.-C., Pan, W.-R., Tan, Y.-K., Chen, S., & Wang, F. (2024). Age-Related Influence on Static and Dynamic Balance Abilities: An Inertial Measurement Unit-Based Evaluation. Sensors, 24(21), 7078. https://doi.org/10.3390/s24217078

Meng, Y., Meng, Y., Hu, Y., Hu, Y., Yang, W., Yang, W., Xue, Y., Yang, S., & Yang, S. (2025). Effects of elastic band resistance training on lower limb strength and balance function in older adults: a systematic review and meta-analysis. Frontiers in Sports and Active Living, 7.

https://doi.org/10.3389/fspor.2025.1649305
Miller, K., Weitzel, K. J., Bliss, R., Duren, D. L., Ball, S. D., & Baker, B. S. (2022). Older adults who resistance train improve physical function and adopt long-term exercise habits despite COVID-19 restrictions. Journal of Sports Sciences, 40(19), 2128–2135. https://doi.org/10.1080/02640414.2022.2140912
Morgan, R., Kalbarczyk, A., Mohan, D., Jacobs, C., Mishra, M., Tyagi, P., Jacobs, C., & Williamson, C. (2024). Counting older women: Measuring the health and wellbeing of older women in LMICs. Cell Reports Medicine, 5(6), 101607. https://doi.org/10.1016/j.xcrm.2024.101607
Murphy, E., An, Y. W., Lee, S.-R., & Wood, R. H. (2023). Effects Of Postural Change On Gait And Postural Sway In Older Adults. Medicine and Science in Sports and Exercise, 55(9S), 743–744. https://doi.org/10.1249/01.mss.0000986828.26804.e8
Nj, S., Weitzel, K. J., Miller, K., Oliveira, M. N., Ball, S., & Baker, B. S. (2023). Improving Older Adults' Functional Health Using the Progressive Stay Strong, Stay Healthy Program. Journal of Applied Gerontology, 43(1), 37–46. https://doi.org/10.1177/07334648231199996
Papalia, G. F., Papalia, R., Diaz Balzani, L. A., Torre, G., Zampogna, B., Vasta, S., Fossati, C., Alifano, A. M., & Denaro, V. (2020). The Effects of Physical Exercise on Balance and Prevention of Falls in Older People: A Systematic Review and Meta-Analysis. Journal of Clinical Medicine, 9(8), 2595. https://doi.org/10.3390/JCM9082595
Pirauá, A. L. T., Cavalcante, B. R., de Oliveira, V. M. A., Beltrão, N. B., Batista, G. de A., Pitangui, A. C. R., Behm, D. G., de Araújo, R. C., & de Araújo, R. C. (2019). Effect of 24-week strength training on unstable surfaces on mobility, balance, and concern about falling in older adults. Scandinavian Journal of Medicine & Science in Sports, 29(11), 1805–1812. https://doi.org/10.1111/SMS.13510
Podsiadlo, D. and Richardson, S. (1991), The Timed "Up & Go": A Test of Basic Functional Mobility for Frail Elderly Persons. Journal of the American Geriatrics Society, 39: 142-148. https://doi.org/10.1111/j.1532-5415.1991.tb01616.x
Puspitasari, M. D., Rahardja, M. B., Herartri, R., & Surbakti, I. M. (2023). Managing Age-Related Disability in Indonesia: An Issue That Extends Beyond the Concept of Active Aging. Journal of Aging & Social Policy, 1–17. https://doi.org/10.1080/08959420.2023.2226313
Puszczałowska-Lizis, E., Bujas, P., Jandzis, S., Omorczyk, J., & Zak, M. (2018). Inter-gender differences of balance indicators in persons 60–90 years of age. Clinical Interventions in Aging, 13, 903–912. https://doi.org/10.2147/CIA.S157182
Queen, R. M., & Schmitt, D. (2021). Sex-Specific Difference in Dynamic Balance Following Total Hip Replacement. Innovation in Aging, 5(2). https://doi.org/10.1093/GERONI/IGAB019
Ribeiro, A. S., Nunes, J. P., & Schoenfeld, B. J. (2020). Selection of Resistance Exercises for Older Individuals: The Forgotten Variable. Sports Medicine, 50(6), 1051–1057. https://doi.org/10.1007/S40279-020-01260-5
Rodrigues, F. M. S., Antunes, R., Matos, R., Jacinto, M., Monteiro, D., Forte, P., & Barbosa, T. M. (2023). Anthropometric Measures, Muscle Resistance, and Balance in Physically Active, Aged Adults. Sports, 11(6), 113. https://doi.org/10.3390/sports11060113
Sadaqa, M., Németh, Z., Makai, A., Prémusz, V., & Hock, M. (2023). Effectiveness of exercise interventions on fall prevention in ambulatory community-dwelling older adults: a systematic review with narrative synthesis. Frontiers in Public Health, 11. https://doi.org/10.3389/fpubh.2023.1209319
Saragih, I. D., Yang, Y.-P., Saragih, I. S., Batubara, S. O., & Lin, C.-J. (2021). Effects of resistance bands exercise for frail older adults: A systematic review and meta-analysis of randomised controlled studies. Journal of Clinical Nursing, 31, 43–61. https://doi.org/10.1111/JOCN.15950
Schaun, G. Z., Bamman, M. M., Andrade, L. S., David, G. B., Krüger, V. L., Marins, E. F., Nunes, G. N., Häfele, M., Mendes, G. F., Gomes, M. L. B., Campelo, P. C., Pinto, S. S., & Alberton, C. L. (2022). High-velocity resistance training mitigates physiological and functional impairments in middle-

aged and older adults with and without mobility-limitation. GeroScience, 44(3), 1175–1197. https://doi.org/10.1007/s11357-022-00520-8

Sedighi Darijani, S., Sahebozamani, M., Eslami Shahrbabaki, M., Babakhanian, S., Alimoradi, M., & Iranmanesh, M. (2024). The effect of neurofeedback and somatosensory exercises on balance and physical performance of older adults: a parallel single-blinded randomized controlled trial. Dental Science Reports, 14(1). https://doi.org/10.1038/s41598-024-74980-7

Shilpa Dogra, David W. Dunstan, Takemi Sugiyama, Afroditi Stathi, Paul A. Gardiner, Neville Owen. 2022. Active Aging and Public Health: Evidence, Implications, and Opportunities. Annual Review Public Health. 43:439-459. https://doi.org/10.1146/annurev-publhealth-052620-091107

Shumway-Cook, A., Brauer, S., & Woollacott, M. (2000). Predicting the probability for falls in community-dwelling older adults using the Timed Up & Go Test. Physical therapy, 80(9), 896–903.

Su, Y., Chen, H. L., Lin, Y.-K., & Liu, C. H. (2022). Effectiveness of Elastic Band Exercises on the Functional Fitness of Older Adults in Long-Term Care Facilities. Journal of Nursing Research, 30(5), e235. https://doi.org/10.1097/jnr.0000000000000511

Waters, D. L., Qualls, C., Cesari, M., Cesari, M., Rolland, Y., Vlietstra, L., Vellas, B., & Vellas, B. (2019). Relationship of Incident Falls with Balance Deficits and Body Composition in Male and Female Community-Dwelling Elders. Journal of Nutrition Health & Aging, 23(1), 9–13. https://doi.org/10.1007/S12603-018-1087-4

Xu, H., Wei, J.-P., Quan, H.-L., Han, X.-J., Li, T.-X., & Shi, J.-P. (2025). Effectiveness of exercise prescription variables to reduce fall risk among older adults: a meta-analysis. European Review of Aging and Physical Activity, 22. https://doi.org/10.1186/s11556-025-00374-x

Yu, L., Zhao, Y., Wang, H., Sun, T.-L., Murphy, T. E., & Tsui, K.-L. (2021). Assessing elderly's functional balance and mobility via analyzing data from waist-mounted tri-axial wearable accelerometers in timed up and go tests. BMC Medical Informatics and Decision Making, 21(1), 108. https://doi.org/10.1186/S12911-021-01463-4

Zhang, S., Qian, G., Xu, H., Gu, M., Mao, S., Wang, Y., Zhang, Y., & Zhou, W.-S. (2025). Effects of different exercise modalities on balance performance in healthy older adults: a systematic review and network meta-analysis of randomized controlled trials. BMC Geriatrics, 25(1). https://doi.org/10.1186/s12877-025-06212-0

Zhong, Y.-J., Chen, P., Guo, W., Wang, Y., Yang, X., Chen, P., & Liu, J. (2025). Effects of different neuromuscular training modalities on balance performance in older adults: a systematic review and network meta-analysis. Frontiers in Physiology, 16. https://doi.org/10.3389/fphys.2025.1623908