

Changes in Blood Pressure and Dynamic Balance After Low Impact Aerobic Exercise in Older Women

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Abstract

Background: Hypertension and impaired dynamic balance are common in older adults. This study evaluated changes following low-impact aerobic exercise, with findings interpreted cautiously due to the absence of a control group.

Objective: To evaluate changes in blood pressure and dynamic balance after a four-week low-impact aerobic exercise program in older women with a history of hypertension.

Methods: This pre-experimental one-group pretest-posttest study included 20 women aged 60–75 years who completed 12 supervised sessions over four weeks. Each 30-minute session was conducted three times weekly. Blood pressure was measured using a digital sphygmomanometer, and dynamic balance was assessed using the Timed Up and Go Test. Pretest and posttest values were compared using paired-sample t tests.

Results: Systolic blood pressure decreased from 142.50 ± 17.733 to 124.70 ± 13.095 mmHg, while diastolic blood pressure decreased from 88.20 ± 9.423 to 77.90 ± 4.962 mmHg (both $p < 0.001$). Timed Up and Go time decreased from 16.07 ± 3.23 to 12.78 ± 3.24 seconds ($p < 0.001$).

Conclusion: Blood pressure and Timed Up and Go time decreased after four weeks of low-impact aerobic exercise. These pretest-to-posttest changes do not establish a causal effect because the study lacked a control group and potential confounders were not fully documented.

Keywords

Exercise; Hypertension; Aged; Blood Pressure; Postural Balance; Geriatric Assessment

Introduction

Population ageing is increasing the number of older adults who require strategies to maintain cardiovascular health, mobility, and independence. Ageing is accompanied by progressive changes in cardiovascular, respiratory, musculoskeletal, and functional systems that may increase vulnerability to chronic disease and mobility limitations. Physical activity is an important component of healthy ageing, including for older adults living with chronic conditions such as hypertension.^{1,2}

Hypertension is particularly relevant in later life because age related vascular changes may contribute to elevated blood pressure. The World Health Organization emphasizes lifestyle modification alongside pharmacological management for hypertension.^{1,3} Older women with hypertension represent a clinically relevant group because blood pressure responses observed during an exercise program may reflect exercise exposure as well as concurrent medication and behavioural factors.⁴ In the present study, all participants were reported to be taking antihypertensive medication, although medication class, dose stability, adherence, and changes in treatment were not documented.

Dynamic balance is another important functional concern in older adults. Reduced balance may impair mobility and independence and is associated with fall risk. The Timed Up and Go Test is a commonly used measure of functional mobility that records the time required to rise from a chair, walk, turn, return, and sit.⁵ Exercise involving stepping, weight transfer, changes of direction, and coordinated limb movement may therefore be relevant to dynamic balance.⁶

Low impact aerobic exercise consists of rhythmic movements performed with reduced impact loading compared with activities involving jumping. Previous studies in the submitted evidence base have reported changes in blood pressure and dynamic balance following low impact aerobic or related exercise programs. Broader evidence from systematic reviews and meta analyses also supports reductions in blood pressure following aerobic exercise in adults with hypertension.^{7–12} Studies have additionally examined low impact aerobic exercise in relation to dynamic balance and functional outcomes in older adults.^{9–11}

Despite this evidence, the evidence base remains heterogeneous with respect to participant characteristics, exercise dose, outcome measures, and study design. Previous studies have examined blood pressure or balance separately, while evidence directly describing both outcomes within the same four-week low impact program in older women with hypertension is more limited.^{9–11,13–16} This gap is clinically relevant because blood pressure and functional mobility represent distinct but complementary domains of health in older adults.¹⁷ However, the present one group pretest posttest design is not capable of separating intervention related change from history, maturation, regression to the mean, medication changes, changes in physical activity, or other external influences. The contribution of this study is therefore best framed as a description of temporal changes in two clinically relevant outcomes within a defined community-based group, rather than as definitive evidence of causal effectiveness.

The objective of this study was to evaluate changes in systolic blood pressure, diastolic blood pressure, and dynamic balance after four weeks of low impact aerobic exercise in older women with a history of hypertension in Banjar Badung Tengah, Desa Ayunan, Kecamatan Abiansemal, Kabupaten Badung.

Methods

This quantitative pre-experimental study used a one group pretest posttest design. Baseline assessments were performed before the exercise program and repeated after completion of the four-week intervention. The study was conducted in Banjar Badung Tengah, Desa Ayunan, Kecamatan Abiansemal, Kabupaten Badung, from April to May 2026.

The source population consisted of 50 older women residing in Banjar Badung Tengah. According to the author confirmation form, 50 individuals were screened, 20 met the eligibility criteria, 30 were excluded because they did not meet the inclusion criteria, no individuals declined participation, 20 were enrolled, all 20 completed the intervention, and all 20 were analyzed. The confirmed recruitment technique was purposive sampling. The earlier use of the term total sampling is therefore not retained in the final description.

Inclusion criteria were women aged 60 to 75 years, a history of hypertension with current use of antihypertensive medication, residence and active participation in activities in Banjar Badung Tengah, and a stated good physical, mental, and social health condition. Exclusion criteria applied before enrollment were recovery from conditions such as fracture, geriatric status with complications, and inability to perform physical activity. Failure to attend exercise sessions regularly was treated as an adherence or discontinuation issue rather than an eligibility criterion. All enrolled participants completed the required 12 sessions, and no dropout or missing pretest or posttest data was reported.

No a priori sample size calculation was performed or reported. The final sample consisted of 20 participants who met the eligibility criteria and completed the intervention. The absence of an a priori sample size determination is acknowledged as a methodological limitation.

The intervention consisted of low impact aerobic exercise delivered three times per week for four weeks, with 30 minutes per session and 12 sessions in total. The program used the same dose throughout the four week period, with no structured progression and no individualized modification based on physical capacity, physiological response, blood pressure, or balance. The exercise sequence was based on an official video associated with Rumah Sakit Jantung dan Pembuluh Darah Harapan Kita and was delivered under supervision.

Each 10-minute sequence consisted of approximately four minutes of warm up, three minutes of core exercise, and three minutes of cool down, and the sequence was repeated three times to achieve a total session duration of 30 minutes. Warm up activities included breathing exercises, shoulder stretching, head flexion and extension, rotation and lateral flexion, shoulder rotation, arm swings, trunk rotation, and coordinated upper and lower limb movements. Core activities included marching, step touch, V step, grapevine, heel touch, toe touch, knee lift, and side leg raise. Cool down activities included marching, stretching, head, arm, and leg coordination, and breathing exercises. Each movement was reported as two sets of eight repetitions.

Exercise intensity was monitored using heart rate. Maximum heart rate was estimated using 220 minus age, with a target of approximately 50% to 60% of estimated maximum heart rate and a reported exercise heart rate range of 78 to 93 beats per minute. Heart rate was checked before and after each session. Heart rate reserve, rating of perceived exertion, and the talk test were not used. The same protocol was applied across all 12 sessions. The author confirmation form states that no specific system was used to document protocol deviations and that the identity and qualification of the instructor were not specifically recorded in the study report.

Blood pressure was assessed before and after the intervention using a OneMed sphygmomanometer. Participants were seated comfortably with both feet flat on the floor and the arm positioned at heart level. A minimum five-minute rest period preceded measurement. The cuff was placed snugly around the upper arm. At least two measurements were taken with an interval of one to two minutes. Systolic and diastolic blood pressure were recorded in mmHg. The calibration status of the device was not available in the study records.

Dynamic balance was assessed using the Timed Up and Go Test. Participants began seated in a chair, responded to the verbal command to start, stood, walked three metres, turned, walked back three metres, and sat down again. Timing began at the start command. Participants wore shoes and did not use an assistive device, although they were accompanied and supervised for safety. Familiarization was provided and one test trial was performed. The chair height was not measured and therefore cannot be specified retrospectively. The study used the following categories: less than 10 seconds as normal or full independence, less than 20 seconds as mild fall risk, 20 to 29 seconds as moderate fall risk, and more than 30 seconds as high fall risk. The source identified by the author for these cutoffs was Sari et al. (2022) in the thesis documentation, but the complete bibliographic details were not provided in the author confirmation form.

Blood pressure categories were based on thresholds reported by the author as derived from the World Health Organization and International Society of Hypertension Working Group: optimal, less than 120/80 mmHg; normal, less than 130/85 mmHg; normal high, 130 to 139/85 to 89 mmHg; grade I hypertension, 140 to 159/90 to 99 mmHg; grade II hypertension, 160 to 179/100 to 109 mmHg; and grade III hypertension, at least 180/110 mmHg. The exact source document used for the classification was not supplied with the author confirmation form.

Data were processed using IBM SPSS Statistics. Descriptive statistics summarized participant characteristics and continuous outcomes. The original analysis used the Shapiro Wilk test followed by paired sample t tests with a significance threshold of $p < 0.05$. The author confirmation form indicates that Shapiro Wilk testing was performed separately for pretest and posttest measurements rather than on paired change scores. Therefore, the normality assumption relevant to the paired t test was not directly assessed in the reported analysis. The paired sample t test results were nevertheless retained because they were generated from the original statistical output.

For the paired comparisons, the confirmed mean differences, standard deviations of the paired differences, t statistics, degrees of freedom, and p values were used to report 95% confidence intervals and Cohen dz effect sizes. These quantities were calculated from the confirmed paired difference statistics without altering the underlying study data. No missing data were reported. The study was approved by the Health Research Ethics Committee of the Faculty of Medicine, Universitas Dhyana Pura, under Ethical Approval No. 001555/KEP Universitas Dhyana Pura/2026. Written informed consent was obtained from all participants before study procedures.

Results

The participant flow is summarized in Figure 1. Fifty older women were screened, 20 were eligible and enrolled, and 30 were excluded because they did not meet the inclusion criteria. No individuals declined participation. All 20 enrolled participants completed all 12 required sessions and were included in the analysis. No missing pretest or posttest data were reported.

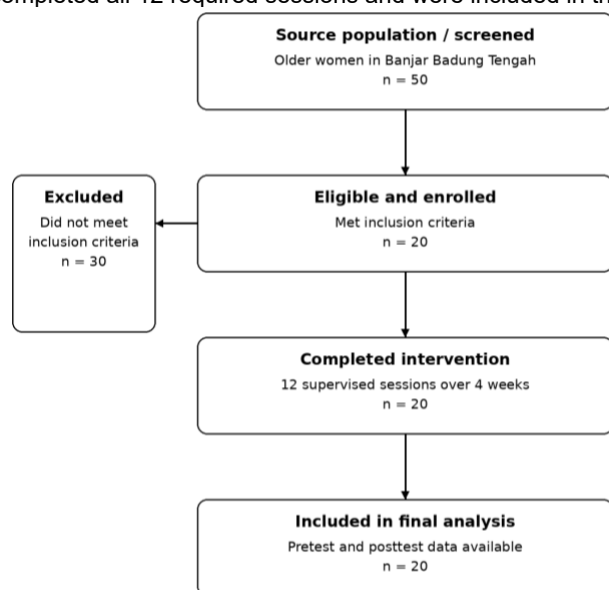


Figure 1. Participant flow from the source population to the final analysis.

All analyzed participants were women. Seven participants were aged 60 to 63 years, three were aged 64 to 67 years, three were aged 68 to 71 years, and seven were aged 72 to 75 years. All participants were reported to have a history of hypertension and to be taking antihypertensive medication. Medication class, dose stability, adherence, comorbidities, and changes in therapy were not available. Table 1 summarizes the demographic characteristics of the 20 analyzed participants.

Table 1. Baseline demographic characteristics of the analyzed participants.

Characteristic	n (%)
Female	20 (100%)
Age 60 to 63 years	7 (35%)
Age 64 to 67 years	3 (15%)
Age 68 to 71 years	3 (15%)
Age 72 to 75 years	7 (35%)

The distribution of blood pressure categories changed after the four-week program. The proportion classified as optimal increased for both systolic and diastolic blood pressure, while the proportions classified as grade I and grade II hypertension decreased. Table 2 presents the absolute frequencies and percentages.

Table 2. Blood pressure category distribution before and after the intervention.

Category	SBP pre, n (%)	SBP post, n (%)	DBP pre, n (%)	DBP post, n (%)
Optimal	3 (15%)	9 (45%)	6 (30%)	17 (85%)
Normal	3 (15%)	8 (40%)	1 (5%)	2 (10%)
Normal high	0 (0%)	0 (0%)	2 (10%)	1 (5%)
Grade I hypertension	10 (50%)	3 (15%)	7 (35%)	0 (0%)
Grade II hypertension	4 (20%)	0 (0%)	3 (15%)	0 (0%)
Grade III hypertension	0 (0%)	0 (0%)	1 (5%)	0 (0%)
Total	20 (100%)	20 (100%)	20 (100%)	20 (100%)

Classification thresholds are based on the categories reported by the author and should be verified against the source guideline before submission.

The distribution of Timed Up and Go categories also shifted after the intervention. The number classified as normal or fully independent increased from 0 to 6 participants, while the number classified as having moderate fall risk decreased from 4 to 0 participants. The absolute frequencies and percentages are presented in Table 3.

Table 3. Dynamic balance category distribution before and after the intervention. Cutoff definitions were supplied by the author and the cited source should be verified before submission.

Category	Pretest n (%)	Posttest n (%)
Full independence, normal	0 (0%)	6 (30%)
Mild fall risk	16 (80%)	14 (70%)
Moderate fall risk	4 (20%)	0 (0%)
Severe fall risk	0 (0%)	0 (0%)
Total	20 (100%)	20 (100%)

The paired analysis showed lower systolic blood pressure, lower diastolic blood pressure, and shorter Timed Up and Go time after four weeks. The confirmed paired statistics are summarized in Table 4.

Table 4. Pretest and posttest continuous outcomes.

Outcome	Pretest mean $\pm$ SD	Posttest mean $\pm$ SD	Mean difference	95% CI	Cohen dz	t	df	p
Systolic blood pressure, mmHg	142.50 $\pm$ 17.733	124.70 $\pm$ 13.095	17.80	12.34 to 23.26	1.527	6.827	19	<0.001
Diastolic blood pressure, mmHg	88.20 $\pm$ 9.423	77.90 $\pm$ 4.962	10.30	6.17 to 14.43	1.166	5.215	19	<0.001
Timed Up and Go, seconds	16.0665 $\pm$ 3.22796	12.7845 $\pm$ 3.24214	3.282	2.88 to 3.69	3.797	16.979	19	<0.001

Mean difference represents pretest minus posttest. Confidence intervals were calculated from the confirmed paired difference standard deviations and $n=20$. Cohen dz was calculated as the mean paired difference divided by the standard deviation of the paired differences.

The paired sample *t* test showed statistically significant pretest to posttest differences for all three outcomes. Systolic blood pressure decreased by 17.80 mmHg, diastolic blood pressure by 10.30 mmHg, and Timed Up and Go time by 3.282 seconds. These estimates describe within participant changes and do not establish that the intervention caused the changes. Change score normality was not directly assessed in the original analysis.

Discussion

The present study identified lower systolic blood pressure, lower diastolic blood pressure, and shorter Timed Up and Go time after a four-week low impact aerobic exercise program in 20 older women with a history of hypertension. The paired estimates were large in standardized terms, with Cohen *dz* values of 1.527 for systolic blood pressure, 1.166 for diastolic blood pressure, and 3.797 for Timed Up and Go time. These effect size estimates should nevertheless be interpreted as within participant standardized changes rather than as unbiased intervention effects because the study did not include a control group.

The blood pressure findings are directionally consistent with evidence from systematic reviews and meta analyses showing that aerobic exercise can reduce blood pressure in adults with hypertension.^{7,8} The present reductions are also broadly compatible with previous reports of low impact aerobic exercise among older adults and people with hypertension.¹¹ However, direct comparison of the magnitude of change across studies should be made cautiously because exercise dose, participant characteristics, medication use, measurement protocols, and study design differ.^{13,14} In the current study, all participants were taking antihypertensive medication, but the class of medication, dose stability, adherence, and changes in treatment were not recorded. Consequently, pharmacological treatment may have contributed to the observed blood pressure changes.

The reduction in Timed Up and Go time is consistent with the functional characteristics of the exercise sequence. Marching, step touch, V step, grapevine, heel touch, toe touch, knee lift, and side leg raise require repeated stepping, weight transfer, changes of direction, and coordination of the upper and lower limbs. Previous studies have reported improvements in balance or functional outcomes after aerobic or low impact exercise in older adults.^{10,15,16} The present findings therefore have biological and functional plausibility. Nevertheless, the study did not measure proprioception, vestibular function, neuromuscular adaptations, lower limb strength, or cardiovascular mechanisms, so these processes cannot be considered demonstrated explanations for the observed change.

Several physiological mechanisms may plausibly contribute to changes in blood pressure and functional mobility following aerobic exercise, including adaptations in cardiovascular regulation, physical fitness, and postural control.¹⁷ However, mechanisms proposed in the original manuscript, including increased parasympathetic activity, vasodilation, reduced peripheral resistance, proprioceptive adaptation, vestibular adaptation, and neuromuscular changes, were not measured. They should therefore remain hypotheses supported by external literature rather than explanations demonstrated by the present data.

The magnitude of the within participant changes should also be considered in relation to the study design. A one group pretest posttest design is vulnerable to history, maturation, regression to the mean, measurement variation, and concurrent changes in treatment or behaviour. Regression to the mean is particularly relevant when participants are recruited partly on the basis of elevated blood pressure. The absence of a control group prevents separation of these influences from the temporal changes observed after the exercise program. The statistically significant *p* values therefore demonstrate differences between measurements rather than causal effectiveness.

Intervention fidelity was improved in the present report by documenting that all participants completed 12 sessions and that the same exercise dose was applied throughout the four-week period. Heart rate was monitored before and after each session, with a target of approximately 50% to 60% of estimated maximum heart rate. However, the study did not use heart rate reserve, rating of perceived exertion, or the talk test, and no structured progression or individualized tailoring was applied. The instructor identity and qualifications were also not documented, and no formal system for recording protocol deviations was reported. These factors limit the reproducibility and interpretation of the intervention.

Measurement reporting was also constrained by the original study records. Blood pressure measurement procedures were described sufficiently to document seated positioning, a minimum five-minute rest period, upper arm cuff placement, repeated measurements, and the OneMed device. However, calibration information was unavailable. For the Timed Up and Go Test, the three-metre walking distance, footwear, supervision, familiarization, and single trial were documented, but the chair height was not measured. These omissions should be regarded as reporting limitations rather than retrospectively reconstructed methodological details.

The analysis also requires cautious interpretation. The author confirmation form provided the paired difference standard deviations and *t* statistics, allowing calculation of confidence intervals and Cohen *dz* effect sizes. However, the Shapiro Wilk procedure was performed on pretest and posttest values separately rather than on the paired change scores, which is not the principal normality assumption for a paired *t* test. The current report therefore transparently states that change score normality was not assessed. This issue does not justify inventing or replacing the original analysis. Future studies should prespecify assessment of paired change scores and, if the assumption is not met, use an appropriate nonparametric alternative.

Baseline clinical information was limited. All participants were reported to use antihypertensive medication, but medication class, dose stability, adherence, comorbidities, dietary behaviour, other physical activity, other therapy, and medication changes were not available. These unmeasured factors may have influenced both blood pressure and functional performance. The lack of these data limits adjustment for confounding and should be considered when interpreting the observed changes.

The study has several practical strengths, including a clearly defined four-week intervention, complete attendance among the analyzed participants, consistent pretest and posttest outcomes, ethical approval, and direct assessment of clinically relevant cardiovascular and functional measures. However, the absence of a control group, lack of a priori sample size calculation, limited recruitment transparency in the original report, incomplete baseline clinical characterization, incomplete measurement

standardization, and lack of documented co intervention control restrict internal validity and generalizability. The sample was drawn from a single community-based setting and included only older women with a history of hypertension, which further limits transferability to other populations.

From a clinical perspective, the findings support further investigation of supervised low impact aerobic exercise as a potentially feasible activity for older women with hypertension, particularly when blood pressure and functional mobility are of interest. The present study does not establish safety because adverse events were not recorded, and it does not establish cost effectiveness, prevention of cardiovascular complications, or prevention of actual falls because these outcomes were not measured. Any practical implementation should therefore remain conditional on appropriate participant screening, clinical supervision, and more rigorous evaluation.

Future research should use a controlled design with an a priori sample size calculation, transparent participant flow, standardized measurement protocols, formal intervention fidelity procedures, objective and prespecified intensity targets, and systematic monitoring of medication and other co interventions. Larger samples and longer follow up would improve precision and generalizability. Additional outcomes such as lower limb strength, functional performance, quality of life, and actual fall incidence could help determine whether improvements in Timed Up and Go time translate into clinically meaningful functional benefits.

Conclusion

In this one group pretest posttest study, systolic blood pressure, diastolic blood pressure, and Timed Up and Go time were lower after a four-week low impact aerobic exercise program in 20 older women with a history of hypertension. The paired analyses demonstrated statistically significant pretest to posttest differences, with large within participant standardized changes. These findings should be interpreted as temporal changes within the studied participants rather than definitive evidence of causal intervention effects because there was no control group and potentially important confounding factors were not documented. Further controlled studies with adequate sample size determination, standardized outcome measurement, transparent participant flow, and systematic monitoring of medication and other co interventions are warranted.

Author Contribution

Juli Yanti Laia: Conceptualization, Methodology, Investigation, Data Curation, Formal Analysis, Writing Original Draft.

Agung Wahyu Permadi: Methodology, Supervision, Writing Review and Editing.

Ni Luh Made Reny Wahyu Sari: Conceptualization, Methodology, Supervision, Writing Review and Editing, Project Administration.

I Made Yoga Parwata: Validation, Supervision, Writing Review and Editing.

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Conflict of Interest Statement

The authors declare no conflict of interest.

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Ethics Statement

This study received ethical approval from the Health Research Ethics Committee of Universitas Dhyana Pura, Bali, Indonesia, under approval number 001555/KEP Universitas Dhyana Pura/2026. All participants were informed about the study objectives, procedures, benefits, and their rights before providing written informed consent.

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