Salud, Ciencia y Tecnología. 2025; 5:1148
doi: 10.56294/saludcyt20251148

ORIGINAL

Low-Intensity Resistance Exercise with Blood Flow Restriction Improves Balance in Elderly Women: A Comparative Study on the Lower Quarter Y-Balance Test

El Ejercicio de Resistencia de Baja Intensidad con Restricción del Flujo Sanguíneo Mejora el Equilibrio en Mujeres Mayores: Un estudio comparativo con la prueba de equilibrio en Y del cuarto inferior

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Cite as: Ramadhan NA, Tinduh D, Nugraheni N, Narasinta I, Subadi I, Setiawan A, et al. Low-Intensity Resistance Exercise with Blood Flow Restriction Improves Balance in Elderly Women: A Comparative Study on the Lower Quarter Y-Balance Test. Salud, Ciencia y Tecnología. 2025;5:1148. https://doi.org/10.56294/saludcyt20251148

Submitted: 09-03-2024 **Revised:** 22-07-2024 **Accepted:** 29-11-2024 **Published:** 01-01-2025

Editor: Prof. Dr. William Castillo-González

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ABSTRACT

Introduction: enhancing leg muscle strength in elderly could play a crucial role in reducing fall risk. A novel approach to enhance muscular strength involves the use of low-intensity resistance exercises in conjunction with blood flow restriction (BFR), as an alternative to high-intensity exercise. This study aimed to evaluate the effects of low-intensity strength exercise with BFR on lower quarter Y-balance test (LQ-YBT) performance, compare to moderate-intensity strength exercise in elderly female.
Method: the study employed a true experimental randomized design, assessing balance using the LQ-YBT in 26 elderly women over a six-week exercise period. Subjects were divided into two groups: one performing medium-intensity strengthening exercises (≥40-60 % 1 RM (Repetition Maximum)) and another engaging in low-intensity strengthening exercises (20-30 %1RM) with BFR. The BFR technique involved applying a cuff to the upper third of the thigh with a restrictive pressure of 50 mmHg or 40 % Artery Occlusion Pressure, which was released during rest periods.
Results: the moderate and BFR groups exhibited notable distinctions in all directions (anterior, posterolateral, posteromedial and composite) for both left and right legs ($p<0,001$). The disparity in LQ-YBT values between groups was notable in the right anterior ($p=0,017$), right posterolateral ($p<0,001$), right composite ($p<0,001$), left anterior ($p=0,007$), and left composite ($p=0,050$) directions.
Conclusions: this study showed that low-intensity resistance exercise with BFR for six weeks may yield superior improvements in the LQ-YBT for elderly women compared to moderate-intensity strengthening exercises.

Keywords: Elderly; Exercise; Posture balance; BFR Therapy; Strengthening.

RESUMEN

Introducción: la mejora de la fuerza muscular de las piernas en los ancianos podría desempeñar un papel

crucial en la reducción del riesgo de caídas. Un enfoque novedoso para mejorar la fuerza muscular implica el uso de ejercicios de resistencia de baja intensidad junto con la restricción del flujo sanguíneo (BFR), como alternativa al ejercicio de alta intensidad. El objetivo de este estudio era evaluar los efectos de los ejercicios de fuerza de baja intensidad con BFR en el rendimiento de la prueba de equilibrio Y del cuarto inferior (LQ-YBT), en comparación con los ejercicios de fuerza de intensidad moderada en mujeres de edad avanzada.

Método: el estudio empleó un verdadero diseño experimental aleatorio, evaluando el equilibrio utilizando el LQ-YBT en 26 mujeres de edad avanzada durante un período de ejercicio de seis semanas. Los sujetos se dividieron en dos grupos: uno que realizaba ejercicios de fortalecimiento de intensidad media (≥40-60 % 1 RM (Repetición Máxima)) y otro que realizaba ejercicios de fortalecimiento de baja intensidad (20-30 %1 RM) con BFR. La técnica de BFR consistía en aplicar un manguito en el tercio superior del muslo con una presión restrictiva de 50 mmHg o presión de oclusión arterial del 40 %, que se liberaba durante los periodos de descanso.

Resultados: los grupos moderado y BFR mostraron notables diferencias en todas las direcciones (anterior, posterolateral, posteromedial y compuesta) tanto para la pierna izquierda como para la derecha ($p<0,001$). La disparidad en los valores de LQ-YBT entre los grupos fue notable en las direcciones anterior derecha ($p=0,017$), posterolateral derecha ($p<0,001$), compuesta derecha ($p<0,001$), anterior izquierda ($p=0,007$) y compuesta izquierda ($p=0,050$).

Conclusiones: este estudio demostró que el ejercicio de resistencia de baja intensidad con BFR durante seis semanas puede producir mejoras superiores en el LQ-YBT en mujeres de edad avanzada en comparación con los ejercicios de fortalecimiento de intensidad moderada.

Palabras clave: Ancianos; Ejercicio; Equilibrio postural; Terapia BFR; Fortalecimiento.

INTRODUCTION

Dynamic balance refers to the capacity to sustain postural control when an individual's center of gravity shifts beyond the base of support.[1] Dynamic balance decreases with age, and an inability to maintain balance may result in falls, particularly in elderly.[2,3,4,5] This decline can affect daily activities such as dressing, walking, and climbing stairs.[6] Age-related musculoskeletal changes lead to balance impairment and altered gait, primarily due to decreased muscle mass and strength.[7,8,9]

Balance disorders are associated with an increase in falls in the elderly population.[10,11] Falls are the primary cause of injuries, decreased quality of life, and placement in care facilities[12], and women are more susceptible to falls and injuries than men.[13] In Indonesia, the fall rate is 40 %, with a prevalence of 67 % among those aged 65–74 years and 78 % among individuals aged 75 years and older.[14] Among elderly, falls can result in severe injuries, including fractures of the hip (50 %), arm fractures (13 %), head traumas (10 %), and fatalities.[8,15]

Evaluating dynamic balance using standardized objective measures is crucial for identifying increased fall risk. Although computerized dynamic posturography is considered the standard for evaluating dynamic postural control, it necessitates costly equipment that is not widely accessible.[16] A rapid and straightforward assessment to detect changes in dynamic postural control is necessary to prevent significant fall risk in healthy elderly.[17] The lower quarter Y-balance test (LQ-YBT) serves as an assessment instrument for evaluating functional dynamic postural control.[17] This test is performed with one leg maximizing reach in three directions (anterior, posterolateral, and posteromedial) while maintaining the other leg in central position. The LQ-YBT was developed as a modification of the star excursion balance test (SEBT) to address variations often observed in SEBT.[18] LQ-YBT offers advantages over the SEBT owing to its adherence to standardized protocols and has demonstrated high interrater reliability (0,80–1,00) and intra-rater reliability (0,85–0,91) across various populations.[18,19] Furthermore, the LQ-YBT is relatively cost-effective, portable, and can be performed by various healthcare professionals.[20]

High-intensity resistance exercise is a widely used method to enhance muscle strength and mass.[21,22] However, this exercise may be contraindicated in many elderly because of its high mechanical stress and cardiovascular risk. Moreover, elderly individuals often encounter obstacles when participating in or adhering to high-intensity resistance exercise programs.[22] An emerging alternative is low-intensity resistance exercise combined with blood flow restriction (BFR). It has been proven successful in enhancing muscle strength, size, and peripheral vascular adaptations.[23,24] Similar outcomes have been observed in elderly women, suggesting their potential applicability to this population.[23]

The use of muscle-strengthening exercises with BFR in elderly in Indonesia remains limited. Furthermore, no studies have been published regarding the application of LQ-YBT to assess balance in elderly Indonesian populations. This research aimed to compare the improvements in dynamic balance using the LQ-YBT with low-

intensity resistance exercise combined with blood flow restriction in elderly female.

METHOD

This study employed true experimental design with randomized control study. The study was carried out in Departmen of Physical Medicine and Rehabilitation Dr. Soetomo General Academic Hospital, located in Surabaya, Indonesia. Ethical clearance was granted by the hospital's ethics committee from June 2023 – June 2024 (number 0683/KEPK/VI/2023).

Participant Selection

The study sample was chosen based on specific inclusion criteria: 1) Female participants aged 60-80 years, to minimize hormonal and musculoskeletal biases. The upper age limit was set to 80 years for safety reasons. 2) Adequate cognitive function, as demonstrated by a score ≥ 26 on the MoCA-Ina (Montreal Cognitive Assessment, Indonesian version) test. 3) Ability to stand on one leg for over 10 s. 4) Voluntary participation was confirmed by signing an informed consent form after receiving comprehensive explanations about the study's purpose, procedures, and potential side effects. Precautionary measures, including medications and protocols for managing adverse effects, were prepared at the study location.

Exclusion Criteria

Factors that could impact study parameters or participant safety were excluded. These included: 1) severe physical disabilities; 2) visual and hearing impairments; 3) balance disorders; 4) blood clotting disorders; 5) peripheral artery disease in both legs; 6) lower extremity neuropathy; 7) severe cardiorespiratory disorders; 8) deep vein thrombosis in both legs; 9) uncontrolled hypertension (≥ 140/90 mmHg); 10) uncontrolled diabetes mellitus; 11) history of vascular surgery; 12) history of skin grafts on the lower extremities; 13) recent lower limb bone surgery (within 12 weeks); 14) recent immobilization (within 4 weeks); 15) history of compartment syndrome and fasciotomy; 16) history of stroke; 17) statin use; 18) sarcopenia; 19) severe knee osteoarthritis (visual analog scale score >4) with limited joint range of motion, and 20) liver dysfunction. These conditions were assessed using anamnesis, physical examination, and relevant tests.

Study Design

Participants were allocated to either a low-intensity strength exercise group with BFR or a moderate-intensity strength exercise group. Both groups engaged in exercise sessions twice weekly for six weeks, with 3-4 to days of rest between sessions. The moderate-intensity group performed quadriceps femoris strengthening exercises using ankle weights (≥ 40-60 % one repetition maximum (1RM)), completing 8-12 repetitions for 3 sets with a 2-minute rest between sets. The BFR group performed low-intensity quadriceps femoris strengthening exercises with ankle weights (20-30 % 1RM) and BFR. Their sessions comprised four sets: the first set included 30 repetitions, while the following three sets each contained 15 repetitions. BFR was applied by restrictive pressure of 50 mmHg or 40 % artery occlusion pressure using a cuff applied to the upper thigh, which is released for 30 seconds during rest periods between sets.

Data Collection

Data measurements of the LQ-YBT were conducted before and after the intervention (following the 6th week of exercise). The LQ-YBT is considered safe for assessing injury risk and fall risk in elderly.[20] No injuries were reported during LQ-YBT examinations, making it feasible and safe for use in older populations. LQ-YBT has also been recognized as a valid and reliable test for elderly people.[17,20] LQ-YBT results were significantly correlated with lower extremity strength and balance in elderly. Two studies demonstrated a positive correlation between LQ-YBT and the strength of lower body (an additional factor for fall risk) in elderly women.[8]

The subject preparation involved performing a one-leg stand (OLS) alternately on both feet. The LQ-YBT was administered only if the OLS was > 10 seconds. The subjects were instructed to wear comfortable clothing and have sufficient rest the night before the exercise session. The testing environment required a room of at least 3x3 meters. The equipment preparation included tape and a measuring tape, which were placed on the floor to form three long lines resembling the letter Y (with a 120-degree angle), representing the three reach directions: anterior, posterolateral, and posteromedial. The test results were recorded on an examination record sheet.

Prior to the test, the examiner explained the purpose of the LQ-YBT and demonstrated it to the participants. Familiarization was conducted by having the participants perform two practice trials before the actual measurement. The actual test was conducted after two successful attempts to measure each limb. The tests were performed without using socks or gloves.

The participants were positioned on their selected lower limb, with the first toe placed centrally on the grid. They were then instructed to elevate the contralateral limb, extend it maximally along each of the three

designated lines, make contact with the line, and return to the initial position while maintaining a unipedal stance at the center of the frame. The subjects completed six practice trials on each foot for each of the three reach directions prior to the assessment. The evaluation comprised three consecutive examinations in the right and left anterior, right and left posteromedial, and right and left posterolateral directions. Any trial where a participant used the ground for support or shifted their foot position was disregarded. The data used for analysis were the average of three examinations.

The scoring used for data analysis utilized the absolute reach distance (cm) in each direction, normalized as a percentage of each subject's leg length. Leg length (LL) measurements were conducted with the subject in the supine position and measured from the anterior superior iliac spine (ASIS) to the ipsilateral medial malleolus. All reach distances were normalized as a percentage of the stance LL or called Maximized Reach Distance (%MAXD) using the formula [%MAXD = (excursion distance/LL) x100]. A composite score was then calculated, which is the average value of the three reach distances measured for each lower extremity [Comp = ((ANT+PM+PL) / (3xLL)) x 100].[20]

Statistical Methods

The study sample was chosen based on specific inclusion criteria: 1) Female participants aged 60-80 years. To characterize the study participants, descriptive statistics were utilized. The Shapiro-Wilk test was employed to evaluate data normality. For normally distributed data, parametric tests were used, while non-parametric tests were applied to non-normally distributed data. Comparisons between pre- and post-treatment conditions within each group were made using paired t-tests or Wilcoxon signed-rank tests, depending on the data's distribution. To compare between groups, independent t-tests or Wilcoxon-Mann Whitney tests were employed. A p-value less than 0,05 was considered statistically significant. Cohen's formula is used to calculate effect sizes and evaluate the statistical impact of changes.

RESULTS

A total of 26 research subjects met the inclusion requirement and were not excluded based on the exclusion criteria. The subjects were subsequently divided into two groups: the moderate group, which received moderate-intensity strengthening exercises, and the BFR group, which received low-intensity strengthening exercises combined with BFR, with 13 subjects in each group. The general characteristics of the research subjects in both the groups are shown in table 1. Subject characteristics, such as age, body height and weight, Body Mass Index, and Leg length, were tested for homogeneity using the Levene test and for normality using the Monte Carlo test. Statistical tests indicated that the data were normally distributed and homogenous, allowing parametric comparisons.

Table 1. Characteristics of the study subjects in both groups prior to intervention

No	Characteristic	Moderate (n=13)	BFR Group (n=13)	p normality	p Homogeneity
1	Age (year)	65,62 ± 5,30	68,08 ± 6,90	0,098	0,281
2	Body Weight (kg)	57,96 ± 9,85	55,31 ± 8,41	0,963	0,446
3	Body Height (cm)	154,27 ± 5,53	155,62 ± 6,04	0,500	0,912
4	BMI (kg/m^2)	24,48 ± 3,69	23,12 ± 3,23	0,801	0,569
	a. Underweight n (%)	1 (7,7 %)	1 (7,7 %)		
	b. Normal n (%)	3 (23,1 %)	7 (53,85 %)		
	c. Overweight n (%)	3 (23,1 %)	2 (15,38 %)		
	d. Obese n (%)	6 (46,2 %)	3 (23,1 %)		
5	Comorbid n (%)				
	a. Hypertension	8 (61,54 %)	6 (46,16 %)		
	b. Diabetes Mellitus	0 (0 %)	4 (30,77 %)		
	c. Dyslipidemia	4 (30,76 %)	6 (46,15 %)		
	d. Low Back Pain	3 (23,07 %)	4 (30,76 %)		
	e. Knee osteoarthritis	2 (15,38 %)	3 (23,07 %)		
6	Daily physical activity n (%)				
	a. High	0 (0 %)	0 (0 %)		
	b. Moderate	13 (100 %)	13 (100 %)		
	c. Low	0 (0 %)	0 (0 %)		
7	Leg length (cm)	78,31 ± 3,45	80,0 ± 3,67	0,615	0,734

*Statistically significant at p<0,05

In this study, both groups had similar leg length ranges and no statistically significant variations detected in

terms of homogeneity or normality. Additionally, no differences in leg length were observed between the two sides. Research has shown no significant differences in LQ-YBT performance between the dominant and non-dominant legs,[25] thus validating the use of this test on both limbs.

Table 2. %MAXD Y-Balance Test Before and After Intervention

Y-*Balance*	Moderate group						BFR group					
	Right Leg (n = 13)			Left leg (n = 13)			Right leg (n = 13)			Left leg (n = 13)		
Direction	Pre	Post	p-value	Pre	Post	p- value	Pre	Post	p-value	Pre	Post	p- value
Anterior	62,8 ± 12,2	88,0 ± 11,1	<0,001*	62,8 ± 11,0	88,8 ± 8,1	<0,001*	58,4 ± 8,5	92,9 ± 8	<0,001*	56,5 ± 9,9	93,0 ± 7,9	<0,001*
Postero-medial	62,4 ± 13,1	91,9 ± 11,9	<0,001*	61,8 ± 10,9	93,9 ± 12,2	<0,001*	61,6 ± 9,0	100,3 ± 9,9	<0,001*	59,6 ± 7,7	96,9 ± 9,9	<0,001*
Postero-lateral	71,6 ± 9,4	99,2 ± 7,5	<0,001*	65,7 ± 9,6	96,2 ± 8,4	<0,001*	66,9 ± 7,4	109,1 ± 9,0	<0,001*	65,1 ± 8,3	104,7 ± 9,9	<0,001*
Composite	65,6 ± 10,6	93,1 ± 9,1	<0,001*	62,9 ± 10,2	92,4 ± 6,8	<0,001*	62,3 ± 7,3	100,8 ± 7,9	<0,001*	60,7 ± 6,0	98,2 ± 7,7	<0,001*

*Statistically significant at p<0,05

The %MAXD of the LQ-YBT was evaluated at the beginning and end of the research period for each group. The LQ-YBT scores for both legs in the moderate and BFR groups before and after treatment are shown in Table 2. Based on parametric statistical tests (paired t-test), both the moderate and control groups revealed significant enhancements in the LQ-YBT in all directions (p < 0,001).

Table 3. Comparison of LQ-YBT Differences Before and After Intervention

Delta LQ-YBT	BFR group (n = 13)	Moderate group (n = 13)	p-value	Effect Size (Cohen's D)
Right Anterior	34,50 ± 7,23	25,24 ± 10,84	0,017*	-1,006 (large)
Right Posteromedial	38,70 ± 3,86	29,51 ± 12,31	0,062	-0,769 (medium)
Right Posterolateral	42,16 ± 8,4	27,57 ± 8,5	<0,001*	-1,728 (large)
Right Composite	38,45 ± 6,66	27,44 ± 8,2	<0,001*	-1,475 (large)
Left Anterior	36,41 ± 8,42	26,03 ± 9,38	0,007*	-1,164 (large)
Left Posteromedial	37,34 ± 13,03	32,08 ± 16,43	0,375	-0,355 (small)
Left Posterolateral	38,65 ± 10,53	30,52 ± 11,9	0,128	-0,735 (medium)
Left Composite	37,11 ± 7,38	30,37 ± 10,17	0,050*	-0,810 (large)

*Statistically significant at p<0,05

The BFR group demonstrated a more substantial enhancement in the LQ-YBT than the moderate group. As shown in Table 3, parametric statistical tests (independent t-test) revealed significant differences in the right anterior (p = 0,017), right posterolateral (p < 0,001), right composite (p < 0,001), left anterior (p = 0,007), and left composite (p = 0,050). The effect size of the LQ-YBT difference before and after the intervention was calculated using Cohen's D. On the right side, the delta LQ-YBT demonstrated large effect size in the anterior (-1,006), posterolateral (-1,728), and composite (-1,475) directions. On the left side, the delta LQ-YBT exhibited large effect size in the anterior (-1,164) and composite (-0,810) directions.

Adverse Event

Two subjects in the moderate group reported post-exercise muscle pain and delayed onset muscle soreness (DOMS). These adverse events were reported in the 3rd week of exercise following an increase in exercise intensity in the moderate group. Muscle pain resolved within 30 min to 1 h after management, and DOMS symptoms disappeared within three days post-exercise.

DISCUSSION

The mean age of the subjects in the moderate group was 65,62 ± 5,29 years, whereas the BFR group exhibited a mean age of 68,07 ± 6,90 years. Balance requires the interaction and coordination of multiple systems, including sensory, musculoskeletal, and neuromuscular systems.[26] The ability of an individual to control their posture decreases with age.[27] This decline is due to the reduced muscle strength and motor

responses in elderly. Alterations in postural control that result in impaired balance can increase the risk of falls.[26] Therefore, early and appropriate balance interventions are critical for preventing serious fall-related injuries, particularly in the elderly population.

The LQ-YBT is a modification of the SEBT, developed to minimize potential fatigue effects and redundancy among the eight directions in the original SEBT. This test measures in three directions: anterior, posterolateral, and posteromedial. An anterior reach distance discrepancy greater than 4 cm between the right and left legs increases the risk of lower-extremity injury by 2,5 times.[28] In this investigation, no significant differences were observed between the two limbs prior to treatment. Composite values were measured in all three directions, and the results showed composite scores in both limbs averaging < 80. A composite reaching a distance of less than 94 % of limb length increases the likelihood of lower extremity injury by 6,5 times.[28] The test has demonstrated excellent inter-rater reliability and strong intra-rater and test-retest reliability in identifying dynamic balance impairments.[29]

This study demonstrated that six weeks of moderate-intensity strength exercise in both the Moderate and BFR groups significantly improved the LQ-YBT scores in both limbs ($p < 0,001$). These findings are consistent with those of Yokokawa et al, who compared low-intensity strength exercise with BFR and dynamic balance exercise in elderly individuals at a risk of falling.[30] intervention over eight weeks resulted in significant improvements in balance parameters and knee extensor strength.[30] Various studies have linked muscle strength improvement to enhanced balance in the elderly because intrinsic aging factors, such as degenerative processes in the muscular and nervous systems, contribute to muscle weakness and gait instability. Six weeks of supervised strength exercise in healthy elderly increased balance by 68 % from baseline, suggesting that cognitive factors, such as motivation, may contribute to better exercise quality.[31] Six weeks of strength exercise is sufficient to enhance muscle quality, as indicated by increased muscle thickness and quadriceps femoris 1RM.[32]

The LQ-YBT is a validated, reliable, and straightforward assessment for evaluating dynamic balance on one leg.[17,18] This evaluation requires participants to perform a single-leg squat while extending the opposite leg as far as possible in anterior, posterolateral, and posteromedial directions.[18] The reach distance achieved by the non-supporting leg indicates the dynamic stability and control of the stance leg.[33] To maintain postural equilibrium during the reaching action, co-contractions of knee extensors and flexors occur in the supporting leg.[34] Consequently, the strength of knee extensors significantly influences LQ-YBT performance.[35] Additionally, the ability to regulate knee extensor force plays a crucial role in determining LQ-YBT outcomes and overall dynamic balance capability.[35]

Kaur et al.[36] examined muscle activation during the LQ-YBT. The results showed moderate-to-large effect sizes for quadriceps femoris activation, particularly in the vastus medialis, vastus lateralis, and rectus femoris in all directions.[36] This supports the findings of this study, in where six weeks of quadriceps femoris strengthening improved scores in all directions.

The comparison of delta LQ-YBT scores between the Moderate and BFR groups revealed significant differences in the right-left anterior direction, right posterolateral direction, and right-left composite score with p-value < 0,05. These findings align with the research of Bigdeli et al.[37], which demonstrated that elderly participants who engaged in six weeks of low-intensity functional strength exercise, both with and without BFR, experienced improvements in balance function. The observed enhancements were attributed to several factors, including increased muscle strength and coordination, as well as alterations in neural mechanisms. These neural changes encompassed improved synergistic muscle activation, decreased antagonist muscle co-activation, better motor unit synchronization, and heightened recruitment of fast-twitch motor units.[37] The significant delta difference in the right side between the two groups indicates that exercise effects were more pronounced in the dominant (right) limb. Significant differences were also observed in the anterior direction, aligning with research showing that knee extensor strengthening improves LQ-YBT scores in the anterior direction.[38]

Adverse events occurred in two subjects from the moderate group in the third week of exercise when exercise intensity was increased. Following exercise, two participants reported different types of muscle discomfort: one individual experienced immediate soreness, while the other developed delayed onset muscle soreness (DOMS). The symptoms resolved within 30 minutes to 1 hour after treatment, and DOMS fully subsided within three days. This finding is consistent with studies using BFR for muscle exercise. Harper et al.[39] conducted a study on elderly with grade II osteoarthritis, showing that moderate-intensity strength exercise had more adverse events, such as exercise-related pain, than the BFR group. High-intensity resistance exercise with BFR conducted by Karabulut et al.[40] showed no adverse events, and no increase in inflammatory markers (IL-6) or muscle damage markers (CK). Yasuda et al.[41] also demonstrated that elderly individuals (aged 61-84 years) engaging in low-intensity resistance exercise with BFR twice weekly for 12 weeks using 20-30 % of their 1RM, did not experience significant increases in FDP, D-dimer, or creatine kinase (CK) levels. Physical exercise that contains weight exercise is known to improve the functional status of the elderly, including balance.[42] This suggests that low-intensity resistance exercise combined with BFR may be a more secure exercise option for the elderly.

For further recommendation, additional research is required to generalize the findings to elderly men for broader applicability to the elderly population. Studies with more diverse characteristics and specific groups are suggested to evaluate the efficacy of BFR exercise in other populations. The implementation of low-intensity BFR exercise in elderly women can generally be proposed as an effective method for improving balance due to its superior efficacy and safety.

CONCLUSIONS

In conclusion, this study on the strength exercise with blood flow restriction on balance function, as measured by the LQ-YBT in elderly women, represents the first such study conducted in Indonesia. The study showed that low-intensity resistance exercise combined with BFR and moderate-intensity resistance exercise both effectively improved the balance in elderly women. Low-intensity resistance exercise combined with BFR was well tolerated by elderly subjects.

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FINANCING

The authors did not receive financing for the development of this research.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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