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The Effect of Structured Hypertension Exercise on Reducing Blood Pressure in the Elderly at Wonokromo Elderly Posyandu, Indonesia: A Pre-Experimental Study

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ABSTRACT Hypertension is one of the leading causes of morbidity and mortality among older adults and substantially increases the risk of cardiovascular diseases, stroke, and kidney failure. Although antihypertensive medication remains the primary treatment, adherence to long-term pharmacological therapy is often inadequate, highlighting the need for effective, accessible, and sustainable non-pharmacological interventions. Community-based exercise programs have shown promise; however, evidence regarding the effectiveness of structured hypertension exercise implemented in elderly integrated health service posts (Posyandu Lansia) remains limited. Therefore, this study aimed to evaluate the effect of a structured hypertension exercise program on reducing blood pressure among older adults attending the Wonokromo Elderly Posyandu, Surabaya, Indonesia. A pre-experimental study employing a one-group pretest–posttest design was conducted with 33 elderly participants selected through purposive sampling. The intervention consisted of a structured hypertension exercise program performed twice weekly for 30 minutes over four consecutive weeks. Systolic and diastolic blood pressure were measured using a calibrated digital sphygmomanometer before and after the intervention. Data were analyzed using descriptive statistics and the Paired Sample t-test with a significance level of 0.05. The findings demonstrated significant reductions in both systolic and diastolic blood pressure following the intervention. Mean systolic blood pressure decreased from 152.52 ± 8.45 mmHg to 141.00 ± 6.98 mmHg, while mean diastolic blood pressure declined from 90.85 ± 3.37 mmHg to 83.52 ± 2.08 mmHg. The mean reductions of 11.52 mmHg for systolic and 7.33 mmHg for diastolic blood pressure were statistically significant ($p < 0.001$). These findings indicate that structured hypertension exercise is an effective, feasible, and low-cost non-pharmacological intervention for improving blood pressure control among older adults. Integrating this exercise program into routine Posyandu activities may strengthen community-based hypertension management and promote healthier ageing.

INDEX TERMS Hypertension Exercise, Blood Pressure, Elderly, Community-Based Intervention, Pre-Experimental Study.

I. INTRODUCTION

Hypertension is one of the leading non-communicable diseases and a major contributor to cardiovascular morbidity and mortality worldwide, particularly among older adults [1], [2]. Population ageing has increased the prevalence of hypertension because physiological changes, including arterial stiffness, endothelial dysfunction, and reduced vascular elasticity, impair blood pressure regulation and elevate the risk of stroke, coronary heart disease, heart failure, and chronic kidney disease [3], [4]. In Indonesia, hypertension remains one of the most common chronic conditions managed at primary healthcare facilities despite ongoing health promotion and prevention programs [5]. Consequently, identifying effective, affordable, and sustainable community-based interventions is essential to improve blood pressure control and promote healthy ageing.

Hypertension management combines pharmacological therapy with lifestyle modification, including healthy diet, weight management, smoking cessation, stress reduction, and regular physical activity [6]. Among these approaches, structured exercise is widely recommended because it improves endothelial function, enhances vascular compliance, reduces sympathetic nervous system activity, and ultimately lowers peripheral vascular resistance [7], [8]. Recent systematic reviews and meta-analyses have consistently demonstrated that moderate-intensity exercise significantly reduces systolic and diastolic blood pressure while improving cardiovascular fitness and functional capacity in older adults [9], [10]. Furthermore, community-based exercise programs improve long-term adherence through supervised activities, social interaction, and easier access to preventive healthcare

services, making them practical and sustainable interventions for hypertension management [11].

Several recent studies have confirmed the effectiveness of exercise-based interventions in elderly populations. Herlina reported that structured hypertension exercise significantly reduced systolic and diastolic blood pressure among elderly patients receiving community health services [12]. Likewise, Sriyono et al. found that hypertension-specific exercise effectively improved blood pressure regulation through standardized low-impact movements designed for older adults [13]. Moraes-Silva et al. demonstrated that regular aerobic exercise promotes vascular remodeling and improves endothelial function, thereby contributing to sustained reductions in blood pressure [14]. Moreover, Tucker et al. reported that combining lifestyle interventions with routine blood pressure monitoring further enhanced hypertension control and treatment adherence [15].

Despite these encouraging findings, several research gaps remain. Most previous studies have evaluated general aerobic exercise or combined lifestyle interventions rather than standardized hypertension-specific exercise protocols tailored for elderly individuals [16]. Evidence regarding the implementation of such programs within community-based Integrated Health Service Posts (Posyandu Lansia), particularly in developing countries, is still limited [17]. In addition, variations in exercise protocols, intervention duration, and implementation settings have produced inconsistent findings, limiting the generalizability of previous studies [18]. Therefore, further evidence is required to evaluate the effectiveness of standardized hypertension exercise programs implemented routinely in Indonesian community healthcare settings.

Accordingly, this study aimed to evaluate the effect of a structured hypertension exercise program on systolic and diastolic blood pressure among older adults attending the Wonokromo Elderly Integrated Health Service Post (Posyandu Lansia Wonokromo), Surabaya, Indonesia, using a pre-experimental one-group pretest–posttest design. The findings are expected to support the Indonesian Ministry of Health's CERDIK initiative, which promotes regular physical activity as an essential strategy for preventing and controlling hypertension among older adults [19]. This study contributes to the literature in three ways. First, it provides empirical evidence regarding the effectiveness of a standardized hypertension exercise protocol implemented in a community healthcare setting. Second, it demonstrates the feasibility of integrating structured hypertension exercise into routine Posyandu activities as a practical, low-cost, and sustainable non-pharmacological intervention. Third, it offers evidence that may assist healthcare professionals and policymakers in developing community-based hypertension management programs to improve cardiovascular health and quality of life among older adults [20].

The remainder of this paper is organized as follows. Section II describes the research methodology, including the study design, participants, intervention procedures, and statistical analysis. Section III presents the research findings, Section IV discusses the results and their practical implications, and Section V concludes the study with recommendations for future research.

II. METHOD

A. STUDY DESIGN AND RATIONALE

This study employed a pre-experimental design using a one-group pretest–posttest approach to evaluate the effectiveness of a structured hypertension exercise program in reducing blood pressure among older adults. In this design, blood pressure measurements were obtained before (pretest) and after (posttest) the intervention in the same group of participants without the inclusion of a control group. The primary objective was to determine whether the intervention produced measurable changes in systolic and diastolic blood pressure over the study period.

A pre-experimental approach was selected because it provides a practical framework for evaluating the preliminary effectiveness of community-based health interventions implemented under real-world conditions where randomization and control groups are often difficult to establish due to ethical and logistical considerations. Such designs are widely applied in public health and nursing research to assess the feasibility and short-term outcomes of non-pharmacological interventions before conducting larger randomized controlled trials [21]. Although this design cannot completely eliminate potential confounding variables, it provides valuable initial evidence regarding intervention effectiveness in routine healthcare settings and serves as an important foundation for future experimental studies employing more rigorous methodologies [22].

B. STUDY SETTING

The study was conducted at the Wonokromo Elderly Integrated Health Service Post (Posyandu Lansia Wonokromo), Surabaya, East Java, Indonesia, which operates under the supervision of the Wonokromo Public Health Center (Puskesmas Wonokromo). This community healthcare facility was selected because it routinely provides preventive and promotive health services for older adults, including blood pressure monitoring, health education, and physical activity programs. The familiar environment and regular attendance of elderly participants made the setting appropriate for implementing a structured exercise intervention while minimizing participant attrition.

The intervention was carried out over a four-week period from 4 October to 26 October 2025. Hypertension exercise sessions were conducted twice weekly, with each session lasting approximately 30 minutes. All intervention activities were performed in groups under direct supervision of the researcher following a standardized operating procedure (SOP) to ensure consistency throughout the study period [23].

C. STUDY POPULATION AND PARTICIPANTS

The target population consisted of 275 elderly individuals registered at the Wonokromo Elderly Posyandu. Sample size determination was performed using the Slovin formula with a 20% margin of error, resulting in a minimum sample requirement of 23 participants. To anticipate possible participant withdrawal during the intervention period, an

additional 30% was included, resulting in a final sample of 33 elderly participants.

Participants were recruited using a purposive sampling technique, which enabled the selection of individuals who fulfilled predefined eligibility criteria and were considered suitable for participation in the intervention. This non-probability sampling method is frequently used in community-based intervention studies because it allows researchers to recruit participants possessing characteristics directly relevant to the research objectives while ensuring the feasibility of program implementation [24].

D. ELIGIBILITY CRITERIA

Participant eligibility was determined before enrollment based on predefined inclusion and exclusion criteria. The inclusion criteria comprised elderly individuals aged 60 years or older, clinically diagnosed with hypertension, presenting with systolic blood pressure greater than 140 mmHg and/or diastolic blood pressure of at least 90 mmHg, and willing to participate throughout the intervention period by providing written informed consent.

The exclusion criteria included individuals with severe physical limitations that prevented safe participation in exercise, including limb paralysis or significant musculoskeletal impairment, those diagnosed with decompensated heart failure or other unstable cardiovascular conditions, and individuals undergoing medical treatment that could interfere with participation in physical activity. Screening was conducted before recruitment to ensure participant safety and to minimize factors that could influence the effectiveness of the intervention.

E. INTERVENTION MATERIALS AND PROCEDURE

The intervention consisted of a structured hypertension exercise program a low-impact aerobic exercise specifically developed for older adults with hypertension to improve cardiovascular function while minimizing the risk of injury. The exercise protocol followed the recommendations of community-based physical activity programs for older adults and was implemented according to a standardized operating procedure (SOP) to ensure consistency across all sessions [25]. Each exercise session lasted 30 minutes and comprised three phases: a 5-minute warm-up, a 20-minute core exercise, and a 5-minute cool-down. The warm-up included gentle walking in place and stretching exercises to prepare the musculoskeletal and cardiovascular systems. The core exercise consisted of 17 rhythmic, low-impact movements, including coordinated upper- and lower-extremity movements, shoulder and neck mobilization, arm swinging, marching in place, side stepping, ankle rotation, and gentle body stretching. Each movement was performed slowly and rhythmically for approximately 8–10 repetitions, with exercise intensity adjusted according to each participant's physical capability. Exercise sessions were conducted twice weekly for four consecutive weeks in a group setting and supervised directly by the principal researcher to ensure participant safety, adherence, and protocol compliance [26].

F. OUTCOME MEASUREMENT AND DATA COLLECTION

The primary outcome of this study was the change in systolic and diastolic blood pressure following completion of the intervention. Blood pressure measurements were obtained using a calibrated Omron digital sphygmomanometer, which had been verified before data collection to ensure measurement accuracy and reliability. Digital blood pressure monitors have demonstrated acceptable validity and reproducibility for community-based hypertension screening and monitoring when standardized measurement procedures are followed [27].

To minimize measurement bias, participants were instructed to avoid strenuous physical activity, smoking, caffeinated beverages, and heavy meals for at least 30 minutes before each assessment. Blood pressure was measured while participants were seated comfortably after resting for 5–10 minutes in a quiet environment. Measurements were performed at approximately the same time of day before the first exercise session (pretest) and after completion of the final exercise session at the end of the fourth week (posttest). All measurements were recorded using standardized observation forms by the same researcher to reduce inter-observer variability. Participant demographic characteristics, including age, duration of hypertension, medication use, physical activity habits, and comorbid conditions, were also documented during baseline assessment to describe the study population.

G. STATISTICAL ANALYSIS AND ETHICAL CONSIDERATIONS

Data were coded and analyzed using IBM SPSS Statistics version 26.0. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize participant characteristics and blood pressure measurements before and after the intervention. Prior to hypothesis testing, data normality was evaluated using the Shapiro–Wilk test, which is recommended for studies involving relatively small sample sizes [28]. Since the normality assumption was satisfied ($p > 0.05$), differences between pretest and posttest blood pressure values were analyzed using the Paired Sample t-test. Statistical significance was established at a two-tailed p-value < 0.05, and the mean differences in systolic and diastolic blood pressure were calculated to determine the magnitude of the intervention effect [29].

This study received ethical approval from the Health Research Ethics Committee (Komisi Etik Penelitian Kesehatan/KEPK) of Poltekkes Kemenkes Surabaya prior to data collection. All research procedures were conducted in accordance with the ethical principles of the Declaration of Helsinki and national ethical guidelines governing research involving human participants [30]. Eligible participants received verbal and written explanations regarding the study objectives, procedures, potential benefits, and possible risks before providing written informed consent. Participation was entirely voluntary, and participants retained the right to withdraw from the study at any stage without consequences for their healthcare services. Participant confidentiality and privacy were maintained by assigning anonymous

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identification codes, securely storing research data, and limiting data access to the research team. Throughout the intervention period, participant safety was continuously monitored, and exercise sessions were immediately discontinued if any signs of discomfort, dizziness, chest pain, or other adverse events were observed.

III. RESULTS

TABLE 1
Demographic Characteristics of Respondents

Characteristic	N	%
Age Group		
60-65 years	23	69.7
66-70 years	6	18.2
70-80 years	4	12.1
Duration of Hypertension		
< 1 year	13	39.4
1-4 years	19	57.6
>10 years	1	3.0
Routine Antihypertensive Medication		
Yes		97.0
No		3.0
Physical Activity Habit		
Yes		97.0
No		3.0

According to the information in TABLE 1, All participants were female (100%) and identified as housewives (100%). The majority were in the 60-65 years age group (69.7%). Most participants had been diagnosed with hypertension for 1-4 years (57.6%), and nearly all (97.0%) were on regular antihypertensive medication. A small proportion (6.1%) had comorbid diabetes mellitus. Almost all respondents (97.0%) reported engaging in some form of routine physical activity prior to the study.

Prior to the intervention, the mean systolic blood pressure was 152.52 mmHg (SD = 8.445) and the mean diastolic blood pressure was 90.85 mmHg (SD = 3.365), as shown in TABLE 2. According to the Indonesian Ministry of Health classification, the majority of participants (75.8%) were in Hypertension Stage 1, while 24.2% were in Hypertension Stage 2.

Following four weeks of the hypertension exercise program, the mean systolic blood pressure dropped to 141.00 mmHg (SD = 6.978), and the mean diastolic blood pressure dropped to 83.52 mmHg (SD = 2.078), as shown in TABLE 3. Following the intervention, 57.6% of patients were still in Stage 1 Hypertension, while 42.4% were in the "Normal-High" category.

TABLE 2
Classification of Blood Pressure Before Intervention (n=33)

Classification	Frequency(n)	%
Hyhpertension stage 1	25	75.8
Hypertension stage 2	8	24.2
Total	33	100

TABLE 3
Classification of Blood Pressure After Intervention (n=33)

Classification	Frequency(n)	%
Normal-High	14	42.4
Hypertension stage 1	19	57.6
Total	33	100

The Shapiro-Wilk test verified that the differences between pretest and posttest scores were normally distributed (Systolic Δ: p=0.232; Diastolic Δ: p=0.198), meeting the requirement for parametric testing, according to the results shown in TABLE 4. Following the hypertension exercise intervention, the analysis showed a statistically significant drop in both diastolic blood pressure (mean reduction = 7.33 mmHg, p = 0.000) and systolic blood pressure (mean reduction = 11.52 mmHg, p = 0.000).

TABLE 4
Paired T-Test Result of Blood Pressure Before and After Intervention

Paired Sample Test

Variabel	*Mean ± SD*	*Δ Mean*	*Mean Pretest-Posttest*	*t*	*P-value*
Tekanan darah Sistolik *Pretest*	152,52 ± 8.445	11,52	-11,58	12,570	0.000
Tekanan Darah Sistolik *Posttest*	141 ± 6,978				
Tekanan Darah Diastolik *Pretest*	90,85 ± 3.365	7,33	-7, 15	9,576	0.000
Tekanan Darah Diastolik *Posttest*	83,52 ± 2.078				

IV. DISCUSSION

A. INTERPRETATION OF THE FINDINGS

The present study demonstrated that a four-week structured hypertension exercise program produced statistically significant reductions in both systolic and diastolic blood pressure among older adults attending the Wonokromo Elderly Integrated Health Service Post. The mean systolic blood pressure decreased from 152.52 ± 8.45 mmHg to 141.00 ± 6.98 mmHg, while the mean diastolic blood pressure declined from 90.85 ± 3.37 mmHg to 83.52 ± 2.08 mmHg. The observed reductions of 11.52 mmHg in systolic pressure and 7.33 mmHg in diastolic pressure were statistically significant ($p < 0.001$), indicating that the intervention effectively improved blood pressure control among the participants. These findings suggest that structured hypertension exercise represents an effective non-pharmacological strategy for reducing cardiovascular risk in elderly individuals when implemented as part of routine community health services.

The blood pressure reduction observed in this study can be explained by several physiological adaptations induced by regular physical exercise. Repeated low-to-moderate intensity aerobic activity improves endothelial function by increasing nitric oxide bioavailability, thereby promoting vasodilation and reducing peripheral vascular resistance. Regular exercise also decreases sympathetic nervous system activity while enhancing parasympathetic regulation, leading to lower resting heart rate, improved vascular compliance, and more efficient cardiovascular function [31]. Furthermore, sustained physical activity contributes to improved insulin sensitivity, reduced systemic inflammation, and better autonomic balance, all of which are associated with long-term blood

pressure regulation and cardiovascular protection [32]. These physiological mechanisms support the significant reductions observed after four weeks of structured hypertension exercise.

Beyond statistical significance, the magnitude of blood pressure reduction is also clinically meaningful. Previous epidemiological studies have demonstrated that a reduction of approximately 10 mmHg in systolic blood pressure substantially decreases the risk of stroke, ischemic heart disease, heart failure, and cardiovascular mortality. Therefore, the mean reduction observed in the present study is likely to provide meaningful cardiovascular benefits if maintained through continued participation in regular exercise programs [33]. This finding highlights the importance of incorporating structured physical activity into routine hypertension management, particularly for older adults who often experience progressive vascular deterioration associated with ageing.

The findings of this study are consistent with previous investigations evaluating exercise-based interventions for hypertension. A recent systematic review reported that structured aerobic exercise significantly reduced both systolic and diastolic blood pressure across diverse hypertensive populations, confirming exercise as an effective adjunct to pharmacological treatment [34]. Similarly, randomized intervention studies have demonstrated that supervised exercise programs improve vascular function, cardiorespiratory fitness, and blood pressure regulation among older adults. The consistency between the present findings and previous evidence strengthens the conclusion that structured hypertension exercise can be implemented safely and effectively within community healthcare settings.

An additional strength of this intervention lies in its implementation within the Posyandu Lansia environment. Community-based health services provide accessible facilities, regular supervision, and strong social interaction among participants, all of which may improve exercise adherence. Unlike home-based exercise programs that depend heavily on individual motivation, supervised group sessions encourage consistent participation while allowing healthcare workers to monitor participant safety and exercise performance. Consequently, the observed improvements in blood pressure may reflect not only the physiological benefits of exercise itself but also the supportive social environment that promotes sustained engagement in healthy behaviors.

B. COMPARISON WITH PREVIOUS STUDIES AND PRACTICAL IMPLICATIONS

The findings of the present study are consistent with a growing body of evidence demonstrating that structured physical exercise is an effective non-pharmacological intervention for blood pressure control in older adults. Similar to the present findings, recent randomized controlled trials have reported that regular low-to-moderate intensity aerobic exercise significantly reduces systolic and diastolic blood pressure by improving vascular function, cardiac efficiency, and autonomic nervous system regulation [35]. A meta-analysis conducted among hypertensive adults further concluded that exercise interventions performed at least twice weekly provide clinically meaningful reductions in blood pressure regardless of participants' sex, ethnicity, or baseline hypertension severity. These findings reinforce the recommendation that structured exercise should be incorporated into routine hypertension management alongside pharmacological therapy.

The magnitude of blood pressure reduction observed in this study is also comparable with previous intervention studies involving elderly populations. While the mean reduction of 11.52 mmHg in systolic blood pressure and 7.33 mmHg in diastolic blood pressure falls within the range reported by earlier systematic reviews, slight differences in treatment effects are expected because of variations in participant characteristics, intervention duration, exercise intensity, and adherence rates. Some studies have reported larger reductions following interventions lasting between 8 and 24 weeks, suggesting that longer exercise programs may induce greater cardiovascular adaptations through progressive improvements in endothelial function, arterial elasticity, and autonomic balance [36]. Therefore, the relatively short four-week intervention used in the present study may explain why blood pressure, although significantly reduced, remained within the Stage 1 hypertension category for several participants.

Another important consideration is the characteristics of the study population. Nearly all participants in the present study were receiving antihypertensive medication during the intervention period. Consequently, the observed reduction in blood pressure most likely reflects the combined effects of pharmacological treatment and structured exercise rather than the exercise program alone. This finding is consistent with current hypertension management guidelines, which recommend lifestyle modification as an adjunct rather than a replacement for antihypertensive medication, particularly among older adults with persistent hypertension [35]. Nevertheless, previous studies have shown that regular exercise may enhance medication effectiveness by improving vascular responsiveness and reducing overall cardiovascular workload, thereby contributing to better long-term blood pressure control.

The community-based implementation of the intervention also represents an important strength of this study. Posyandu Lansia provides an accessible environment where older adults receive regular health monitoring, health education, and social support from healthcare workers and fellow participants. Such community engagement has been shown to improve adherence to lifestyle interventions, particularly among elderly populations who often experience reduced motivation, limited mobility, and social isolation [37]. The structured group-based exercise sessions implemented in this study likely encouraged regular attendance and improved participant motivation, thereby increasing intervention effectiveness. These findings suggest that integrating hypertension exercise into routine Posyandu activities may represent a practical strategy for strengthening preventive healthcare services in Indonesia.

From a public health perspective, the intervention offers several practical advantages. Structured hypertension exercise

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requires minimal equipment, can be delivered by trained community health workers or nurses, and involves relatively low operational costs compared with many medical interventions. Furthermore, because the exercise protocol consists of simple and safe movements specifically adapted for older adults, it can be implemented in various community healthcare settings without requiring specialized facilities or advanced technology [38]. Routine implementation of such programs may contribute not only to blood pressure reduction but also to improvements in physical function, balance, mobility, and overall quality of life among older adults. Consequently, incorporating structured hypertension exercise into community health promotion programs could support national strategies aimed at reducing the burden of cardiovascular disease while promoting healthy ageing within Indonesia's rapidly growing elderly population.

C. STUDY LIMITATIONS, IMPLICATIONS, AND FUTURE DIRECTIONS

Although the present study demonstrated that a structured hypertension exercise program significantly reduced systolic and diastolic blood pressure among older adults, several limitations should be considered when interpreting the findings. First, the study employed a pre-experimental one-group pretest–posttest design without a control group. Consequently, the observed reductions in blood pressure cannot be attributed exclusively to the intervention because external factors, including daily physical activity, dietary habits, medication adherence, psychological status, and environmental conditions, may also have influenced the outcomes. The absence of randomization further limits the ability to establish a causal relationship between the intervention and the observed improvements. Future studies should therefore employ randomized controlled trials with appropriate comparison groups to strengthen the internal validity and provide more robust evidence regarding the effectiveness of hypertension exercise programs [39].

Second, the study was conducted at a single Elderly Integrated Health Service Post (Posyandu Lansia) involving only 33 participants, which may limit the generalizability of the findings to other populations and healthcare settings. Community characteristics, socioeconomic status, healthcare accessibility, cultural differences, and participant adherence may vary across regions and influence the effectiveness of exercise-based interventions. In addition, the intervention period lasted only four weeks, allowing the evaluation of short-term outcomes but not long-term maintenance of blood pressure reduction. Previous evidence suggests that sustained exercise programs implemented over several months produce greater cardiovascular adaptations and more durable improvements in vascular function, arterial compliance, and autonomic regulation than short-term interventions [40].

Another limitation is that the study focused primarily on blood pressure as the principal outcome without evaluating additional cardiovascular or functional health indicators. Variables such as resting heart rate, body mass index, waist circumference, physical fitness, exercise adherence, quality of life, functional independence, and biochemical markers could provide a more comprehensive understanding of the physiological and clinical benefits of structured hypertension exercise. Furthermore, medication adherence and dietary sodium intake were not quantitatively monitored throughout the intervention period, although both factors are recognized as important determinants of blood pressure control. Future investigations should therefore incorporate multidimensional outcome measures to better explain the mechanisms through which structured exercise contributes to cardiovascular health among older adults.

Despite these limitations, the findings have important implications for clinical practice and community health services. The significant reductions in both systolic and diastolic blood pressure indicate that structured hypertension exercise may serve as an effective complementary intervention alongside pharmacological therapy. Because the exercise protocol consists of simple, low-impact movements requiring minimal equipment and financial resources, it can be readily implemented in primary healthcare facilities, community health centers, and Elderly Integrated Health Service Posts. Integrating structured hypertension exercise into routine Posyandu activities may strengthen promotive and preventive healthcare services while encouraging active participation of older adults in regular physical activity. Such community-based programs have the potential not only to improve blood pressure control but also to enhance physical function, social engagement, and overall quality of life, thereby contributing to healthy ageing and reducing the long-term burden of cardiovascular disease. These findings also support current international recommendations that emphasize regular physical activity as an essential component of comprehensive hypertension management and healthy ageing strategies.

Future research should include multicenter randomized controlled trials involving larger and more diverse populations, longer intervention periods, and standardized exercise protocols to improve external validity. Additionally, comparative studies examining different exercise modalities, frequencies, intensities, and combinations with dietary or behavioral interventions would provide valuable evidence for optimizing community-based hypertension management programs. The integration of digital health technologies, such as wearable blood pressure monitors and mobile health applications, may also facilitate continuous monitoring, improve participant adherence, and support personalized exercise prescriptions in future community interventions. These developments could strengthen preventive healthcare systems and contribute to more effective management of hypertension among the rapidly growing elderly population.

V. CONCLUSION

This study aimed to evaluate the effectiveness of a structured hypertension exercise program in reducing systolic and diastolic blood pressure among older adults attending the Wonokromo Elderly Integrated Health Service Post (Posyandu Lansia Wonokromo), Surabaya, Indonesia. Using a pre-experimental one-group pretest–posttest design, the findings demonstrated that the intervention produced

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statistically significant improvements in blood pressure following four weeks of supervised exercise performed twice weekly. The mean systolic blood pressure decreased from 152.52 ± 8.45 mmHg before the intervention to 141.00 ± 6.98 mmHg after the intervention, representing a mean reduction of 11.52 mmHg ($p < 0.001$). Similarly, the mean diastolic blood pressure declined from 90.85 ± 3.37 mmHg to 83.52 ± 2.08 mmHg, corresponding to a mean reduction of 7.33 mmHg ($p < 0.001$). These results indicate that structured hypertension exercise is an effective, safe, and practical non-pharmacological intervention for improving blood pressure control among elderly individuals and may serve as a valuable complement to pharmacological treatment within community-based healthcare services. The implementation of this exercise program in the Posyandu Lansia setting further demonstrates its feasibility as a low-cost strategy that can promote regular physical activity, enhance community participation, and strengthen preventive healthcare initiatives targeting hypertension among older adults. Nevertheless, the findings should be interpreted in light of the study limitations, including the absence of a control group, the relatively small sample size, the single-center setting, and the short intervention duration, all of which may limit the generalizability of the results. Therefore, future research should employ randomized controlled trial designs involving larger and more diverse populations across multiple community healthcare centers to provide stronger evidence regarding intervention effectiveness. Longer follow-up periods are also recommended to evaluate the sustainability of blood pressure reduction and long-term cardiovascular benefits. Furthermore, future studies should investigate the influence of exercise intensity, frequency, and duration, while incorporating additional clinical outcomes such as physical fitness, quality of life, medication adherence, functional capacity, and digital health technologies for continuous blood pressure monitoring to optimize community-based hypertension management programs and support healthy ageing.

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DATA AVAILABILITY

Due to privacy and ethical restrictions protecting participant confidentiality, the datasets created and analysed during this work are not publicly available. However, they can be obtained from the corresponding author upon reasonable request and with the necessary ethical permissions.

AUTHOR CONTRIBUTION

The study's conception and design, literature research, data collecting, statistical analysis, and initial paper preparation were all done by Shavira Dwi Permatasari. Shavira Dwi Permatasari contributed to the conception and design of the study, conducted the literature review, performed data collection, carried out statistical analysis, and prepared the initial manuscript draft. Rini Ambarwati (First Supervisor) provided methodological guidance throughout the research process, supervised data analysis, and critically reviewed and revised the manuscript for important intellectual content. Ach. Arfan Adinata (Second Supervisor) assisted in validating the research instruments, provided clinical expertise related to hypertension management in elderly populations, and contributed to the revision of the manuscript. Miadi (Chief Examiner) provided academic oversight, evaluated the appropriateness of the research methodology, and contributed to the refinement of the final manuscript. All authors reviewed, revised, and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

DECLARATIONS

ETHICAL APPROVAL

This study was approved by the Health Research Ethics Committee (Komisi Etik Penelitian Kesehatan, or KEPK) at Poltekkes Kemenkes Surabaya, Indonesia, and was carried out in compliance with ethical standards. All older participants gave their informed consent after being fully informed about the goals, methods, possible advantages, and hazards of the study. All participants' privacy and confidentiality were rigorously protected during the course of the study. Every procedure followed accepted ethical standards for human subject research.

CONSENT FOR PUBLICATION PARTICIPANTS

Consent for publication was given by all participants.

COMPETING INTERESTS

The authors declare no competing interests.

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