PROCEEDING
1st Banten International Conference on Health Advancement & Research
binar@poltekkesbanten.ac.id
https://binar.poltekkesbanten.ac.id/

The Effect of Inspiratory Muscle Training (IMT) on Blood Pressure in Late Adults with Hypertension

Husni [1], Widia Lestari[2], Muhammad Gilang Ilahi[2]

[1]Department of Nursing, Health Polytechnic of the Ministry of Health, Bengkulu,

[2]Applied Bachelor's Program in Nursing, Bengkulu, Indonesia

*Corresponding author: husni@poltekkesbengkulu.ac.id

ABSTRACT

Background: Hypertension in Indonesia affects 30.8% of adults, with contributing factors including diet, smoking, physical activity, and stress. An initial survey in the Lingkar Timur Community Health Center area found data on 781 adults with hypertension. Based on interviews with 10 hypertensive patients, it was found that they only underwent pharmacological therapy and were unaware that inspiratory muscle training techniques could lower blood pressure.
Objectives: The purpose of this study was to assess the influence of Inspiratory Muscle Training (IMT) on the blood pressure of hypertensive late adults within the Lingkar Timur Health Center's jurisdiction.
Methods: This was a quasi-experimental study with a total sample of 44 participants, divided into an intervention group (n=22) and a control group (n=22). Non-probability sampling with a purposive method was used, selecting respondents based on inclusion criteria: late adult age, systolic blood pressure >140 mmHg, and diastolic blood pressure >90 mmHg.
Results: Statistical analysis, utilizing the independent t-test for systolic blood pressure and the Mann-Whitney U test for diastolic blood pressure, revealed a p-value of $\alpha \leq 0.05$. This signifies a statistically significant outcome of Inspiratory Muscle Training (IMT) on the blood pressure of hypertensive patients.
Conclusion: Inspiratory Muscle Training (IMT) effectively lowers blood pressure for late adults in conjunction with hypertension.

Keywords: adult, hypertension, IMT

INTRODUCTION

Hypertension is widely recognized as a "*silent killer*" because many individuals remain unaware of their condition until severe organ damage occurs, potentially leading to fatal outcomes. The serious consequences of hypertension, such as cardiac dysfunction, coronary artery disease, renal impairment, cognitive decline, or stroke, often manifest only in advanced stages. The incidence of hypertension and its complications has risen significantly in recent years, necessitating urgent prevention and treatment, especially in adulthood to mitigate fatal impacts (Ervina & Ayubi, 2018).

Epidemiological data indicate a heightened risk of hypertension in adults aged 20 and above, a trend closely linked to lifestyle factors. Adulthood is typically categorized into early adulthood (20-30 years), middle adulthood (31-39 years), and late adulthood (40-60 years). Globally, 40% of adults are projected to be affected by hypertension, with this figure expected to reach 29% worldwide by 2025, and 31.7% in Indonesia. Essential hypertension accounts for 95% of all cases (Dewati et al., 2023). The Framingham Heart Study revealed that over 90% of participants with normal blood pressure at age 55 eventually developed hypertension (Franklin et al., 2021). Late adults face a 2.9 times higher risk of hypertension compared to early and middle adults due to decreased vascular elasticity, leading to arterial stiffness and subsequent blood pressure elevation (Ekarini et al., 2020).

The global prevalence of hypertension is on the rise. In 2023, the World Health Organization (WHO) estimated that 1.28 billion grown-ups aged 30-60 worldwide had hypertension, with a significant most

people in low and middle-income countries like Indonesia. A concerning statistic is that roughly 46% of these individuals are unaware they have the condition (WHO, 2022). The Indonesian Ministry of Health has identified hypertension as the most frequently diagnosed non-communicable disease (NCD) in its healthcare facilities. This is further corroborated by data from the Institute for Health Metrics and Evaluation (IHME), which reported Indonesia's mortality rate at 1.7 million. Hypertension stands as the primary risk factor for death in Indonesia at 23.7%, followed by hyperglycemia (18.4%) and smoking (12.7%). Overall, hypertension comes in second for causes of death within the country (Kemenkes, 2023).

According to the 2023 Indonesian Health Survey, hypertension is the fourth highest risk factor for death, accounting for 10.2% of fatalities. Indonesian Health Survey also reported a national hypertension prevalence of 30.8%. While the lowest prevalence was observed in Papua Pegunungan Province (19.9%), Central Kalimantan Province recorded the highest at 40.7%. Bengkulu Province's hypertension prevalence of 24.8% ranks 30th nationally, which is lower than the national average (Dinkes Kota Bengkulu, 2023). Despite this, hypertension prevalence in Bengkulu City is substantial, with the city's Health Office reporting 50,898 diagnosed cases. Among the 20 Community Health Centers in Bengkulu City, Community Health Centers Lingkar Timur ranks fifth highest with 2,906 cases, indicating a significant burden of hypertension in its working area (Rahmadhani, 2021).

Hypertension development is influenced by both controllable and uncontrollable elements. Modifiable factors include lifestyle elements such as dietary patterns, stress, smoking, physical activity, and obesity. Non-modifiable factors encompass genetic predisposition, particularly a family history of hypertension, and increasing age (Putra et al., 2024). Current approaches to managing hypertension predominantly involve pharmacological therapy, specifically antihypertensive medications. However, non-pharmacological interventions also offer viable alternatives, especially for individuals with mild to moderate hypertension. Commonly implemented non-pharmacological strategies include breathing relaxation techniques, walking, massage, acupuncture, cupping therapy, traditional herbal remedies, and acupressure (Mardiansyah et al., 2022).

Breathing relaxation therapy is a complementary approach increasingly utilized for hypertension management. This technique is highly effective in reducing blood pressure because it diminishes sympathetic activity, slows heart rate, and promotes stable vasodilation, thereby lowering blood pressure (Yusuf, 2023). Various forms of breathing relaxation exist, including inspiratory muscle training, abdominal breathing, slow and deep breathing, alternate nostril breathing, pursed-lip breathing, resonance breathing, and visualized breathing (Barrera et al., 2020). Inspiratory Muscle Training (IMT) specifically involves respiratory muscle exercises designed to enhance muscle flexibility, alleviate stress, and reduce muscle tension. This practice facilitates vasodilation by stretching and relaxing stiff muscles, providing comfort to patients and optimizing blood circulation. IMT is a structured breathing exercise method that strengthens the muscles involved in inspiration, such as the diaphragm and intercostal muscles, through the use of a specialized device that provides resistance during inhalation, thereby improving the strength and efficiency of respiratory muscles (Aulia et al., 2024).

MATERIALS AND METHODS

This study used a quantitative research approach with aiquasi-experimental design, specifically a pre-test and post-test with a control group design. This design allowed for the comparison of outcomes between an intervention group receiving Inspiratory Muscle Training (IMT) and a control group.

RESULTS AND DISCUSSION

Characteristics and Equivalence of Respondents

Table 1. Demographic Profile of Respondents in Lingkar Timur Community Health Center's Service Area, Bengkulu City (2025)

Variable	Group		P Value
	Intervention (n=22)	Control (n=22)	
Age			0,457
Mean	47,27	49,41	*
Min	41	41	
Max	54	58	
SD	3,966	4,944	
CI 95%	45,51 ; 49,03	47,22 ; 51,60	

Gender				0,112
Men	10 (45,5%)	5 (23,7%)	**	
Women	12 (54,5%)	17 (77,3%)		
Work				0,757
Not Working	13 (59,1%)	14 (63,6%)	**	
Working	9 (40,9%)	8 (36,4%)		
History of Hypertension				0,540
> 5 years	14 (63,6%)	12 (54,5%)	**	
< 5 years	8 (36,4%)	10 (45,5%)		
Genetic History				
No history	6 (27,3%)	3 (13,6)		0,457
There is a history	16 (72,7%)	19 (86,4%)	**	
Smoking History				0,472
No smoking	16 (72,7%)	18 (81,8%)	**	
Smoking	6 (27,3%)	4 (18,2%)		
Medication History				0,365
Compliant	13 (59,1%)	10 (45,5%)	**	
non-compliant	9 (40,9%)	12 (54,5%)		

***T Independent test*
***Chi-Square test*

Table 1 shows the baseline characteristics of the study participants. During the intervention group, the mean age was 47.27 years (SD=3.966), with a slight majority being female (54.5%). Most respondents were not working (59.1%), reported adherence to hypertension medication (59.1%), had a history of hypertension for more than 5 years (63.6%), had a genetic history of hypertension (72.7%), and were non-smokers (72.7%). Conversely, in the comparison group, the mean age was 49.41 years (SD=4.944), with a larger proportion being female (77.3%). The majority were not working (63.6%), had a history of hypertension for more than 5 years (54.5%), reported non-adherence to medication (54.5%), predominantly had a genetic history (86.4%), and were non-smokers (81.8%). Equivalence testing for all characteristics (age, gender, occupation, history of hypertension, genetic history, smoking history, and medication adherence) between the intervention and control groups showed a p-value >0.05, indicating that these variables were comparable between the two groups at baseline.

Table 2: Impact of Inspiratory Muscle Training on Systolic Blood Pressure in Hypertensive Older Adults: Lingkar Timur Community Health Center, Bengkulu City (2025)

Variable	Intervention	Control	*p*
Pre Intervention			
Systolic Blood Pressure			
Mean	154,36	148,91	
Median	154,5	149	
Min	132	129	0,173***
Max	200	170	
SD	13.464	10,871	
CI 95%	148,39-160,3	144,09-153,73	
3			
Diastolic Blood Pressure			
Mean	94,14	94,05	
Median	95	93,5	0,921*
Min	90	90	
Max	100	100	
SD	3,091	2,984	
CI 95%	92,77-95,51	92,72-95,37	

Variable	Intervention	Control
Post Intervention		
Systolic Blood Pressure		
Mean	139,05	141,82
Median	139	140
Min	123	127
Max	178	159
SD	12,148	9,535
CI95%	133,66-144,43	137,59-146,05
Diastolic Blood Pressure		
Mean	86,27	89,27
Median	87	90
Min	75	85
Max	92	95
SD	3,894	3,042
CI 95%	84,55-88,00	87,92-90,62

**** Mann-Whitney Test*

Before the intervention, Table 2 indicates the mean systolic blood pressure for the intervention group was 154.36 mmHg (SD=13.464), while the control group averaged 148.91 mmHg (SD=10.871). For diastolic blood pressure, the pre-intervention mean was 94.14 mmHg (SD=3.091) within the intervention group, while 94.05 mmHg (SD=2.984) in the control group. Equivalence tests showed that both systolic (p=0.173) and diastolic (p=0.921) blood pressures were comparable between the two groups before intervention (p > 0.05). Following the intervention, the intervention group's average systolic blood pressure was 139.05 mmHg (SD=12.148), while in the control group, it was 141.82 mmHg (SD=9.535). The mean diastolic blood pressure post-intervention was 86.27 mmHg (SD=3.894) for the intervention group and 89.27 mmHg (SD=3.042) for the control group.

Table 3: Difference in Respondent Blood Pressure Before and After Intervention in the Intervention Group in the Working Area of Community Health Center Lingkar Timur, Bengkulu City 2025

Variable	Median (min – max)	Z	P value
Systolic Blood Pressure			
Before Intervention	154,36(132-200)	-4,12	0,001****
After Intervention	139,05(123-178)		
Diastolic Blood Pressure			
Before Intervention	94,14(90-100)	-4,14	0,001****
After Intervention	86,27(75-92)		

**** Wilcoxon Signed-Rank Test

Table 3 indicates that the Wilcoxon Signed-Rank Test found a significant difference in the median systolic and diastolic blood pressure within the intervention group when comparing measurements before and after the intervention. The p-value for both systolic and diastolic blood pressure was 0.001 (≤α0.05). This demonstrates a notable reduction in blood pressure within the intervention group following the IMT intervention.

Table 4: Difference in Respondent Systolic Blood Pressure Before and After Intervention in the Control Group in the Working Area of Community Health Center Lingkar Timur, Bengkulu City 2025

Variable	n	Mean ± SD	Difference Mean ± SD	CI 95%	t	*P value*
Systolic Blood Pressure						
Before Intervention	22	148,91 ± 10,871				
After Intervention	22	141,82 ± 9,535	7,091 ±3,963	5,334-8 ,848	8,392	0,001*****

***** Paired Samples T-test

Table 4 displays the findings from a Paired Samples T-test, showing a significant differenceiin systolic blood pressure within the control group from before to after the intervention. The mean difference observed was 7.091 (p=0.001 ≤α0.05), indicating a notable change in systolic blood pressure for this group.

Table 5: Difference in Respondent Diastolic Blood Pressure Before and After Intervention in the Control Group in the Working Area of Community Health Center Lingkar Timur, Bengkulu City 2025

Variable		Median (min – max)		Z	P value
Diastolic Blood Pressure					
Before Intervention		93,5(90-100)		-4,0	0,00
After Intervention	2	89,27(85-95)	22	1****	
	2				

**** Wilcoxon Signed-Rank Test

Table 5 shows that the Wilcoxon Signed-Rank Test found a significant difference in median diastolic blood pressure within the control group from before to after the intervention (p=0.001 ≤ α0.05). This suggests a noticeable change in diastolic blood pressure for this group.

Table 6: The Effect of Inspiratory Muscle Training on Systolic and Diastolic Blood Pressure Reduction in Late Adults with Hypertension in the Working Area of Community Health Center Lingkar Timur, Bengkulu City 2025

Variable	n	Mean ± SD	Difference Mean	CI 95%	t	*P value*
Systolic Blood Pressure						
Intervention	22	15,32	8,227	4,610-11.84	4.510	
Control	22	±7,415		5		0,001*
		7,09± 3,963				

Variable	n	Median (Min-Max)	U	P-value
Diastolic Blood Pressure				
Intervention	22	95(90-100)	108,500	0,002***
Control	22	93(90-100)		

**Independent t-test*
*** Mann-Whitney U Test

Table 6 indicates that the independent t-test found a significant difference in the mean reduction of systolic blood pressure between the intervention and control groups (p=0.001 ≤ α0.05). This suggests that Inspiratory Muscle Training (IMT) has a significant effect on reducing systolic blood pressure in hypertensive patients. The results of the Mann-Whitney U test, which revealed a significant difference in the change in diastolic blood pressure between the intervention and control groups (p=0.002 ≤ α0.05). This suggests a significant effect of Inspiratory Muscle Training (IMT) on reducing diastolic blood pressure in hypertensive patients.

This study explored how Inspiratory Muscle Training (IMT) affects Hypertension management in older adults living in the service area of the Community Health Center Lingkar Timur in Bengkulu City. Our results illuminate the characteristics of this patient group and demonstrate the effectiveness of IMT as a non-pharmacological approach to managing hypertension.

The demographic profile of our respondents showed a mean age in the late adulthood category (47.27 years for the intervention group and 49.41 years for the control group), consistent with other studies on hypertension prevalence (Nisak, 2024). This reinforces the understanding that hypertension risk increases with age due to natural physiological changes like decreased vascular elasticity and reduced heart function (Falah, 2019). We observed a higher proportion of female respondents in both groups (54.5% in intervention, 77.3% in control), aligning with other research indicating higher hypertension prevalence in women, particularly those in perimenopause age due to declining estrogen levels affecting vascular flexibility (Wegrzynowicz et al., 2024).

A significant majority of respondents in both groups were unemployed (59.1% intervention, 63.6% control). This finding, echoed by other studies (Ramdhika et al., 2023), suggests a correlation between reduced physical activity and increased hypertension risk, as lower activity levels can lead to a higher resting heart rate and greater cardiac workload. Most respondents had a hypertension of less than 5 years (63.6% intervention, 54.5% control), consistent with previous findings (Nurdin et al., 2024), indicating that accumulated risk factors can accelerate hypertension onset (Putra et al., 2024). A strong genetic predisposition to hypertension was observed in both groups (72.7% intervention, 86.4% control), reinforcing the well-established understanding of hypertension as a heritable condition (Khairunnissa et al., 2022).

Interestingly, most respondents in both groups were non-smokers (72.7% intervention, 81.8% control), consistent with other local studies (Hanifah et al., 2025). While not directly causative, smoking contributes to arterial damage and reduced blood vessel elasticity, increasing the heart's workload (Garwahusada & Wirjatmadi, 2020). Regarding medication adherence, the intervention group showed higher adherence (59.1%) compared to the control group (54.5% non-adherent). This varied finding highlights the complex nature of medication adherence, as noted by Susanto et al. (2023) (Nurdin et al., 2024), emphasizing the need for comprehensive support from family and healthcare professionals to encourage consistent medication use (Moningkey et al., 2023).

The core findings of this study demonstrate a significant positive impact of Inspiratory Muscle Training (IMT) on blood pressure in late adults with hypertension. We observed a significant reduction in both systolic ($p=0.001$) and diastolic ($p=0.001$) blood pressure within the intervention group after IMT. Furthermore, a comparison between the intervention and control groups revealed a statistically significant difference in the mean reduction of both systolic ($p=0.001$) and diastolic ($p=0.002$) blood pressure, indicating IMT's effectiveness in lowering blood pressure. These results align strongly with previous research by (Kahraman et al., 2023) and (Craighead et al., 2021), Both of whom reported similar significant benefits of IMT on blood pressure. The mechanism by which IMT likely achieves this effect involves strengthening respiratory muscles, which can lead to improved cardiovascular autonomic balance, a decrease in sympathetic nervous system activity, and enhanced endothelial function. These physiological changes collectively promote vasodilation and contribute to a reduction in systemic blood pressure. Our findings underscore the potential of non-pharmacological interventions like IMT as a valuable alternative or complementary approach to conventional antihypertensive drug therapy.

This study, while providing compelling evidence, is not without limitations. Its quasi-experimental design, while practical for a real-world setting, meant that complete randomization was not possible, which might have introduced unmeasured confounding variables compared to a fully randomized controlled trial. Furthermore, conducting the study at a single Puskesmas in Bengkulu City may limit the generalizability of these findings to more diverse populations or other healthcare systems. The relatively short intervention period of 12 days might also restrict the observation of long-term blood pressure effects or sustained adherence to IMT. Future studies ought to utilize a randomized controlled trial design involving larger and more geographically diverse participant pools, extending the intervention duration, and integrating objective measures of IMT adherence and intensity to strengthen the evidence base. Despite these limitations, the study's implications are significant for the Sustainable Development Goals (SDGs), with a specific focus on SDG 3, which addresses Good Health and Well-being. By demonstrating the effectiveness and feasibility of IMT as a non-pharmacological intervention, this research contributes directly to the global target of reducing premature mortality from non-communicable diseases (NCD) by one-third through prevention and treatment by 2030. Integrating IMT into primary healthcare settings, such as Puskesmas in Indonesia, offers an accessible, scalable, and potentially cost-effective strategy to improve hypertension management at the community level. This aligns well with broader efforts to strengthen national capacities for early warning,

risk reduction, and the comprehensive management of public health risks, ultimately contributing to better cardiovascular health outcomes and overall well-being.

The study primarily reveals how the interventions affected blood pressure. In the intervention group, the mean systolic blood pressure significantly decreased from 154.36 mmHg (SD=13.464) before IMT to 139.05 mmHg (SD=12.148) after. Similarly, diastolic blood pressure in this group reduced from 94.14 mmHg (SD=3.091) to 86.27 mmHg (SD=3.894) post-IMT. For the control group, who received medication adherence monitoring, the mean systolic blood pressure decreased from 148.91 mmHg (SD=10.871) to 141.82 mmHg (SD=9.535), and diastolic blood pressure changed from 94.05 mmHg (SD=2.984) to 89.27 mmHg (SD=3.042).

These results are consistent with existing literature supporting the efficacy of IMT in lowering blood pressure. Craighead et al. (2021) in Colorado, reported reductions in mean systolic and diastolic blood pressure from 135.2/79.2 mmHg to 126.3/77.2 mmHg after IMT. Further supporting evidence comes from Craighead et al. (2022) In Colorado, also significant reductions in mean systolic blood pressure from 137.23 mmHg to 118.56 mmHg and diastolic from 86.48 mmHg to 72.62 mmHg following IMT (Hüzmeli et al., 2025). More recently, Hüzmeli et al. (2025) in Turkey, reported similar trends, with mean systolic blood pressure dropping from 124.33 mmHg to 117.44 mmHg and diastolic from 73.40 mmHg to 70.66 mmHg after IMT intervention. The consistent findings across these studies, including our own, underscore the therapeutic potential of IMT in hypertension management. The observed reductions in the control group's blood pressure, while present, were less pronounced than those in the intervention group, highlighting the specific benefit of IMT beyond general monitoring. The mechanisms driving these improvements are believed to involve enhanced respiratory muscle strength, leading to improved autonomic nervous system balance and vascular function.

Blood pressure changes varied significantly between the intervention and control groups after their respective interventions, a core finding of this study ($p=0.001$). Both groups experienced a reduction in blood pressure, but the intervention group, which received Inspiratory Muscle Training (IMT), exhibited a more substantial decrease. Specifically, the intervention group showed an average systolic blood pressure reduction of 15.31 mmHg and a diastolic blood pressure reduction of 7.87 mmHg. The control group, only receiving medication adherence monitoring, saw more modest average reductions: 7.09 mmHg in systolic and 4.78 mmHg in diastolic blood pressure.

These findings are consistent with several other studies demonstrating the effectiveness of IMT. Barrera et al. (2020) reported average reductions of 8.0 mmHg in systolic and 4.7 mmHg in diastolic blood pressure. Craighead et al. (2021) found mean differences of 8.9 mmHg in systolic and 2.0 mmHg in diastolic blood pressure. Further supporting evidence comes from Hüzmeli et al. (2025), with average decreases of 6.89 mmHg systolic and 2.47 mmHg diastolic. A more pronounced effect was noted by Craighead et al. (2022), showing average reductions of 24 mmHg in systolic and 14.86 mmHg in diastolic blood pressure. The consistency across these studies reinforces that IMT significantly impacts blood pressure.

The mechanism behind IMT's blood pressure-lowering effect is primarily attributed to its influence on the sympathetic nervous system. IMT, as a form of resistive breathing exercise, induces significant intrathoracic negative pressure during inspiration. This pressure stimulates mechanoreceptors in the respiratory tract and chest wall, which reflexively modulate the autonomic nervous system. While not significantly improving lung function or cardiovascular baroreflex sensitivity, IMT has been shown to reduce sympathetic nerve activity to vascular smooth muscles, as evidenced by a decrease in muscle sympathetic nerve activity (MSNA) burst frequency (Falah, 2019). This reduction in sympathetic activity directly leads to a decrease in vasoconstrictor tone, promoting peripheral vasodilation and consequently lowering systemic vascular resistance and blood pressure. Furthermore, IMT may contribute to improved endothelial function and nitric oxide (NO) bioavailability by reducing oxidative stress, further supporting its blood pressure-lowering effects (Aulia et al., 2024). The consistent daily monitoring in the control group likely contributed to their observed blood pressure reduction, but the significantly larger reductions in the IMT group underscore the specific physiological benefits of this targeted respiratory exercise. The intervention in this study involved IMT three times a week for four weeks for the intervention group, alongside daily medication adherence monitoring for the control group.

The most significant finding of this study is the demonstration of a clear and statistically significant influence of Inspiratory Muscle Training (IMT) on blood pressure in hypertensive patients at Puskesmas Lingkar Timur, Bengkulu. Our analysis yielded a p-value of 0.001 for both systolic and diastolic blood pressure, both well below the significance level of $\alpha<0.05$. This robust statistical evidence confirms the positive impact of IMT. These results are strongly consistent with a growing body of evidence from other studies. Barrera et al. (2020) in Arizona, a significant effect of IMT on hypertension with a p-value of 0.002.

Craighead et al. (2021) In Colorado, similarly, a significant influence, with p-values of 0.001 for systolic and 0.003 for diastolic blood pressure. Further supporting this, Hüzmeli et al. (2025) in Turkey, a significant effect of IMT on lowering both systolic (p=0.001) and diastolic (p=0.008) blood pressure in hypertensive patients. The consistent findings across these diverse studies, including our own, provide compelling evidence for IMT as a valuable intervention for managing hypertension.

CONCLUSION

Both the intervention and control groups saw a reduction in their systolic and diastolic blood pressure, according to the study's conclusion. However, the reduction observed in the intervention group was significantly greater than that in the control group, both before and after treatment. This suggests that inspiratory muscle training effectively lowered both systolic and diastolic blood pressure in hypertensive patients in Bengkulu City's Community Health Center Lingkar Timur area.

CONFLICT OF INTEREST

The authors state that they have no conflicts of interest, whether financial or otherwise, that might be seen as affecting this study's results or interpretation. All research was carried out independently, and no external funding or support was accepted from any company whose product relates to this manuscript or from a company producing a competing product.

ACKNOWLEDGEMENTS

The authors extend their sincere gratitudeito all individuals and institutions who contributed to this research. We particularly acknowledge the invaluable assistance of the health cadres at Community Health Center Lingkar Timur for their dedicated support during data collection. Our appreciation also goes to the three nursing student colleagues who provided essential help with the research execution and ensured consistency in data gathering. This study received administrative and technical support from Community Health Center Lingkar Timur, Bengkulu City, for facilitating access to the study site and participants.

REFERENCES

Aulia, D., Siswadi, A. G. P., & Abidin, F. A. (2024). Gambaran Gaya Hidup Sehat Dewasa Indonesia dalam Perspektif Sosiodemografi. *Journal of Psychological Science and Profession*, *8*(2), 168–176. https://doi.org/10.24198/jpsp.v8i2.56417

Barrera, G. E. R., DeLucia, C. M., & Bailey, E. F. (2020). Inspiratory muscle training lowers blood pressure and sympathetic activity in older adults with OSA: A randomized controlled pilot trial. *Journal of Applied Physiology*, *129*(3), 449–458. https://doi.org/10.1152/japplphysiol.00024.2020

Craighead, D. H., Heinbockel, T. C., Freeberg, K. A., Rossman, M. J., Jackman, R. A., Jankowski, L. R., Hamilton, M. N., Ziemba, B. P., Reisz, J. A., D'Alessandro, A., Brewster, L. M., Desouza, C. A., You, Z., Chonchol, M., Bailey, E. F., & Seals, D. R. (2021). Time-efficient inspiratory muscle training lowers blood pressure and improves endothelial function, no bioavailability, and oxidative stress in midlife/older adults with above-normal blood pressure. *Journal of the American Heart Association*, *10*(13). https://doi.org/10.1161/JAHA.121.020980

Craighead, D. H., Tavoian, D., Freeberg, K. A., Mazzone, J. L., Vranish, J. R., DeLucia, C. M., Seals, D. R., & Bailey, E. F. (2022). A multi-trial, retrospective analysis of the antihypertensive effects of high-resistance, low-volume inspiratory muscle training. *Journal of Applied Physiology (Bethesda, Md. : 1985)*, *133*(4), 1001–1010. https://doi.org/10.1152/japplphysiol.00425.2022

Dewati, C. A., Natavany, A. R., Putri, Z. M., Nurfaizi, A., Rumbrawer, S. O., & Sri Rejeki, D. S. (2023). Literature Review: Faktor Risiko Hipertensi di Indonesia. *Jurnal Kesehatan Masyarakat*, *11*(3), 290–307. https://doi.org/10.14710/jkm.v11i3.34514

Dinkes Kota Bengkulu. (2023). *Angka Kejadian Hipertensi Kota Bengkulu*.

Ekarini, N. L. P., Wahyuni, J. D., & Sulistyowati, D. (2020). Faktor - Faktor Yang Berhubungan Dengan Hipertensi Pada Usia Dewasa. *Jkep*, *5*(1), 61–73. https://doi.org/10.32668/jkep.v5i1.357

Ervina, L., & Ayubi, D. (2018). Peran Kepercayaan Terhadap Penggunaan Pengobatan Tradisional Pada

Penderita Hipertensi Di Kota Bengkulu. *Perilaku Dan Promosi Kesehatan: Indonesian Journal of Health Promotion and Behavior*, *1*(1), 1. https://doi.org/10.47034/ppk.v1i1.2101

Falah, M. (2019). Hubungan Jenis Kelamin Dengan Angka Kejadian Hipertensi Pada Masyarakat Di Kelurahan Tamansari Kota Tasikmalaya. *Jurnal Keperawatan & Kebidanan STIKes Mitra Kencana Tasikmalaya*, *3*(1), 88.

Franklin, S. S., Larson, M. G., Khan, S. A., Wong, N. D., Leip, E. P., Kannel, W. B., & Levy, D. (2021). Does the relation of blood pressure to coronary heart disease risk change with aging?: The Framingham Heart Study. *Circulation*, *103*(9), 1245–1249. https://doi.org/10.1161/01.CIR.103.9.1245

Garwahusada, E., & Wirjatmadi, B. (2020). Hubungan Jenis Kelamin, Perilaku Merokok, Aktivitas Fisik dengan Hipertensi Pada Pegawai Kantor. *Media Gizi Indonesia*, *15*(1), 60–65. https://e-journal.unair.ac.id/MGI/article/view/12314/9068

Hanifah, N. N., Sumarni, T., Deswita, D., & Yusra, A. (2025). *Overview of Risk Factors in Hypertension Disease*. *1*(2), 31–38. https://doi.org/https://doi.org/10.70920/jahns.v1i1.180

Hüzmeli, İ., Katayıfçı, N., Abay, B., Akkuş, O., & Özer, A. Y. (2025). The effectiveness of functional inspiratory muscle training on exercise capacity and peripheral muscle strength in patients with essential hypertension: a three-arm randomized controlled trial. *BMC Sports Science, Medicine and Rehabilitation*, *17*(1). https://doi.org/10.1186/s13102-025-01082-w

Kahraman, B. O., Tanriverdi, A., Savci, S., Odaman, H., Akdeniz, B., Sevinc, C., Ozsoy, I., Acar, S., Balci, A., Baran, A., & Ozpelit, E. (2023). Effects of Inspiratory Muscle Training in Patients With Pulmonary Hypertension. *The American Journal of Cardiology*, *203*, 406–413. https://doi.org/10.1016/J.AMJCARD.2023.06.097

Kemenkes. (2023). *Survei Kesehatan Indonesia 2023 (SKI)*.

Khairunnissa, K., Norfai, N., & Hadi, Z. (2022). Faktor-Faktor yang Berhubungan dengan Kejadian Hipertensi di Wilayah Kerja Puskesmas Barabai Tahun 2021. *Jurnal Akademika Baiturrahim Jambi*, *11*(2), 165. https://doi.org/10.36565/jab.v11i2.455

Mardiansyah, M. J., Haerani, M., Anggraeni, N., Aqiila qurrotua, H., & Arini Ayu, S. (2022). Pengaruh Relaksasi Nafas Dalam (Deep Breathing) Dalam Menurunkan Tekanan Darah Terhadap Pasien Hipertensi. *Jurnal Lentera*, *5*, 81–86.

Moningkey, S., Aprilyanri, I., AN Hirania, I. G., Arita, L., & L Atmodjo, W. (2023). Contribution of Anti-hypertensive Medication Adherence with Control of Blood Pressure in Hypertensive Patients in Cisauk Primary Health Care Centre. *Journal of Medicine and Health*, *5*(1), 56–63. https://doi.org/10.28932/jmh.v5i1.6097

Nisak, R. (2024). Lama Sakit dan Dukungan Keluarga Terhadap Self Care Behaviour (Perilaku Perawatan Diri) Pada Penderita Hipertensi. *Jurnal Penelitian Perawat Profesional*, *6*(5474), 3063–3072.

Nurdin, N., Marsia, M., & Baedlawi, A. (2024). Hubungan Kepatuhan Minum Obat Anti Hipertensi Terhadap Penurunan Tekanan Darah Pada Pasien Hipertensi Di Puskesmas Parit Timur Kubu Raya. *Scientific Journal of Nursing Research*, *5*(2), 21. https://doi.org/10.30602/sjnr.v5i2.1349

Putra, M. A., Nurhikmawati, & Khalid, N. F. (2024). Terapi Non Farmakologi dalam Pengendalian Tekanan Darah pada Pasien Hipertensi. *Media Publikasi Promosi Kesehatan Indonesia (MPPKI)*, *7*(5), 1094–1100. https://doi.org/10.56338/mppki.v7i5.4995

Rahmadhani, M. (2021). Faktor-Faktor Yang Mempengaruhi Terjadinya Hipertensi Pada Masyarakat Di Kampung Bedagai Kota Pinang. *Jurnal Kedokteran STM (Sains Dan Teknologi Medik)*, *4*(1), 52–62. https://doi.org/10.30743/stm.v4i1.132

Ramdhika, M. R., Widiastuti, W., Hasni, D., Febrianto, B. Y., & Jelmila, S. (2023). Hubungan Aktivitas Fisik dengan Kejadian Hipertensi pada Perempuan Etnis Minangkabau di Kota PadangHubungan Aktivitas Fisik dengan Kejadian Hipertensi pada Perempuan Etnis Minangkabau di Kota Padang. *Jurnal Kedokteran Dan Kesehatan*, *19*(1), 91. https://doi.org/10.24853/jkk.19.1.91-97

Simon, M., Papua, S., Kanal, J., & Sorong, K. (2022). *Hubungan Antara Lama Menderita Hipertensi Dan Motivasi Berobat Dengan Kepatuhan Minum Obat Pada Penderita Hipertensi*. *5*, 1–5.

Wegrzynowicz, A. K., Walls, A. C., Godfrey, M., & Beckley, A. (2024). *Insights into Perimenopause : A Survey of Perceptions, Opinions on Treatment, and Potential Approaches*. 1–16.

WHO. (2022). Angka Kematian Dengan Hipertensi. *Global : WHO*.

Yusuf, S. B. (2023). *Berbagai manfaat teknik relaksasi nafas dalam bagi lansia*. 4.