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BLOOD PRESSURE ANALYSIS IN THE RUNNER COMMUNITY TOWARDS THE RISK OF EXERCISE-INDUCED HYPERTENSION

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Abstrak

Hipertensi meningkatkan risiko penyakit jantung secara global, sementara olahraga lari telah menjadi populer sebagai langkah pencegahan. Namun, hal ini juga dapat menyebabkan Hipertensi yang Dipicu oleh Olahraga (EIH), terutama pada pelari jarak jauh berusia paruh baya yang menunjukkan tingkat EIH lebih tinggi dibandingkan kelompok usia lain. Studi ini menyelidiki variasi tekanan darah sebelum dan setelah berlari dalam komunitas pelari. Menggunakan desain pra-eksperimental dengan pendekatan pra-tes dan pasca-tes, studi ini melibatkan responden berusia di atas 18 tahun yang berlari lebih dari 1-kilometer dan berlatih setidaknya dua kali seminggu. Sebanyak 36 anggota komunitas dipilih secara purposif. Tekanan darah dan denyut nadi diukur sebelum dan segera setelah berlari. Sebagian besar responden adalah laki-laki (33,3%), muda (52,78%), dan tidak merokok (72,2%). Temuan menunjukkan bahwa berlari tidak secara signifikan mempengaruhi Tekanan Darah Sistolik (p>0,05), tetapi mempengaruhi Tekanan Darah Diastolik (p<0,05). Tidak terdapat perubahan signifikan pada tekanan darah, menunjukkan adanya EIH (tekanan darah istirahat <140/90 mmHg dan maksimum selama olahraga ≥210 mmHg untuk pria dan ≥190 mmHg untuk wanita). Tekanan darah yang stabil atau menurun dikaitkan dengan vasodilatasi metabolik selama olahraga. Pemantauan tekanan darah secara terus-menerus sangat penting untuk mengurangi risiko kesehatan yang potensial.

Kata kunci: *hipertensi, latihan fisik, pelari, tekanan darah*

Abstract

Hypertension increases the risk of heart disease globally, while running has gained popularity as a preventive measure. However, it can also lead to Exercise-Induced Hypertension (EIH), particularly in middle-aged long-distance runners who exhibit higher EIH levels than other age groups. This study investigates blood pressure variations before and after running within a running community. Utilizing a pre-experimental design with a pre- and post-test approach, the study included respondents over 18 years old, who ran more than 1 kilometer and trained at least twice weekly. A purposive sample of 36 community members was selected. Blood pressure and pulse were measured before and immediately after running. The majority of respondents were male (33.3%), young (52.78%), and non-smokers (72.2%). Findings indicated that running did not significantly affect Systolic Blood Pressure (p>0.05), but it did impact Diastolic Blood Pressure (p<0.05). No significant changes in blood pressure were observed, suggesting EIH (resting blood pressure <140/90 mmHg and maximum during exercise ≥210 mmHg for men and ≥190 mmHg for women). The stable or decreased blood pressure is attributed to metabolic vasodilation during exercise. Continuous blood pressure monitoring is essential to mitigate potential health risks.

Keywords: *blood pressure; hypertension; physical exercise; runner*

INTRODUCTION

Hypertension is classified as a Non-Communicable Disease (NCD) and serves as a major contributory factor to the incidence of cardiovascular diseases, including heart disease and stroke (CDC, 2023). Hypertension presents a significant public health challenge across both developed and developing nations, contributing to the global burden of disease and health system strain. According to estimates by the World Health Organization (WHO), approximately 1.28 billion adults between the ages of 30 and

79 globally are affected by hypertension, with a substantial proportion residing in low- and middle-income countries (WHO, 2023). As many as 119.9 million, or almost half of adults in America, have also been diagnosed with hypertension (CDC, 2023). Hypertension is also still a health problem of concern in Indonesia. Based on a doctor's diagnosis, as many as 8.36% of the population in Indonesia has hypertension, with the highest prevalence in North Sulawesi, namely 13.21%, and as many as 8.61% in Banten province. The prevalence of hypertension in Indonesia has shown a significant upward trend, increasing from 25.8% in 2013 to 34.1% in 2018 (Mahdaniar, 2023).

Definitions of hypertension vary among leading medical organizations, including the American College of Cardiology and American Heart Association (ACC/AHA), the European Society of Cardiology (ESC), and the European Society of Hypertension (ESH), reflecting differences in diagnostic thresholds and clinical guidelines (Sharma et al., 2019). The ACC/AHA recommends changing the blood pressure threshold used to diagnose hypertension to ≥130/80 mmHg (Whelton et al., 2018). Meanwhile, the ESC/ESH defines hypertension as a blood pressure value ≥ 140/90 mmHg (Williams et al., 2018). This definition of hypertension is in line with WHO and the Indonesian Ministry of Health, which defines hypertension as a condition when blood pressure exceeds 140/90 mmHg (WHO, 2023).

Basically, hypertension can be prevented by adopting a healthy lifestyle. Meanwhile, individuals with hypertension are advised to adopt a healthy lifestyle alone or accompanied by drug therapy (CDC, 2023). For individuals diagnosed with obesity, diabetes, chronic kidney disease (CKD), or hypertension, the implementation of traditional low-intensity exercise regimens combined with complementary therapeutic approaches is strongly recommended to support overall health and disease management (Irawati et al., 2024; Kaewmanee et al., 2025). Adopting a healthy lifestyle plays a pivotal role in preventing or delaying the onset of hypertension and significantly contributes to the reduction of cardiovascular disease risk. Physical activity and regular exercise are recommended lifestyle habits and have many benefits (Dhuli et al., 2022; Pojednic et al., 2022). These interventions are effective in preventing the progression of mild to moderate hypertension and play a crucial role in its management (Gibbs et al., 2021; Valenzuela et al., 2021). Engaging in regular aerobic exercise, such as running at moderate intensity with controlled volume, is recommended to effectively reduce resting blood pressure among individuals with hypertension (Igarashi & Nogami, 2020).

Some people are aware of disease prevention by implementing healthy lifestyle behaviors such as physical activity and exercise. A study shows that the most important motivations for doing physical activity are pleasure, mental regeneration, and maintaining health (Grajek et al., 2021). The 2018 Basic Health Research (Riskesdas) results showed that more than half of Indonesia's population is quite physically active. Recent studies and surveys indicate that running has emerged as one of the most widely practiced and popular forms of physical activity globally, reflecting its accessibility and health benefits (Deelen et al., 2019; Statista, 2024). Running is among the most widely embraced forms of physical activity due to its flexibility, cost-effectiveness, and minimal equipment requirements, making it highly accessible across diverse populations

Conversely, recent research has identified Exercise-Induced Hypertension (EIH) as a potential health concern associated with physical activity. Notably, middle-aged long-distance runners exhibit higher levels of EIH compared to their counterparts in other age groups (Kaltwasser, 2024). EIH refers to an abnormal elevation in blood pressure triggered by physical exertion. It is characterized by a resting blood pressure below 140/90 mmHg and an exaggerated maximal exercise-induced blood pressure of ≥210 mmHg in men and ≥190 mmHg in women (C. H. Kim et al., 2020; Y. J. Kim & Park, 2024). EIH contributes to elevated myocardial oxygen demand, primarily resulting from the excessive rise in blood pressure during physical activity (Kaltwasser, 2024). A study involving 606 middle-aged long-distance runners reported an Exercise-Induced Hypertension (EIH) prevalence rate of 56% (n=338), which exceeds the prevalence observed in the general population (Y. J. Kim et al., 2021). EIH not only occurs in individuals with hypertension but can also be experienced by athletes and individuals who have not been diagnosed with hypertension and who can show signs of hypertension and heart problems in the future (Edwards, 2022).

Blood pressure measurement serves as a crucial screening tool for the early detection of risk factors associated with non-communicable diseases, including hypertension, cardiovascular disorders, and related conditions (Mahdaniar, 2023). Blood pressure screening can be an effort to prevent hypertension that is not realized or asymptomatic. Accordingly, this study seeks to evaluate the

variations in blood pressure pre- and post-running to assess the potential risk of Exercise-Induced Hypertension (EIH) among members of the runner community. The specific objectives are to identify the characteristics of the respondents, find out their blood pressure before and after running, and get an overview of the risk of EIH in the runner community. The anticipated benefits of this study include facilitating early detection of cardiovascular disease and enhancing community autonomy in identifying risk factors associated with non-communicable diseases (NCDs).

RESEARCH METHODS

This study employs a pre-experimental design with a pre- and post-test study approach. Sample collection by convenience sampling with inclusion criteria of age >18 years, running distance >1 kilometer, and running frequency of at least 2 times a week (Y. J. Kim et al., 2021). The frequency of running routines in a week, age, and history of smoking was identified by asking respondents to fill out the questionnaire provided. Meanwhile, the exclusion criteria included a history of cardiovascular disease, experiencing impaired physical mobility, and being pregnant. This study used purposive sampling with a total sample involving 36 members of the running community in Tangerang City-Indonesia. Data analysis using the Wilcoxon test.

This study has passed the ethics test with number 187/KEP/III.3.AU/F/FIKes/2025 from the ethics committee by the Faculty of Health Sciences Universitas Muhammadiyah Tangerang. Respondents have received an explanation regarding the objectives, benefits, and procedures of the research to be carried out. The measurement results were recorded on an observation sheet containing the characteristics of the respondents and their blood pressure before and after running. The tool for measuring blood pressure uses an Omron digital tensiometer type HEM-7143T1, which is a new product, so it has been calibrated in advance. Pre-test blood pressure was measured 5 minutes before the respondents ran (Edwards, 2022). Furthermore, respondents ran according to their abilities and the usual distance, which was the target of each respondent. Post-test pulse and blood pressure measurements were carried out immediately, within 6 minutes or no more than 30 minutes after the respondents completed their running activities.

Respondents are strongly advised to promptly consult the health service team if their blood pressure remains above 180/120 mmHg for more than two hours following physical activity, particularly when accompanied by concerning symptoms such as chest pain, dyspnea, speech disturbances, back pain, visual changes, or unilateral numbness and weakness (Edwards, 2022). However, if there are no symptoms, respondents are recommended to rest for 5 minutes and measure their blood pressure again.

RESULTS AND DISCUSSION

This study involved 36 respondents with characteristics including gender, age, and smoking history. Most respondents were male (66.7%), in the initial period of maturity age group (26-37 years) (52.78%), and had never smoked (72.2%).

Table 1. Respondent Characteristic (n=36)

Characteristic	f	%
Sex		
Male	24	66.7
Female	12	33.3
Age		
Youth (17-21 years)	1	2.78
Crown of youth (22-25 years)	3	8.33
Initial period of maturity (26-37 years)	19	52.78
Middle period of maturity (38-49 years)	12	33.33
Full maturity (50-61 years)	1	2.78
Historical smoking		
Active smoker	3	8.3
Formers smoker	7	19.4
Never	26	72.2

The majority of respondents who exercise by running are male (66.7%). Based on age distribution, most respondents' age group is in the initial maturity period (26-37 years) or young age (52.78%). Most respondents in this study also never smoked or had no history of smoking (72.2%). Some former smokers had quit smoking for more than 2 years (19.4%), and a small number were still active smokers (8.3%).

Table 2. Distribution of Blood Pressure Respondents (n=36)

Blood Pressure	Min	Max	Mean
Before			
Systolik	92	178	123.69
Diastolik	47	105	82.31
After			
Systolik	97	165	122.83
Diastolik	57	109	75.92

Table 2 shows that the lowest blood pressure before running is 92/47 mmHg or less than <140/90 mmHg at rest. Meanwhile, blood pressure after running shows a maximum value of 165/109 mmHg or no more than ≥210 mmHg in men and ≥190 mmHg in women. Therefore, it can be concluded that there was no blood pressure in respondents that indicated EIH, namely, blood pressure at rest and maximum blood pressure during exercise ≥210 mmHg in men and ≥190 mmHg in women (C. H. Kim et al., 2020; Y. J. Kim & Park, 2024).

Table 3. Test of Normality

	Shapiro-Wilk		
	Statistic	**df**	**Sig.**
Systolic Blood Pressure Before	0.948	36	0.089
Systolic Blood Pressure After	0.957	36	0.170
Diatolic Blood Pressure Before	0.937	36	0.041
Diatolic Blood Pressure After	0.935	36	0.036

The Shapiro-Wilk normality test shows that the level of significance of SBP before running is 0.089 (p>0.05), and SBP after running is 0.170 (p>0.05), which means that both are normally distributed. The level of significance of DBP before running is 0.041 (p<0.05), and DBP after running is 0.036 (p<0.05), which means that both are generally not distributed. Therefore, the results of systolic blood pressure and diastolic blood pressure were analyzed using the Wilcoxon test.

Table 4. Wilcoxon signed-rank test (n=36)

	Systolic blood pressure pre- and post-run	**Diastolic blood pressure pre- and post-run**
Z	-0.066[b]	-2.909[b]
Asymp. Sig (2-tailed)	0.948	0.004

[b.] based on positive ranks

Table 4 shows that Sig. (2-tailed) is 0.948 (p>0.05), so it can be interpreted that there is no difference between systolic blood pressure before and after running. Therefore, running activity does not affect systolic blood pressure. However, diastolic blood pressure shows different findings, Sig. (2-tailed) is 0.004 (p <0.05). It can be interpreted that there is a difference between diastolic blood pressure before and after running. Therefore, running activity affects diastolic blood pressure.

DISCUSSION

The survey showed that women do less exercise than men, even though both prefer strength training and endurance sports, such as running, compared to other sports (Feraco et al., 2024). Men spend more energy than women by walking and are more physically active, with an average energy

expenditure of 2073 MET-minutes/week, compared to women who only spend 771 MET-minutes/week (Nishanthi et al., 2024). An infodemiology study showed that men showed a higher interest in searching for information via the internet in activities such as running, while women were more interested in activities such as Pilates (Uemura et al., 2024). The age distribution dominated by the initial period of maturity may be due to differences in running motivation between young and old ages. Older people choose to run with a general health orientation, while young runners' motivation is based on achieving personal goals (Gerasimuk et al., 2021).

Based on the characteristics, most respondents did not have a smoking habit (Table 1). This is in line with previous studies, which found that individuals in the runner group rarely have a smoking habit, which reflects an overall healthy lifestyle and the positive effects of individual training sessions in reducing the desire to smoke (Kozlovskaia et al., 2019).

Previous studies have shown that aerobic exercise can immediately improve arterial stiffness in individuals with different smoking statuses and has a more pronounced beneficial effect on light and heavy smokers than on non-smokers (Wang et al., 2023). However, blood pressure measurements showed that systolic blood pressure and diastolic blood pressure decreased significantly in the group of non-smokers who exercised and increased significantly in the group of smokers who did not exercise (J.-Y. Kim et al., 2018). Therefore, a healthy lifestyle, such as aerobic exercise is also recommended for smokers to improve arterial stiffness, delay vascular aging, and reduce vascular damage caused by smoking (Wang et al., 2023). In this study, running activity did not affect systolic blood pressure (Table 4). However, when exercise intensity increases, systolic blood pressure usually shows a linear increase, reflecting increased metabolic needs of the body and increased cardiac output (Pesova et al., 2023). Several factors that affect peak SBP include resting SBP, height, power output, age, resting SBP, gender, endurance sport category, and weight (Pesova et al., 2024). Non-smokers also dominated the characteristics of respondents in this study. Hence, the results of this study showed that the majority of blood pressure after activity tended to be lower than before. Individuals with an excessive blood pressure response during exercise have a 3.6 times higher risk of developing hypertension compared to individuals who show a normal blood pressure response (Caselli et al., 2019).

The results of the BP measurements showed a tendency to decrease after running (Table 2), and running activity affected diastolic blood pressure (Table 4). This is in line with other studies showing that physical activity, such as running has a significant effect on reducing diastolic blood pressure even in individuals with an initial BP of 120 mmHg or lower and a BP of 80 mmHg or lower (Monfared et al., 2024). BP that decreases or tends to be stable can be caused by metabolic vasodilation in the muscles used in sports to ensure adequate oxygen delivery and removal of metabolic waste (Pesova et al., 2023).

This study's results indicate a difference in response between SBP and DBP in respondents after running. This shows that blood pressure responses can vary after a person exercises (Kunimatsu et al., 2024). Thus, close monitoring of dynamic blood pressure responses during exercise can be a primary tool in predicting early cardiovascular events or even sudden cardiac death (Pesova et al., 2023). Therefore, it can be concluded that after the respondents ran, the blood pressure measurement results did not indicate any abnormal or worrying responses such as the occurrence of EIH according to the American Heart Association (AHA), namely if blood pressure at rest is <140/90 mmHg and maximum blood pressure during exercise is ≥210 mmHg in men and ≥190 mmHg in women (Gibbons et al., 2002; C. H. Kim et al., 2020; Y. J. Kim & Park, 2024). Meanwhile, if referring to the European Society of Cardiology (ESC) recommends a slightly higher threshold for abnormal blood pressure responses during exercise, namely 220 mmHg for men and 200 mmHg for women (Williams et al., 2018). Likewise, the threshold for abnormal blood pressure responses during exercise based on the American College of Sports Medicine (ACSM) through a unisex approach is 225 mmHg for both sexes (Hunter et al., 2023). The general mechanism of EIH is due to increased sympathetic tone, which results in increased angiotensin II levels, endothelial dysfunction, and the possibility of increased arterial stiffness (Mohammed et al., 2020). However, measurement results can exceed the EIH criteria threshold in specific populations, such as athletes, due to unique physiological adaptations and do not indicate pathological conditions (Pesova et al., 2023). Therefore, in addition to referring to standardized guidelines, further research also needs to look at more individualized assessments by considering the inherent variability between different groups and individuals (Pesova et al., 2023; Sabbahi et al., 2018).

In addition, monitoring blood pressure during exercise, regular evaluation of cardiovascular health, and understanding risk factors can help in the prevention and management of EIH.

CONCLUSIONS AND SUGGESTIONS

Running sports are more dominated by male participants in the initial period of maturity group or early adulthood and do not have a smoking habit. The blood pressure response after running can vary and is influenced by various factors. In the runner group, running activity did not affect SBP but influenced SBP and tended to decrease. Blood pressure before and after running in the runner group did not show any alarming abnormal responses such as EIH. Blood pressure monitoring before and during running needs to be done. Each individual needs to understand risk factors that can help in the prevention and management of EIH.

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