Original Research Report

HYPERTENSION AND LIPID PROFILES IN MIDDLE-AGED MALE PATIENTS: A STUDY AT A TERTIARY HOSPITAL IN SURABAYA, INDONESIA

Arin Nurtya[1], Artaria Tjempakasari[2], Ummi Maimunah[2] Sulistiawati[3*] ,
I Made Subhawa Harsa[4]

[1]Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia
[2]Department of Internal Medicine, Dr. Soetomo General Academic Hospital, Surabaya, Indonesia
[3]Department of Public Health and Preventive Medicine, Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia
[4]Department of Physiology, Faculty of Medicine, Universitas Wijaya Kusuma Surabaya, Surabaya, Indonesia

ABSTRACT

Hypertension is one of the most frequent non-communicable diseases and a risk factor for cardiovascular disease, contributing to most deaths globally. The risk of hypertension is higher in those with uncontrolled lipids. In this study, the incidence of hypertension and lipid profiles were examined from March 2020 to March 2022. The aim of this study was to determine the relationship between hypertension in men aged 45–60 years and their lipid profiles, which include total cholesterol, triglycerides, low-density lipoprotein (LDL), and high-density lipoprotein (HDL). This study used an analytical observational design with a cross-sectional approach. Medical records were utilized as secondary data. Statistical analysis was conducted using the Spearman rank correlation test. Statistical significance was determined at $p<0.05$. This research examined 115 patients with hypertension. The results showed that the stage of hypertension was correlated with total cholesterol ($r=0.317$; $p=0.001$) and triglyceride levels ($r=0.217$; $p=0.02$). However, the stage of hypertension was not significantly correlated with LDL ($r=0.158$; $p=0.91$) and HDL ($r=0.75$; $p=0.423$). Hence, this current study underscores the nuanced relationship between lipid profiles and the stage of hypertension in middle-aged male patients. This study highlights the importance of sex-specific analysis in hypertensive research. It also provides promising avenues for further investigation.

Keywords: Cardiovascular disease; hypertension; triglycerides; low-density lipoprotein (LDL); high-density lipoprotein (HDL)

***Correspondence:** Sulistiawati, Department of Public Health and Preventive Medicine, Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia. Email: sulistiawati@fk.unair.ac.id

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Highlights:
1. Uncertainty regarding the association between hypertension and the levels of low-density lipoprotein (LDL) and high-density lipoprotein (HDL) signifies the need for more research, particularly in the realm of sex-specific analysis.
2. Our study uncovered significant associations between hypertension and the levels of total cholesterol and triglycerides, expanding our understanding of the impact of lipid profiles on hypertension.
3. This research may potentially pave the way for personalized diagnostic and therapeutic strategies, ultimately enhancing hypertension management and patient outcomes.

INTRODUCTION

Hypertension poses a unique challenge to the population of Surabaya, Indonesia. According to the Eighth Joint National Committee (JNC VIII) guidelines, hypertension is characterized by systolic or diastolic blood pressure exceeding 140/90 mmHg. This condition poses a significant threat to cardiovascular health and is a major contributor to global mortality. Hypertension is broadly classified into two categories: primary hypertension, which lacks a specific underlying cause and accounts for approximately 90% of cases, and secondary hypertension, which is linked to underlying medical conditions such as renal, vascular, thyroid, or adrenal diseases (James et al. 2014, Putri et al.

2021).

The prevalence of hypertension is a global concern, affecting an estimated 1.13 billion people worldwide. This number is projected to increase to 1.5 billion by 2025 (Kingue et al. 2015, Nawi et al. 2021). The hypertension epidemic is a pressing public health concern because it particularly affects Southeast Asian populations, including those in Indonesia. Alarmingly, the Indonesian Ministry of Health data indicated that only 32.2% of hypertensive individuals in Indonesia have been diagnosed and treated. Their recent Basic Health Research report revealed a troubling increase in hypertension prevalence, rising from 25.8% in 2013 to 34.11% in 2018. East Java Province is of particular concern, with a hypertension rate of 36.32%. Surabaya, the province's capital city, revealed a prevalence of 31.58% (Minister of Health of the Republic of Indonesia 2013, 2018). The specifics of what differentiates the population in Surabaya from other regions warrant further research and analysis. Factors such as lifestyle, dietary habits, genetics, access to healthcare, and environmental influences may play a role in the higher prevalence of hypertension in this area. It is essential to understand these distinctive elements for the development of targeted public health interventions and policies to address the challenges of hypertension management in Surabaya and its surrounding areas.

An increased risk of hypertension has been associated with dyslipidemia. This imbalance of lipids is defined by elevated total cholesterol, low-density lipoprotein (LDL), and triglyceride levels together with lower high-density lipoprotein (HDL) levels (Islam et al. 2014, Astana & Triyono 2018). According to earlier research, excess triglycerides and lipids contribute to atheroma formation on blood vessel walls, impairing flexibility and potentially leading to hypertension. Notably, a significant portion of individuals with hypertension exhibit moderate blood cholesterol levels of 200–239 mg/dL (Kusmiati & Pratiwi 2015, Maryati 2017).

For several reasons, it is essential to research hypertension in men, particularly in the age group of 45–60. There are notable sex-specific differences in how hypertension presents, with men exhibiting a higher prevalence compared to women. The investigation of hypertension in men allows for the identification of distinct risk factors, etiological factors, and health implications. Age-specific variations in hypertension have also been documented, with the risk increasing with age. Focusing on this age group allows for a better understanding of age-related patterns and correlations, leading to more targeted preventive measures and interventions. Additionally, given the significant health concern of hypertension in older men, this study may help uncover the factors contributing to its high prevalence by offering insights to guide public health efforts. Lastly, understanding sex and age-specific differences enables the customization of preventive strategies and interventions through lifestyle modifications, targeted screening, or specialized treatments tailored to the needs of this specific population (Choi et al. 2017). In summary, this research is crucial for gaining insights into the unique factors contributing to hypertension in middle-aged men and, in turn, providing information on effective strategies for its prevention, diagnosis, and management.

Numerous studies have reported age- and sex-specific variations in hypertension. However, comprehensive research on the relationship between lipid profiles and hypertension, especially among men aged 45–60 in the Surabaya area, remains scarce. Consequently, further investigations are warranted to elucidate this connection in an endeavor to reduce hypertension prevalence and promote public health awareness. This research aimed to determine the relationship between lipid profiles (i.e., total cholesterol, triglycerides, LDL, and HDL levels) and hypertension in men aged 45–60 years in the Department of Internal Medicine and Department of Cardiology, Dr. Soetomo General Academic Hospital, Surabaya, Indonesia, in the period of March 2020–March 2022.

MATERIALS AND METHODS

This analytical observational research used a cross-sectional design and utilized secondary data from the medical records of hypertensive patients. The medical records were collected from patients at Dr. Soetomo General Academic Hospital, Surabaya, Indonesia, who met the specified inclusion and exclusion criteria. This study examined all medical record data of hypertensive patients admitted to the Department of Internal Medicine and Department of Cardiology in the period spanning from March 2020 to March 2022. The total samples were 115 hypertensive patients selected via non-random total sampling. The specified inclusion criteria were individuals who were diagnosed with primary hypertension, were male, and fell within the age group of 45–60 years. Meanwhile, the exclusion criteria pertained to patients with incomplete medical record data regarding their lipid profiles from the laboratory tests. The data collected included hypertension severity and lipid profiles, with data on the stage of hypertension retrieved from the initial patient records (Cuschieri 2019).

The measurement of total cholesterol, triglyceride, LDL, and HDL levels was conducted through laboratory tests. The results of the laboratory tests were recorded in the patients' medical records. Desirable total cholesterol levels were defined as being <200 mg/dL, while levels of 200–239 mg/dL and ≥240 mg/dL were categorized as borderline high and high, respectively. The acceptable range for triglyceride levels is defined as being below 200 mg/dL. Levels from 200 to 399 mg/dL are considered as borderline high, while equal to or beyond 400 mg/dL are categorized as significantly high. The desired LDL levels are below 130 mg/dL, while between 130 and 159 mg/dL are borderline high, and equal to or above 160 mg/dL are categorized as high. Conversely, HDL levels were considered desirable if they were >50 mg/dL, borderline high if they were 40–49 mg/dL, and high if they were <40 mg/dL. The measurement of blood pressure was conducted by utilizing systolic and diastolic pressure readings, expressed in millimeters of mercury (mmHg). According to the Eighth Joint National Committee (JNC VIII) guidelines, blood pressure readings of 140–159 mmHg systolic and 90–99 mmHg diastolic were categorized as stage 1 hypertension. On the other hand, blood pressure readings of ≥160 mmHg systolic and ≥100 mmHg diastolic were categorized as stage 2 hypertension (MacLaughlin et al. 2018).

The statistical analysis was conducted using IBM SPSS Statistics for Mac, version 26.0 (IBM Corp., Armonk, N.Y., USA). The analysis began with univariate analysis, which provided a descriptive representation of the variables through frequency distribution tables. Subsequently, bivariate analysis was employed to examine the relationship between lipid profiles and the incidence of hypertension. A Kolmogorov-Smirnov test was conducted to assess the normality of the continuous variables, and the results indicated that all of the variables had a non-normal distribution ($p<0.05$). Hence, an analysis of the association between continuous variables was carried out by employing Spearman's rank correlation coefficient, which assessed the strength of the relationship between two variables on an ordinal or interval scale. The statistical significance level was established at $p<0.05$. The correlation coefficient (r) represented the strength of the association. A negative value signified an inverse correlation, while a positive value implied a linear correlation. The correlation coefficient ranged from 0.00 to 1.00, with specific intervals indicating different levels of relationship strength. The strength of the relationship was categorized into several categories, i.e., very weak (0.00–0.19), weak (0.20–0.39), moderate (0.40–0.59), strong (0.60–0.79), and very strong (0.80–1.00) (Schober & Schwarte, 2018, Aslam, 2020).

This study received ethical approval from the Health Research Ethics Committee of Dr. Soetomo General Academic Hospital, Surabaya, Indonesia, with reference No. 1062/LOE/301.4.2/X/2022 dated 6/10/2022.

RESULTS

This study included 115 subjects who met the specified inclusion and exclusion criteria. Table 1 presents the frequency distribution of patients categorized by age, initial hypertension stage, follow-up hypertension stage, and lipid profiles. Notably, 48.7% of hypertensive patients in the Department of Internal Medicine and Department of Cardiology, Dr. Soetomo General Academic Hospital, Surabaya, Indonesia, fell within the age group of 56–60 years. The primary hypertension stage at the first visit was stage I, accounting for 60% of cases. During follow-up visits, the majority of hypertensive patients (54.8%) exhibited pre-hypertension. Borderline-high total cholesterol levels (43.5%) were prevalent, while borderline-high triglyceride levels were observed in most hypertensive individuals (75.7%). A significant proportion (61.7%) of the patients had desirable LDL levels, and 53% of the patients had borderline-high HDL levels.

Table 2 reveals distinct patterns in lipid profiles among patients diagnosed with stage I and stage II hypertension. The total cholesterol levels were 76% in individuals with stage I hypertension and 64.3% in individuals with stage II hypertension. Borderline-high triglyceride levels were observed in 56.3% of stage I hypertension cases and 43.7% of stage II hypertension cases. A significant proportion of patients in both categories showed desirable LDL levels, comprising 60.6% in stage I hypertension and 39.4% in stage II hypertension. Furthermore, the most frequent HDL category for both stages was borderline high, with 55.7% in stage I hypertension and 44.3% in stage II hypertension.

Table 3 presents the results of the Spearman correlation analysis, which examined the relationship between lipid profiles and hypertension. The results exhibited a significant and moderately positive correlation between total cholesterol and hypertension, with $p=0.001$ ($p<0.01$) and $r=0.317$. Triglycerides had a significant relationship with hypertension, albeit with a very weak positive correlation, with $p=0.020$ ($p<0.05$) and $r=0.217$. Conversely, there was no statistically significant correlation observed between LDL and hypertension, as evidenced by $p=0.091$ ($p>0.05$). Lastly, HDL and hypertension showed no correlation, as indicated by $p=0.423$ ($p>0.05$).

Table 1. Frequency distribution of patients according to age, the stage of hypertension, and lipid profiles.

Variables	n	%
Age (years)		
45-49	16	13.9
50-55	43	37.4
56-60	56	48.7
Initial hypertension stage		
Stage I	69	60
Stage II	46	40
Follow-up hypertension stage		
Normal	15	13.0
Pre-hypertension	63	54.8
Stage I	27	23.5
Stage II	10	8.7
Total Cholesterol (mg/dL)		
Desirable	23	20.0
Borderline high	50	43.5
High	42	36.5
Triglyceride (mg/dL)		
Desirable	26	22.6
Borderline high	87	75.7
High	2	1.7
LDL		
Desirable	71	61.7
Borderline high	33	28.7
High	11	9.6
HDL		
Desirable	11	9.6
Borderline high	61	53.0
High	43	37.4

Table 2. Data distribution of lipid profiles according to the stage of hypertension at the first visit.

Variables		The stage of Hypertension (n=115)		
		Stage I	Stage II	Total
Total Cholesterol	Desirable	16 (69.6%)	7 (30.4%)	23 (100%)
	Borderline high	38 (76%)	12 (24%)	50 (100%)
	High	15 (35.7%)	27 (64.3%)	42 (100%)
Triglyceride	Desirable	20 (76.9%)	6 (23.1%)	26 (100%)
	Borderline high	49 (56.3%)	38 (43.7%)	87 (100%)
	High	0 (0%)	2 (100%)	2 (100%)
LDL	Desirable	43 (60.6%)	28 (39.4%)	71 (100%)
	Borderline high	17 (51.5%)	16 (48.5%)	33 (100%)
	High	9 (81.8%)	2 (18.2%)	11 (100%)
HDL	Desirable	8 (72.7%)	3 (27.3%)	11 (100%)
	Borderline high	34 (55.7%)	27 (44.3%)	61 (100%)
	High	27 (62.8%)	16 (37.2%)	43 (100%)

Table 3. The relationship between lipid profiles and hypertension.

Variable	Hypertension	
	p	r
Total Cholesterol	0.001	0.317**
Triglyceride	0.020	0.217*
LDL	0.091	0.158
HDL	0.423	0.075

DISCUSSION

This study revealed valuable findings regarding the impact of hypertension on total cholesterol and triglyceride levels in middle-aged men, although different patterns were observed for LDL and HDL levels. The Spearman's rank correlation coefficient exhibited a statistically significant positive correlation between total cholesterol and hypertension. This finding suggests that elevated total cholesterol levels are linked to an increased prevalence of hypertension. Triglycerides also showed a positive correlation with hypertension, albeit weaker, and a statistically significant p-value. Triglycerides, which are primarily stored in adipose tissue, have a role in the thickening of blood, resulting in reduced blood flow, elevated blood pressure, and increased cardiac strain. Studies have underscored the association between triglycerides and arterial stiffness, which leads to the narrowing of blood vessel diameter and elevated blood pressure (Suci 2019, Huldani et al. 2020).

In contrast to the findings on total cholesterol and triglycerides, this study found no significant relationship between LDL levels and hypertension. This result aligns with the study conducted by Donni et al. (2023), who revealed that the most frequent LDL levels in hypertensive patients fell within the normal category (47.06%). Patients diagnosed with stage I and II hypertension consistently presented desirable LDL levels, explaining the absence of a significant correlation between LDL and hypertension. Notably, a study examining lipid profiles found that the most prevalent condition was low HDL levels (29.9%). This was followed by high triglyceride levels (20.7%), high total cholesterol levels (14%), and high LDL levels (7.9%) (Wu et al. 2022). These findings highlight the minimal impact of LDL on hypertension.

Consistent with the LDL test results, there was no significant correlation between HDL levels and hypertension observed in this study. The majority of patients had HDL levels that were categorized as borderline high. HDL provides beneficial effects, such as transporting LDL cholesterol away from the blood vessel endothelium and promoting vasodilation by increasing nitric oxide (NO) production (Kuang et al. 2018, Rafsanjani et al.

2019). These findings offer critical insights into the interplay between lipid profiles and hypertension in middle-aged men, aiding in understanding the multifaceted relationship between these variables.

The findings of this study were in line with a number of previous studies. Islam et al. (2014) conducted a study involving 234 patients at the National Centre for Rheumatic Fever and Heart Disease in Dhaka, Bangladesh. The study reported a strong correlation between total cholesterol levels and hypertension (OR=1.1, 95% CI=0.91–1.77, p<0.002). Similarly, a recent study by Chen & Cheng (2022) investigated the relationship between lipid profiles and hypertension in adult Chinese men. They found a robust association between high total cholesterol levels and the occurrence of hypertension among the research subjects. In a study conducted in Indonesia, Feryadi et al. (2014) reported a correlation between total cholesterol levels and hypertension among individuals aged 35–65 from the Minangkabau ethnic group with a significant Chi-square test result (p=0.04).

The research conducted by Osuji et al. (2012) corroborated the findings of this study. In the study, they found that serum triglyceride levels were significantly and positively associated with both systolic and diastolic blood pressure (p<0.001, r=0.063). A complementary study by Kurtkulagi et al. (2022) also demonstrated a significant relationship between triglycerides and hypertension, as supported by the statistical test results (p<0.001). In contrast, several studies found no association between lipid profiles and hypertension. A study conducted by Rahminda et al. (2019) did not observe any association between triglycerides and hypertension among ischemic stroke patients (p=0.27). Furthermore, another study conducted at Budi Asih General Hospital, Jakarta, Indonesia, found similar finding. The study revealed that LDL and hypertension are not correlated. Discrepancies in these findings may be attributed to various factors, such as genetic predisposition, lifestyle patterns, medical history, psychosocial factors, and activities (Kamajaya et al. 2016, Sari 2017).

A study conducted at UKI General Hospital, Jakarta, Indonesia, similarly revealed that the majority of hypertensive patients exhibited normal LDL levels (57.4%). There was no significant relationship observed between LDL and hypertension (Siagian 2017). Additionally, the study conducted by Feryadi et al. (2014) found no significant relationship between LDL and hypertension (p=0.1). Conversely, compared to the aforementioned studies, a significant relationship was observed between LDL levels and hypertension in separate research. The research, however, focused on examining adult women aged 30–50 years. Therefore, the observed differences could be attributed to variations in gender and age within the study samples (Mahmuda et al. 2018).

Previous studies have indicated a lack of a statistically significant relationship between HDL levels and blood pressure. The statistical analysis results of p=0.572 and p=0.268, as reported by Sari (2017) and Putri et al. (2021), respectively, provide evidence of the findings. The findings shown in this study were in opposition to the observations made by Rafsanjani et al. (2019), who observed a relationship between HDL levels and hypertension. Additionally, another study provided support for this contrasting observation. According to Otsuka et al. (2016), low HDL levels were associated with an increased risk of hypertension in individuals with impaired fasting glucose or diabetes. There were several factors that might contribute to the lack of statistical significance in the findings of this study. These factors include alcohol consumption, diabetes, daily food intake, and body mass index (BMI), which were not analyzed in this study.

Hypercholesterolemia contributes to the risk of hypertension through the formation of atherosclerosis-induced foam cells within blood vessels. This process ultimately leads to endothelial dysfunction, arterial wall remodeling, reduced lumen diameter, elevated blood pressure, and organ vasoconstriction (Benslaiman et al. 2022). The pattern that leads to hypertension was evident in this study with the high prevalence of the disease among middle-aged patients, affecting 60–80% of individuals. Notably, the majority of hypertensive patients in this study belonged to the 56–60 age group (48.7%). These results are consistent with age-related pathophysiological changes associated with hypertension, including cholesterol accumulation-induced arterial stiffness, elastin fiber degradation, cross-linking, collagen accumulation, fibrosis, inflammation, smooth muscle cell necrosis, calcification, and the transportation of macro-molecules within arterial walls (Laurent & Boutouyrie 2020, Umar & Mariana 2021). Furthermore, there are several factors that contribute to elevated triglyceride levels in hypertensive patients, such as reduced physical activity due to aging. This can lead to fat accumulation and exercise deprivation (Sondakh et al. 2013, Irnameria et al. 2019).

Notably, six out of eleven hypertensive male patients in this study were identified as smokers, which could further worsen their condition. The potential of carbon monoxide in cigarette smoke to replace oxygen in the bloodstream may contribute to the development of atherosclerosis. The results of a study by Diana et al. (2018) support this association. In their study, 94% of 112 male hypertensive individuals aged 45–59 who were smokers demonstrated a statistically significant increase in hypertension (p=0.039). However, this study revealed that LDL does not have a significant impact on the progression of hypertension. LDL cholesterol and oxidized LDL (ox-LDL) have been known to enhance local oxidative stress. This can lead to endothelial dysfunction, the release of inflammatory mediators, monocyte macrophage infiltration, foam cell formation, and the activation of angiotensin-converting enzyme (ACE). Ultimately, these processes raise angiotensin II concentration and subsequently increase blood pressure. Ox-LDL can impair endothelial function and vasodilation, resulting in increased aldosterone production, arterial and smooth muscle contraction, and peripheral blood vessel resistance. These pathways play a crucial role in hypertension development and recurrence, with an emphasis on the impact of serum cholesterol, particularly LDL (Wu et al. 2022).

It is noteworthy that a study conducted by Jafar et al. (2020) revealed a consistent pattern of lower HDL levels in men compared to women from adolescence to old age. However, the study found that individuals with hypertension in certain age groups, namely 50–59, 60–69, 80–89, and >90, exhibited higher HDL levels in comparison to those under the age of 50. Moreover, Wu et al. (2022) found that hypertensive men in the age groups of 70–79 and 80–89 years had higher HDL levels compared to individuals aged 50–59. This observation suggests that HDL levels in men tend to increase as they get older. HDL plays a notable role in the development of atherosclerosis, particularly in postmenopausal women. This is due to the protective effects of estrogen, which is effective in safeguarding women during premenopause. The risk of atherosclerosis in women increases with the reduction of estrogen during menopause (Zhao et al. 2018, Sawitri & Maulina 2022). The decrease in estradiol, which is a potent antioxidant, can lead to increased lipid peroxidation and the formation of reactive oxygen species. Consequently, this can affect the composition of pro-inflammatory proteins contained in HDL (Wang et al. 2021). The sample in this study specifically consisted of male hypertensive patients aged 45–60 years. Therefore, these factors might explain the prevalence of HDL levels within the normal range for both stage I and stage II hypertension in this study.

Strength and limitations

This research offers valuable insights into the relationship between lipid profiles and hypertension, especially in male patients aged 45–60. It underscores the significance of adopting a healthy lifestyle, including dietary choices and regular exercise, to help manage lipid profiles and mitigate the risk of hypertension. Such measures are crucial, as hypertension can lead to various non-communicable diseases and increased mortality. However, it is important to acknowledge the limitations of this study. The exclusive focus on hypertensive patients at the Department of Internal Medicine and Department of Cardiology, Dr. Soetomo General Academic Hospital, Surabaya, Indonesia, indicates that the findings may not be fully representative of the diverse population in East Java. Moreover, the research concentrated solely on hypertension and lipid profiles without considering potential confounding factors, such as comorbidities, BMI, and smoking habits, which could have influenced the outcomes.

CONCLUSION

This study unveiled a notable correlation between hypertension and both total cholesterol and triglyceride levels by considering sex- and gender-specific distinctions. This correlation is particularly noteworthy due to the dearth of research involving middle-aged men in Surabaya, Indonesia. However, this study did not establish any significant correlation between hypertension and low-density lipoprotein (LDL) or high-density lipoprotein (HDL) levels. Hence, a prospective cohort study with a larger sample is required to investigate the potential relationship on a broader scale.

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Conflict of interest

None.

Ethical consideration

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Author contribution

AN contributed to the conceptualization and design, analysis and interpretation of the data, drafting of the article, critical revision of the article for important intellectual content, and collection and assembly of the data. AT, UM, S, and IMSH contributed to the conceptualization and design, analysis and interpretation of the data, critical revision of the article for important intellectual content, final approval of the article, and provision of study materials, as well as administrative, technical, and logistic support.

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