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Article

Hypertension Control and Cardiovascular Risk Profiles in Patients with Established Coronary Artery Disease: A Single-Centre Study

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ABSTRACT

Coronary artery disease (CAD) remains a leading cause of global morbidity and mortality, driven by interconnected risk factors such as hypertension, diabetes mellitus, smoking, obesity, and dyslipidemia. Effective management of these factors is essential in secondary prevention. This study aimed to compare the level of hypertension control with other cardiometabolic risk factors among CAD patients. Using a cross-sectional design, 40 CAD patients with multiple risk factors at Mitra Medika Amplas Hospital were assessed for hypertension control, smoking status, blood glucose regulation, achievement of ideal body weight, and dyslipidemia management based on clinical measurements and questionnaire data. Data were analyzed using descriptive statistics. Associations between risk factors and their level of control were assessed using the Chi-square test, with Fisher's exact test applied when expected cell counts were small. Hypertension emerged as the most well-controlled risk factor, whereas blood glucose, body weight, and especially dyslipidemia showed poor levels of control. The study also found that an increasing number of coexisting risk factors correlated with progressively lower control of each individual factor. These findings underscore the need for more comprehensive, structured, and multidisciplinary risk-factor management to improve the effectiveness of secondary prevention in CAD patients.

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INTRODUCTION

Coronary artery disease (CAD) is a condition characterized by the accumulation of atherosclerotic plaque in the coronary arteries, leading to narrowing or obstruction of coronary blood flow. The coronary arteries function to deliver oxygen-rich blood to the myocardium. Modifiable risk factors for CAD include hypertension, smoking, diabetes mellitus, dyslipidemia, obesity, physical inactivity, unhealthy diet, alcohol consumption, and psychological stress. CAD

remains the leading cause of death globally. Worldwide statistics indicate that approximately 9.4 million deaths each year are attributed to cardiovascular diseases, with 45% of these deaths caused by CAD, and this number is projected to rise to 23.3 million by the year 2030. In the United States, cardiovascular disease accounts for 56% of all deaths, predominantly due to CAD, while in the United Kingdom, CAD similarly remains a major cause of mortality[1].

In Indonesia, coronary artery disease (CAD) ranks seventh among non-communicable diseases (NCDs). According to National Health Survey data, more than 36 million people die from non-communicable diseases (NCDs) each year, accounting for approximately 63% of all deaths. East Java Province has the highest prevalence of CAD at 1.3% (375,127 cases), while West Papua has the lowest with 6,690 cases. One of the major risk factors for CAD is hypertension. According to the Ministry of Health of the Republic of Indonesia, hypertension or high blood pressure is defined as an increase in systolic blood pressure above 140 mmHg and diastolic blood pressure above 90 mmHg on two measurements at rest. If left uncontrolled, hypertension becomes a major contributor to heart disease, kidney failure, and stroke. Hypertension is often referred to as a silent killer because it is frequently asymptomatic and is only detected after serious complications occur[2,3].

Globally, the prevalence of hypertension remains high. WHO (2019) reported that the global prevalence of hypertension reached 22%, with Africa having the highest prevalence (27%) and Southeast Asia at 25%. Research findings in Indonesia also show the prevalence of hypertension and the influence of social factors such as age, educational level, and economic status [4]. Other studies have stated that the determinants of hypertension also include socio-demographic conditions and dietary intake, particularly among coastal communities[5]. In North Sumatra, the prevalence of hypertension reaches 6.7%, or approximately 12.42 million people, based on data from the Health Research and Development Agency of the Ministry of Health[6].

Hypertension control can be strengthened through community-based efforts involving health cadres, community leaders, and village authorities. Programs such as *Posyandu Lansia* a community-based service providing routine health monitoring and early detection of chronic diseases among older adults and *Prolanis*, a national chronic disease management program for hypertension and type 2 diabetes, have proven effective in reducing complications and long-term healthcare costs. With proper management, individuals with hypertension are expected to maintain adherence to therapy and prevent complications such as coronary artery disease (CAD)[2,3]. Secondary prevention refers to a comprehensive set of strategies aimed at preventing recurrent cardiovascular events, slowing disease progression, and reducing complications in

patients with established coronary artery disease (CAD), through optimal risk factor control, pharmacological therapy, and lifestyle modification[7,8].

Despite extensive programs targeting hypertension, there remains a limited understanding of how well hypertension is controlled in comparison with other cardiometabolic risk factors among patients who have already developed CAD, an important gap in secondary prevention research. In this study, secondary prevention is defined as the control of major modifiable cardiovascular risk factors, including hypertension, smoking, glycemic status, lipid levels, and body weight, in patients with established coronary artery disease. Most existing studies focus on single risk factors rather than comparing multiple risk-factor control within the same patient group[7,9].

The novelty of this study lies in its simultaneous evaluation of hypertension control alongside smoking status, glycemic control, body weight, and lipid profiles among CAD patients. Importantly, this study was conducted in a Type C hospital setting, which represents a more naturalistic and pragmatic level of healthcare delivery within Indonesia's tiered healthcare system, where the majority of patients receive ongoing cardiovascular care. This setting provides a real-world perspective on risk factor control outside of highly specialized tertiary centers, as supported by previous reports[7,9].

Identifying which risk factors are optimally controlled and which remain suboptimal may provide important insights for clinicians and policymakers to prioritize interventions and strengthen comprehensive secondary prevention strategies. Therefore, this study aims to assess hypertension control in relation to other cardiovascular risk factors among patients with established CAD at Mitra Medika Amplas Hospital.

METHODS

This study is descriptive analytic research with a cross-sectional approach conducted at Mitra Medika Amplas Hospital, Medan, from June to August 2024. This approach was chosen to obtain a direct overview of the level of control of various risk factors among patients with coronary artery disease (CAD) without requiring long-term follow-up. The sample size in this study was determined using the single population proportion formula with a 95% confidence level ($Z = 1.96$), an assumed prevalence of CAD patients with uncontrolled risk factors of 50% ($p = 0.5$), and a precision level (d) of 0.15. These parameters were inserted into the formula $n = Z^2 \times p\,(1 - p) / d^2$, resulting in a minimum required sample of approximately 40 subjects. During data collection, 40 patients met the eligibility criteria and agreed to participate.

The participants in this study were adult patients with a clinical diagnosis of coronary artery disease based on hospital medical records, able to communicate, and willing to participate

through the signing of informed consent. Patients with incomplete clinical data, impaired consciousness, or conditions that prevented proper measurement of the study variables were excluded. Data collection was conducted through structured interviews to obtain information on smoking habits and medical history, blood pressure measurements using a calibrated sphygmomanometer, and height and weight measurements for determining body mass index. Laboratory data, including LDL levels, fasting blood glucose, or HbA1c, were obtained from the most recent examinations recorded in the medical records. Risk factors were classified as controlled if they met the clinical thresholds commonly used in cardiology practice, namely blood pressure <140/90 mmHg, fasting blood glucose <126 mg/dL or HbA1c <7%, body mass index of 20–25 kg/m^2, non-active smoking status, and LDL level < 55 mg/dL.

All collected data were verified, coded, and cleaned prior to analysis. Descriptive statistics were used to summarize patient characteristics and the proportion of controlled risk factors. The Chi-square and Fisher Exact Test were applied, as appropriate, to evaluate the association between the number of risk factors and their control status. This study received ethical approval from the Health Research Ethics Committee of the Faculty of Medicine, Universitas Muhammadiyah Sumatera Utara. All research procedures were conducted with strict confidentiality of participant information and in full accordance with established ethical principles for health research.

RESULTS

A total of 40 patients with coronary artery disease (CAD) were included in this study, all of whom had one or more risk factors assessed for their level of control. The variables analyzed included hypertension, smoking habits, blood glucose levels, ideal body weight, and dyslipidemia. The results showed that the level of control for each risk factor varied across risk factors. Among all respondents, hypertension was the most successfully controlled risk factor, with 95% of patients achieving target blood pressure, while only 5% remained uncontrolled. Smoking habits also showed favorable outcomes, in which 80% of patients had quit smoking or were no longer exposed to cigarette smoke, and only 20% had not yet succeeded in controlling this habit.

In contrast to the two risk factors above, the control of blood glucose levels showed lower results. Only 47.5% of patients achieved target blood glucose levels, while 52.5% still exhibited uncontrolled glucose levels. The control of ideal body weight was also not optimal, with only 42.5% of patients maintaining an ideal body weight, whereas 57.5% remained overweight or obese. The risk factor with the poorest level of control was dyslipidemia; none of the patients

achieved the recommended lipid targets, resulting in 100% uncontrolled dyslipidemia. Table 1 presents the complete distribution of risk factor control among all patients.

Table 1. Control of Cardiovascular Risk Factors Among Patients With Coronary artery Disease (CAD)

Variable	***Sample***	***Controlled***	***Uncontrolled***
Hypertension Control	40	38 respondents (95%)	2 respondents (5%)
Smoking Control	40	32 respondents (80%)	8 respondents (20%)
Blood Glucose Control	40	19 respondents (47.5%)	21 respondents (52.5%)
Ideal Body Weight Management	40	17 respondents (42,5%)	23 respondents (57,5%)
Dyslipidemia Management	40	0 respondent (0%)	40 respondents (100%)

In addition, this study also evaluated 14 patients who had multiple risk factors, namely those with three or more concurrent risk factors. In this group, the level of risk factor control tended to decrease compared with the overall population. Hypertension remained relatively well controlled in 86% of patients, but smoking control decreased to 57%. Control of ideal body weight showed a balanced distribution, with 50% categorized as controlled and 50% as uncontrolled. Blood glucose levels were the risk factor with a low level of control in this group; only 30% of patients achieved the target, while the remaining 70% did not. Dyslipidemia continued to be the risk factor with the poorest control, with all patients (100%) remaining uncontrolled.

Table 2. Control of Risk Factors Among Study Subjects With Multiple Risk Factors (Hypertension, Diabetes Mellitus, Smoking)

Variable	***Sample***	***Controlled***	***Uncontrolled***
Hypertension Control	14	12 respondents (86%)	2 respondents (14%)
Smoking Control	14	8 respondents (57%)	6 respondents (43%)
Ideal Body Weight Management	14	7 respondents (50%)	7 respondents (50%)
Blood Glucose Control	14	5 respondents (30%)	9 respondents (70%)
Dyslipidemia Management	14	0 respondent (0%)	14 respondents (100%)

Table 3. Association Between Number of Risk Factors and Hypertension

Number of Risk Factors	***Controlled, n (%)***	***Uncontrolled, n (%)***	***Total***
Multiple (≥3)	12 (85.7%)	2 (14.3%)	14
Non-multiple (<3)	26 (100%)	0 (0%)	26
Total	38 (95.0%)	2 (5.0%)	40

Chi-square test: $\chi^2 = 3.91$, df = 1, p = 0.048
Fisher's exact test (two-tailed): p = 0.117

Bivariate analysis was performed to assess the association between the number of coexisting cardiovascular risk factors and hypertension (Table 3). Patients with multiple risk factors (≥3) had a lower proportion of controlled hypertension compared to those with fewer risk factors (85.7% vs 100%). The Chi-square test demonstrated a statistically significant association ($\chi^2 = 3.91$, df = 1, p = 0.048). However, given the presence of small expected cell counts, Fisher's exact test was also conducted and yielded a non-significant result (p = 0.117).

Table 4. Association Between Number of Risk Factors and Overall Risk-Factor Control

Number of Risk Factors	***Controlled, n (%)***	***Uncontrolled, n (%)***	***Total***
Multiple (≥3)	1 (7.1%)	13 (92.9%)	14
Non-multiple (<3)	5 (19.2%)	21 (80.8%)	26
Total	6 (15.0%)	34 (85.0%)	40

Chi-square test: $\chi^2 = 1.12$, df = 1, p = 0.29
Fisher's exact test (two-tailed): p = 0.41

Another bivariate analysis was performed to assess the association between the number of coexisting cardiovascular risk factors and overall risk-factor control (Table 4). Patients with multiple risk factors (≥3) demonstrated a lower proportion of controlled risk factors compared to those with fewer risk factors (7.1% vs 19.2%). However, the Chi-square test did not show a statistically significant association ($\chi^2 = 1.12$, df = 1, p = 0.29). Similarly, Fisher's exact test also demonstrated a non-significant result (p = 0.41).

DISCUSSION

The result of this study shows that hypertension is the most well-controlled risk factor among patients with coronary artery disease (CAD), whereas other risk factors such as smoking, blood glucose levels, ideal body weight, and particularly dyslipidemia exhibit low levels of control. This condition is consistent with a study reporting that hypertension control is better

among patients with higher levels of knowledge and good medication adherence, making hypertension relatively easier to manage compared with other metabolic risk factors[10].

Several possible factors contributing to the poor control of risk factors other than hypertension include inadequate patient education on the importance of multifactorial control, low adherence to dyslipidemia medications or diabetes therapy due to side effects and cost, as well as limitations in monitoring systems, such as the absence of regular laboratory evaluations or recall clinics. These issues make metabolic factors such as lipid and glucose levels more difficult to control compared with blood pressure[11].

Dyslipidemia was the risk factor with the lowest level of control in this study. Dyslipidemia contributes to CAD through the accumulation of low-density lipoprotein (LDL) cholesterol in the arterial intima, leading to endothelial dysfunction and the formation of atherosclerotic plaques. Oxidized LDL triggers inflammation, macrophage activation, and foam cell formation, resulting in plaque progression and eventual rupture, which can cause thrombosis and coronary artery obstruction. This finding is consistent with previous studies reporting a strong association between dyslipidemia and CAD, as well as low adherence to lipid-lowering therapy. The challenge is further compounded by limitations in treatment accessibility, including the lack of high-intensity statins in certain healthcare programs. International evidence also highlights substantial gaps in cholesterol control, particularly in developing countries, indicating that dyslipidemia remains one of the most difficult risk factors to manage[11,12].

Although the association between multiple risk factors and hypertension control reached statistical significance in the Chi-square analysis, this was not supported by Fisher's exact test, suggesting limited robustness likely due to small sample size. Similarly, while a consistent trend toward poorer overall control was observed among patients with multiple risk factors, this did not reach statistical significance. Nevertheless, the observed pattern aligns with the concept of cardiometabolic risk clustering, where increasing complexity of comorbid conditions may hinder optimal management.

The decline in risk-factor control among patients with multiple risk factors is further supported by the study of Rodriguez et al., which stated that the greater the number of cardiovascular risk factors a person has, the lower the likelihood of achieving control for each respective factor. This is related to increasing treatment burden, interacting metabolic complications, and poor adherence to lifestyle modifications[9].

In the context of secondary prevention, controlling risk factors is crucial, as CAD patients need to prevent recurrence, reinfarction, or the progression of atherosclerosis. Although blood pressure control is important, the regulation of lipid and glucose levels is a key determinant of plaque stability. Several studies, such as EUROASPIRE and INTERHEART, have shown that more

than 70% of CAD patients still have two or more uncontrolled risk factors after the initial diagnosis, indicating that secondary prevention should be comprehensive, not selective[9].

Comparisons with other studies show a consistent pattern. For example, EUROASPIRE IV reported that fewer than 30% of patients achieved LDL targets after myocardial infarction, while the PURE Study found that global hypertension control was better than dyslipidemia control. National studies also indicate that although the prevalence of hypertension is high, multi-factor risk control remains low. Thus, the findings of this study are aligned with global trends showing that blood pressure control is generally better than the control of other metabolic risk factors[9].

The control of smoking habits among CAD patients varies considerably. Smoking promotes CAD through multiple mechanisms, including endothelial dysfunction, increased oxidative stress, and inflammation. Nicotine stimulates sympathetic activation, increasing heart rate and blood pressure, while carbon monoxide reduces oxygen delivery. Smoking also enhances platelet aggregation and thrombosis, accelerating atherosclerosis and increasing the risk of acute coronary events[13]. Other studies have also shown that smoking cessation can reduce the risk of heart disease by up to 50% after several years of quitting. However, another study reported that the success rate of smoking cessation among CAD patients is only around 40–57%, indicating the need for further interventions[13,14].

Studies have found that patients with uncontrolled diabetes mellitus (DM) have a higher risk of cardiovascular complications[15]. Diabetes mellitus contributes to CAD through chronic hyperglycemia, which induces endothelial dysfunction, oxidative stress, and inflammation. Advanced glycation end-products (AGEs) damage vascular structures, while insulin resistance promotes dyslipidemia and pro-thrombotic states, accelerating atherosclerosis and plaque instability[14]. Other research has emphasized the importance of blood glucose control to reduce the risk of cardiac events in CAD patients. However, only about 30–50% of CAD patients are able to achieve adequate DM control, indicating that the trend of diabetes mellitus management remains low [14].

Weight control among CAD patients shows varied outcomes. Excess body weight, particularly central obesity, contributes to CAD through insulin resistance, chronic low-grade inflammation, and dyslipidemia. Adipose tissue secretes pro-inflammatory cytokines such as TNF-α and IL-6, which promote endothelial dysfunction and atherosclerosis. Obesity is also associated with hypertension and metabolic syndrome, further increasing cardiovascular risk[16]. Some studies have indicated that weight reduction can lower the risk of CAD-related mortality by up to 30%. Intervention programs involving strict dietary regulation and physical activity have been shown to improve weight management. However, as observed in other studies, only about

42–50% of CAD patients are able to successfully manage their body weight, and this remains an area that requires greater attention[16-18].

From a policy and clinical recommendation standpoint, an integrated cardiovascular team approach is required in secondary prevention. Patient education should emphasize lifestyle modification and long-term medication adherence. In addition, the establishment of a simple Cardiac Rehabilitation & Risk Factor Clinic in hospitals is recommended to support continuous risk factor management [7,8]. The strength of this study lies in its use of real-world, hospital-based data and its focus on multi–risk factor control, an aspect that is rarely reported at the district-hospital level. However, this study has several limitations, including a small sample size, a cross-sectional design, and the absence of assessments regarding medication adherence or disease duration.

CONCLUSION

Based on the findings of this study, hypertension was identified as the most well-controlled risk factor among patients with coronary artery disease (CAD), whereas dyslipidemia was the least controlled. The study also demonstrates a clear pattern in which an increasing number of cardiovascular risk factors is associated with poorer overall risk-factor control.

Although a large proportion of patients were able to achieve adequate blood pressure control, the management of other risk factors, including smoking, blood glucose levels, and ideal body weight, remained suboptimal. These findings highlight that the presence of multiple risk factors substantially reduces the effectiveness of disease control. Therefore, more comprehensive, continuous, and multidisciplinary strategies, including patient education and integrated risk-factor management, are needed to improve the effectiveness of secondary prevention in CAD patients.

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