

Analysis of Factors Associated with Coronary Artery Disease (CAD) Prevalence in Diabetes Mellitus (DM) Patients at PKU Muhammadiyah Gamping Hospital

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Abstract

Background: Diabetes Mellitus (DM) increases the risk of macrovascular complications such as Coronary Artery Disease (CAD), which is a leading cause of death due to atherosclerosis accelerated by chronic hyperglycemia.

Purpose: This study aims to analyze the relationship between age, gender, hypertension, dyslipidemia, and obesity with the incidence of CAD in diabetic patients at PKU Muhammadiyah Gamping Hospital.

Method: This retrospective case-control study involved 116 patients (58 cases and 58 controls) selected using purposive sampling based on medical record data from 2024. Data analysis was performed using the Chi-Square test and binary logistic regression.

Results: Results showed a significant association between age > 45 years ($p = 0.015$; OR = 5.296), male gender ($p = 0.015$; OR = 2.735), hypertension ($p = 0.002$; OR = 3.617), and dyslipidemia ($p = 0.015$; OR = 5.296) with CAD, while obesity was not significant ($p = 0.097$). Multivariate analysis identified age > 45 years as the dominant factor ($p = 0.032$; OR = 5.887), followed by dyslipidemia, gender, and hypertension.

Conclusion: This study concludes that age > 45 years, male gender, history of hypertension, and dyslipidemia are significantly associated with the incidence of CAD in DM patients, with age being the dominant factor. Obesity, although not statistically significant, remains clinically relevant and requires evaluation with indicators other than BMI.

Recommendation: This study emphasizes the importance of screening and controlling risk factors to prevent cardiovascular complications in DM patients.

Keywords: Coronary Artery Disease, Diabetes Mellitus, Risk Factors.

1. Introduction

Diabetes mellitus (DM) is a chronic metabolic disease characterized by hyperglycemia due to impaired insulin secretion or function. Chronic hyperglycemia can lead to microvascular and macrovascular complications, one of which is coronary artery disease (CAD), which is the leading cause of death among DM patients (WHO, 2024). Data from the International Diabetes Federation (IDF) in 2021 indicates that the global number of DM patients reached 537 million and is projected to continue increasing. Indonesia ranks among the top five countries worldwide, with an estimated

28.6 million patients by 2045. At the regional level, Yogyakarta City has the highest prevalence of DM in the Special Region of Yogyakarta (DIY), at 4.9%, followed by Sleman Regency at 3.3%, as reported by Riskesdas 2018, cited by Fabriyanti et al. (2024).

The increase in the prevalence of DM is influenced by genetic and environmental factors such as obesity, hypertension, dyslipidemia, and unhealthy lifestyles, all of which contribute to the risk of cardiovascular complications, including CAD. Obesity, particularly visceral adiposity, increases insulin resistance and triggers systemic inflammation, which further accelerates the onset of type 2 diabetes and increases the risk of atherosclerosis. Hypertension causes endothelial damage and accelerates the atherosclerosis process, in addition to increasing the burden on the heart and blood vessels. Dyslipidemia, such as high levels of LDL cholesterol and triglycerides and low HDL, accelerates the formation of atherosclerotic plaques. Unhealthy lifestyles such as smoking, an unbalanced diet, and lack of physical activity also increase insulin resistance and cardiovascular disease risk factors (Marx et al., 2023). Previous studies have reported that individuals with diabetes have a higher risk of developing CAD compared to the non-diabetic population, up to 17 times higher (Rahmawati et al., 2020). In Indonesia, cardiovascular diseases continue to rise, with total healthcare costs reaching Rp10.9 trillion according to BPJS Kesehatan (2022), indicating a significant burden on the healthcare system.

PKU Muhammadiyah Gamping Hospital is a referral hospital in Yogyakarta that treats many cases of diabetes mellitus (DM), with 862 DM patient visits throughout 2024, making it the fifth most common chronic disease at this hospital. Meanwhile, coronary artery disease (CAD) is recorded as the third most common cardiovascular diagnosis, indicating that cardiovascular complications remain a major clinical issue. Although the number of CAD cases among DM patients is not as high as the total number of DM cases, these complications are still considered serious due to the risk of repeated hospitalizations, intensive care, disability, and even death, as well as increasing the burden on medical services and healthcare costs.

Previous studies have identified various risk factors for CAD in patients with DM, such as age, hypertension, dyslipidemia, and obesity (Suciana et al., 2021; Nandasari et al., 2020; Naomi et al., 2021). However, differences in methods, population characteristics, location, and variables used across these studies highlight gaps in knowledge, particularly regarding local contexts. This underscores the importance of conducting further research at PKU Muhammadiyah Gamping Hospital to identify factors associated with CAD incidence in DM patients as a basis for developing prevention strategies and managing cardiovascular complications.

2. Methods

This study employed an analytical observational design with a retrospective case-control approach and was conducted at PKU Muhammadiyah Gamping Hospital in June-July 2025. The population consisted of 677 hospitalized DM patients in 2024, with 89 patients experiencing CAD complications. The sample was determined using purposive sampling based on inclusion and exclusion criteria, with 58 respondents each for the case and control groups (total 116 respondents), and the sample size was determined using Kelsey's formula. Secondary data were obtained from patients' medical records, including variables such as age, gender, history of hypertension, dyslipidemia, and obesity based on body mass index (BMI). Data were collected using a checklist, coded, cleaned, and analyzed using SPSS version 25. Univariate analysis was used to describe data distribution, bivariate analysis was performed using the Chi-Square test to assess relationships between variables ($p < 0.05$), and binary logistic regression was used to identify dominant risk factors for CAD occurrence. This study received Ethical Exemption from the Ethics Committee of PKU Muhammadiyah Gamping Hospital No. 159/KEP-PKU/V/2025, and all stages were conducted while maintaining the principles of anonymity, data confidentiality, and benefits for the development of science and practice.

3. Results

3.1. Distribution characteristics of factors associated with Coronary Artery Disease (CAD) in patients with Diabetes mellitus (DM)

An overview of the characteristics of factors contributing to CAD in respondents, including age, gender, history of hypertension, dyslipidemia, and obesity, is presented in Table 1.

Table 1. Distribution of Factors Affecting CAD Incidence Based on Assessment Data at PKU Muhammadiyah Gamping Hospital

Respondent Characteristics	Categori	Total	
		n	%
Age	≤ 45 years old/ Low risk	16	13.8
	> 45 years old/ High risk	100	86.2
	Total	116	100
Gender	Female	50	43.1
	Male	66	56.9
	Total	116	100
History of hypertension	No	60	51.7
	Yes	56	48.3
	Total	116	100
History of dyslipidemia	No	60	86.2
	Yes	56	13.8
	Total	116	100
Obesity	No/ BMI ≤ 27	94	81
	Yes/ BMI > 27	22	18
	Total	116	100

Source: Secondary Data, 2024

The general characteristics of the respondents in this study involved 116 DM patients, the majority of whom were > 45 years old (86.2%) and male (56.9%). Most respondents had no history of hypertension (51.7%) or dyslipidemia (86.2%). Additionally, most respondents were not obese based on a BMI ≤ 27 (81%). These data provide an overview of the characteristics of respondents in the case and control groups in this study.

3.2. Bivariate Analysis

The Chi-Square test was performed to determine the relationship between each independent variable and the incidence of CAD in DM patients. Table 2 presents the results of this analysis.

Table 2. The Relationship between Age, Gender, History of Hypertension, History of Dyslipidemia, and Obesity with the Incidence of CAD in DM Patients at PKU Muhammadiyah Gamping Hospital

Variable	CAD	Total	<i>p-value</i>	OR
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	Yes		No					(IC 95% min-max)
	n	%	n	%	n	%		
Age								
≤ 45 years old/ Low risk	3	5.2	13	22.4	16	13.8	0.015	5.296 (1.421-19.742)
> 45 years old/ High risk	55	94.8	45	77.6	100	88.75		
Gender								
Female	18	31	32	55.2	50	55.2	0.015	2.735 (1.279-5.847)
Male	40	69	26	44.8	66	56.9		
History of hypertension								
No	21	36.2	39	27.50	60	67.2	0,002	3.617 (1.680-7.782)
Yes	37	63.8	19	72.50	56	32.8		
History of dyslipidemia								
No	45	77.6	55	94.8	100	86.2	0.015	5.296 (1.421-19.743)
Yes	13	22.4	3	5.2	16	13.8		
Obesity								
No/ BMI ≤ 27	43	74.1	51	87.9	94	81	0.097	2.542 (0.949-6.803)
Yes/ BMI > 27	15	25.9	7	12.1	22	19		

Chi-Square Test

Based on the results of bivariate analysis of 116 respondents, it was found that age, gender, history of hypertension, and history of dyslipidemia were significantly associated with CAD in DM patients, while obesity did not show a significant association. The majority of patients in the case group were over 45 years old (94.8%), and this group had a 5.296 times higher risk of developing CAD compared to those aged 45 years or younger ($p = 0.015$; 95% CI: 1.421–19.742). Gender also played a role, with males being more prevalent in the case group (69%) and having a 2.735 times higher risk of developing CAD compared to females ($p = 0.015$; 95% CI: 1.279–5.847). A history of hypertension was found in 63.8% of the case group, with a 3.617-fold higher risk of developing CAD ($p = 0.002$; 95% CI: 1.680–7.782). Although most case patients did not have dyslipidemia (77.9%), those with a history of dyslipidemia were still 5.296 times more likely to develop CAD ($p = 0.015$; 95% CI: 1.421–19.743). Meanwhile, obesity was not statistically associated with CAD incidence ($p = 0.097$), although the OR value indicated a trend toward increased risk (OR = 2.542; 95% CI: 0.949–6.803).

3.3. Multivariate Analysis

Multivariate analysis with binary logistic regression was used to evaluate the simultaneous influence of variables with p -values (< 0.25 in bivariate tests) on the

incidence of CAD in patients with DM, with the results of the risk factor relationships presented in Table 3.

Table 3. Multivariate Analysis Results (Binary Logistic Regression) of Factors Associated with CAD Incidence in Diabetes Mellitus Patients at PKU Muhammadiyah Gamping Hospital

Variabel	B	SE	Wald	<i>p-value</i>	OR (Exp(B))	95% CI
Age	1.773	0.826	4.603	0.032	5.887	1.166 – 29.734
Gender	1.056	0.435	5.900	0.015	2.876	1.226 – 6.745
History of hypertension	0.928	0.433	4.590	0.032	2.530	1.082 – 5.914
History of dyslipidemia	1.706	0.782	4.762	0.029	5.504	1.190 – 25.467
Obesity	0.755	0.582	1.683	0.195	2.128	0.680 – 6.659

Binary Logistic Regression Test

Based on the results of binary logistic regression in Table 3, age > 45 years is the most dominant factor that significantly increases the risk of CAD in DM patients ($p = 0.032$; OR = 5.887), followed by male gender ($p = 0.015$; OR = 2.876), history of hypertension ($p = 0.032$; OR = 2.530), and dyslipidemia ($p = 0.029$; OR = 5.504), all of which showed significant effects after being controlled together. Meanwhile, obesity was not statistically significantly associated ($p = 0.195$; OR = 2.128), and thus cannot be considered an independent risk factor in this model.

4. Discussion

4.1. Characteristics of the Distribution of Factors Affecting the Incidence of Coronary Artery Disease (CAD) in Patients with Diabetes Mellitus (DM) at PKU Muhammadiyah Gamping Hospital.

Based on an analysis of 116 respondents, consisting of 58 patients with diabetes mellitus (DM) and coronary artery disease (CAD) and 58 patients with DM without CAD, the majority were over 45 years of age (86.2%) and male (56.9%). Advanced age is an important risk factor due to the accumulation of vascular damage and the progression of atherosclerosis, which leads to impaired myocardial perfusion, particularly in DM patients with endothelial dysfunction (Melyani et al., 2023). Men are more susceptible to CAD due to the absence of hormonal protection from estrogen, which has anti-inflammatory and vasoprotective properties, as well as unhealthy lifestyle habits such as smoking and lack of physical activity (Ikhsan et al., 2022; Subramanian et al., 2025). Additionally, hypertension was found in nearly half of the respondents (48.3%) and plays a role in accelerating endothelial damage and atherosclerotic plaque formation,

even at the stage of high-normal blood pressure. Although only 13.8% of respondents had a history of dyslipidemia, this condition remains clinically significant because lipid profile abnormalities can accelerate atherosclerosis, particularly in DM patients who often do not exhibit symptoms (Ikhsan et al., 2022). Meanwhile, obesity based on body mass index (BMI) was only found in 18% of respondents, but excess visceral fat still needs to be watched out for because it is closely related to insulin resistance, systemic inflammation, and an increased risk of cardiovascular complications (Roth et al., 2020). Overall, the combination of advanced age, male gender, hypertension, dyslipidemia, and obesity reflects the classic risk profile contributing to CAD incidence in DM patients through the mutually reinforcing mechanisms of atherosclerosis, endothelial dysfunction, and chronic inflammation.

4.2. The Relationship Between Age and the Incidence of Coronary Artery Disease (CAD) in Patients with Diabetes Mellitus (DM) at PKU Muhammadiyah Gamping Hospital. **m Hubungan Usia Dengan Kejadian Coronary Aretry Disease (CAD) pada pasien Diabetes Melitus (DM) di RS PKU Muhammadiyah Gamping.**

Advanced age (> 45 years) has been proven to be a significant risk factor (p -value 0.015) for the occurrence of coronary artery disease (CAD) in patients with diabetes mellitus (DM), due to the accumulation of degenerative processes such as reduced vascular elasticity, oxidative stress, and endothelial dysfunction that accelerate atherosclerosis (Marx et al., 2023). Previous studies have shown consistency in this association, whether in individuals over 60 years of age (Ikhsan et al., 2022), the 50–62 age group (Kutacane; $p = 0.002$), or those over 45 years of age (Suciana et al., 2021; OR = 2,6). Although one study at Dr. Ngoerah General Hospital did not find a significant association with age ($p = 0.543$), other factors such as hyperglycemia, hypertension, and obesity remain important (Elkurnia et al., 2023). These findings confirm that age does not act alone but interacts with DM comorbidities. Therefore, patients with DM aged > 45 years should be prioritized for early detection and cardiovascular risk management to prevent CAD and improve quality of life.

4.3. The Relationship Between Gender and the Incidence of Coronary Artery Disease (CAD) in Patients with Diabetes Mellitus (DM) at PKU Muhammadiyah Gamping Hospital.

Male gender has been shown to be significantly associated with the occurrence of coronary artery disease (CAD) in patients with diabetes mellitus (DM) (p -value 0.015), as men biologically lack the protective effects of estrogen hormones, which help maintain endothelial function and suppress vascular inflammation, making them more susceptible to vascular damage and accelerated atherosclerosis. Additionally, men are more frequently exposed to behavioral factors such as smoking and stress, which further increase the risk (Okunrintemi et al., 2020). This finding is supported by the study by Desky & Susanto (2021), where 71.05% of CAD patients were male, and

the gender association was statistically significant. However, Lesjak & Kocet (2025) showed that the contribution of male gender may decrease when hypertension and hyperglycemia are accounted for, indicating that men's risk is not independent but influenced by interactions with other comorbid factors. These results highlight the need to focus on screening for cardiac complications in male DM patients, while considering other accompanying factors.

4.4. The Relationship Between Hypertension History and Coronary Artery Disease (CAD) Incidence in Diabetes Mellitus (DM) Patients at PKU Muhammadiyah Gamping Hospital.

A history of hypertension was found to be significantly associated with the occurrence of coronary artery disease (CAD) in patients with diabetes mellitus (DM) (*p value* 0.002), where high blood pressure exacerbates vascular damage caused by chronic hyperglycemia. Physiologically, hypertension causes endothelial dysfunction, inflammation, and accelerated atherosclerotic plaque formation, thereby increasing the risk of myocardial ischemia (Hernández-López et al., 2024). The study by Suciana et al. (2021) showed that DM patients with hypertension had a fourfold increased risk of CAD ($p = 0.020$), while Desky & Susanto (2021) reported that 76.3% of CAD patients had a history of hypertension. The consistency of these data indicates that hypertension is not merely a common comorbidity in DM but a primary trigger for coronary perfusion disorders through arterial damage and the formation of unstable plaques. These findings underscore the importance of blood pressure control as part of a strategy to prevent cardiac complications in DM patients, through education on healthy lifestyles and adherence to antihypertensive therapy to slow the progression of atherosclerosis.

4.5. The Relationship Between a History of Dyslipidemia and the Incidence of Coronary Artery Disease (CAD) in Patients with Diabetes Mellitus (DM) at PKU Muhammadiyah Gamping Hospital.

The results of the study showed a significant association between dyslipidemia and the occurrence of CAD in DM patients (*p value* 0.015). Dyslipidemia plays an important role in increasing the risk of coronary artery disease (CAD) in patients with diabetes mellitus (DM), as lipid imbalances such as increased low-density lipoprotein (LDL) and decreased high-density lipoprotein (HDL) accelerate the formation of atherosclerotic plaques in the coronary arteries. In DM patients, this condition is exacerbated by chronic hyperglycemia, which triggers oxidative stress, endothelial dysfunction, and vascular inflammation, explaining why dyslipidemia and DM are often found together in patients with cardiac complications (Marx et al., 2023). The study by Ramadhani et al. (2025) showed that 85% of type 2 DM patients with CAD had dyslipidemia ($p = 0.041$), supported by international data from 2023 indicating a higher prevalence of dyslipidemia in CAD patients with DM (75% vs. 37.8%). These findings reinforce that

dyslipidemia is not only a common comorbidity but a key factor in the progression of atherosclerotic heart disease. Therefore, routine lipid screening, healthy lifestyle changes, and statin therapy are important strategies for preventing cardiovascular complications in high-risk DM patients.

4.6. The Relationship Between Obesity and Coronary Artery Disease (CAD) in Diabetes Mellitus (DM) Patients at PKU Muhammadiyah Gamping Hospital.

Obesity in this study did not show a significant association (p value 0.095) with the incidence of coronary artery disease (CAD) in patients with diabetes mellitus (DM), possibly due to the low number of obese respondents and the dominance of other risk factors. However, clinically, obesity remains relevant as it pathophysiologically triggers insulin resistance, lipid dysfunction, chronic inflammation, and hypertension, which accelerate vascular damage (Powell-Wiley et al., 2021). Previous studies have shown varying results, with (Elkurnia et al., 2023) finding that obesity increases the risk of CAD, while (Suciana et al. (2021) reported the opposite, possibly due to the limitation of measuring obesity solely based on body mass index (BMI). Recent evidence emphasizes the importance of considering visceral obesity using waist circumference or waist-to-hip ratio (WHR) measurements to evaluate cardiovascular risk more accurately. Therefore, obesity management remains crucial in preventing CAD in DM patients through a healthy diet, physical activity, and medical interventions to reduce systemic inflammation and improve metabolism.

4.7. Factors most influential in the occurrence of coronary artery disease (CAD) in patients with diabetes mellitus (DM) at PKU Muhammadiyah Gamping Hospital.

Multivariate analysis results indicate that age > 45 years is the most dominant factor in the incidence of coronary artery disease (CAD) in patients with diabetes mellitus (DM), with a risk nearly 6 times greater ($p = 0.032$; OR = 5.887), followed by dyslipidemia ($p = 0.029$; OR = 5.504), male gender ($p = 0.015$; OR = 2.876), and history of hypertension ($p = 0.032$; OR = 2.530). Advanced age plays a significant role because the aging process leads to reduced vascular elasticity, endothelial dysfunction, and oxidative stress, which accelerate atherosclerosis, especially in DM patients with chronic metabolic dysfunction. Additionally, exposure to risk factors such as hypertension and dyslipidemia increases with age, resulting in cumulative risk. The roles of dyslipidemia and hypertension worsen vascular conditions through increased LDL levels, insulin resistance, and chronic inflammation. Male gender also increases risk due to the absence of estrogen hormones and unhealthy lifestyle patterns more commonly found in men. These findings align with the study by Yao et al. (2023), which confirmed that age, hypertension, and dyslipidemia are significant predictors of CAD in DM patients.

5. Conclusion

This study concludes that age > 45 years, dyslipidemia, male gender, and history of hypertension are significant factors associated with the occurrence of coronary artery disease (CAD) in patients with diabetes mellitus (DM), with age being the most dominant factor. Although obesity is not statistically significant, it remains clinically relevant. The implications of these findings emphasize the importance of comprehensive screening and risk management in DM patients, particularly older adults with a history of dyslipidemia and hypertension. Obesity assessment should utilize more representative indicators beyond BMI for cardiovascular risk evaluation.

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7. Author Contributions

EM conceived and designed the study, conducted data collection and statistical analysis, and drafted the initial manuscript. AD and ITS provided academic supervision, contributed to the interpretation of findings, and critically revised the manuscript for important intellectual content. All authors read and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

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