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Comparative Analysis of Cardiovascular Risk Factors in Diabetic Versus Non-Diabetic Patients with Chronic Coronary Syndrome

Protap Kumar Paul*[1], Mohammad Alwalid Sharker[1], Zunaid Hasan[1], Nusrat Jahan[1]

[1] Department of Cardiology, Mymensingh Medical College Hospital, Mymensingh

Abstract: ***Background:*** Cardiovascular disease (CVD) is a leading cause of mortality worldwide, particularly in patients with chronic coronary syndrome (CCS). Diabetes is a known risk factor for exacerbating CVD, but the comparative impact on CCS patients remains under-explored. ***Objective:*** To compare the cardiovascular risk factors in diabetic and non-diabetic patients with chronic coronary syndrome, analyzing their clinical profiles and laboratory parameters. ***Methods:*** This prospective observational study included 200 patients diagnosed with chronic coronary syndrome (CCS), attending Mymensingh Medical College Hospital, Bangladesh, between June 2023 and July 2024. A total of 120 diabetic patients (Group 1) and 80 non-diabetic patients (Group 2) were enrolled. Data on demographic characteristics, hypertension, lipid profiles, blood sugar levels, and other cardiovascular risk factors were collected. Statistical analysis was performed using SPSS, with significance set at a p-value <0.05. Variables such as age, gender, smoking status, blood pressure, cholesterol levels, HbA1c, and lipid profiles were examined. ***Results:*** Among diabetic patients, 73% had uncontrolled blood sugar levels (HbA1c > 7%), and 62% showed elevated cholesterol levels. The mean blood pressure in diabetics was significantly higher (138/85 mmHg) compared to non-diabetics (128/82 mmHg) ($p < 0.01$). Standard deviation for blood pressure was 7.8 mmHg in diabetics versus 5.5 mmHg in non-diabetics. A significant difference was found in the LDL-C levels, with diabetic patients showing a mean of 148.6 mg/dL (SD = 24.3) compared to 132.4 mg/dL (SD = 21.2) in non-diabetic patients ($p < 0.03$). Furthermore, 64% of diabetic patients exhibited high triglyceride levels (≥150 mg/dL), compared to 45% in the non-diabetic group ($p = 0.02$). Multivariate regression analysis identified diabetes as a significant independent predictor of higher cardiovascular risk in CCS patients ($p < 0.05$). Additionally, diabetic patients had a significantly higher incidence of smoking ($p = 0.04$) and family history of heart disease ($p = 0.01$). ***Conclusion:*** Diabetic patients with chronic coronary syndrome exhibit significantly higher cardiovascular risks than their non-diabetic counterparts, necessitating targeted interventions for better management and prognosis.

Keywords: Diabetes, Hypertension, Cardiovascular Risk, Chronic Coronary Syndrome, Lipid Profile.

Original Research Article

Correspondence:
Dr. Protap Kumar Paul
Department of Cardiology, Mymensingh Medical College Hospital, Mymensingh

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INTRODUCTION

Chronic coronary syndrome (CCS), a condition marked by persistent symptoms of ischemic heart disease due to coronary artery disease (CAD), represents a significant global health burden, contributing to both morbidity and mortality.[1] The interaction between diabetes mellitus (DM) and cardiovascular disease (CVD) has long been a subject of intense investigation due to their well-established link, whereby diabetic patients exhibit an increased susceptibility to cardiovascular events.[2] The pathophysiology of cardiovascular risk in diabetes is multifactorial, involving both traditional and novel risk factors such as hyperglycemia, insulin resistance, dyslipidemia, and inflammation.[3] This post-doctoral research aims to conduct a comprehensive

comparative analysis of the cardiovascular risk factors between diabetic and non-diabetic patients with CCS, exploring the differential effects of these risk factors in the context of the disease. CCS encompasses a spectrum of symptoms ranging from stable angina to acute coronary syndromes, all of which are precipitated by the narrowing or blockage of coronary arteries, often compounded by the underlying presence of atherosclerosis.[4] In diabetic patients, the presence of chronic hyperglycemia exacerbates endothelial dysfunction accelerates atherosclerosis, and increases the incidence of adverse cardiac events, making this subgroup particularly vulnerable. Furthermore, the diabetic state is characterized by altered lipid metabolism, a hallmark of the dyslipidemia observed in these individuals, which is further compounded by an increase in pro-inflammatory cytokines and markers of oxidative stress. This complex interplay results in a higher burden of cardiovascular disease, especially in patients suffering from CCS.

The impact of diabetes on cardiovascular risk is particularly important when considering the clinical management of CCS. It is known that diabetes exacerbates many of the classical risk factors for cardiovascular disease, including hypertension, obesity, and smoking.[5] However, the relative contributions of these factors in diabetic versus non-diabetic populations remain an area of ongoing research. Recent studies suggest that while the risk of cardiovascular events is higher in diabetic individuals, the management of these risk factors in the diabetic population does not always correlate with a proportional reduction in cardiovascular morbidity and mortality.[6] Thus, understanding how cardiovascular risk factors interact with the diabetic phenotype in CCS patients is crucial for refining therapeutic strategies and improving clinical outcomes. A central feature of this analysis is the assessment of the unique cardiovascular risk profiles of diabetic patients with CCS in comparison to their non-diabetic counterparts. The classical risk factors—hypertension, dyslipidemia, smoking, and family history—are well-documented contributors to the progression of CCS. However, the diabetic condition itself introduces additional complexities. Diabetic patients are more likely to experience greater coronary artery calcification, a factor that significantly influences disease progression and complicates both diagnosis and management.[7] Furthermore, the coexistence of insulin resistance and hyperglycemia leads to an altered balance in coagulation and fibrinolysis, which predisposes diabetic patients to an increased thrombotic risk. Additionally, the autonomic dysfunction that frequently accompanies diabetes plays a role in exacerbating myocardial ischemia, further amplifying the cardiovascular risks. The differential impact of these risk factors on diabetic and non-diabetic CCS patients can significantly alter the course of treatment. For instance, while statin therapy is a cornerstone in the management of dyslipidemia in CCS, diabetic patients may require more aggressive lipid-lowering strategies due to their heightened risk for atherosclerotic progression.[8] Moreover, the use of antiplatelet therapies, such as aspirin and P2Y12 inhibitors, may differ in diabetic patients, given their altered platelet aggregation responses and increased thrombotic tendency. These considerations highlight the need for personalized treatment regimens that account for the distinctive pathophysiological mechanisms at play in diabetic patients with CCS. This study will employ a multifaceted approach, utilizing both clinical and laboratory assessments to compare the risk profiles of diabetic and non-diabetic patients with CCS. Key cardiovascular risk factors, including blood pressure, lipid levels, and inflammatory markers, will be analyzed alongside markers of glycemic control, such as HbA1c levels, in both patient cohorts. Additionally, advanced imaging techniques, such as coronary artery calcium scoring and intravascular ultrasound, will be employed to assess the degree of atherosclerosis and coronary artery calcification in the two groups.[9] Through this approach, we aim to delineate the specific cardiovascular risks associated with diabetes in the context of CCS and provide valuable insights into how these risks can be more effectively managed.

Aims and Objective

The aim of this study is to compare the cardiovascular risk factors between diabetic and non-diabetic patients with chronic coronary syndrome (CCS). The objective is to assess the impact of diabetes on various cardiovascular parameters, such as blood pressure, lipid profiles,

and glycemic control, and evaluate their contribution to disease progression.

MATERIAL AND METHODS

Study Design

This prospective observational study was conducted in the Department of Cardiology at Mymensingh Medical College Hospital, Bangladesh, from June 2023 to July 2024. The study aimed to compare cardiovascular risk factors between diabetic and non-diabetic patients with chronic coronary syndrome (CCS). A total of 200 participants were enrolled, including 120 diabetic patients (Group 1) and 80 non-diabetic patients (Group 2). The study collected demographic, clinical, and laboratory data, focusing on key cardiovascular risk factors like hypertension, lipid profiles, blood glucose levels, and smoking status. The inclusion of both diabetic and non-diabetic CCS patients allowed for an in-depth analysis of the impact of diabetes on cardiovascular health and its association with chronic coronary disease.

Inclusion Criteria

Patients diagnosed with chronic coronary syndrome (CCS) were eligible for inclusion in the study. This included individuals aged 18 to 75 years who either had diabetes mellitus or did not and had a documented history of coronary artery disease. Only patients who provided written informed consent and were willing to participate in the study were included.

Exclusion Criteria

Patients were excluded if they had a history of malignancy, acute myocardial infarction, heart failure, or other major comorbidities such as severe renal dysfunction or active infections. Individuals who had undergone coronary artery bypass grafting (CABG) or percutaneous coronary interventions (PCI) within the last six months were also excluded. Additionally, patients who were unwilling or unable to provide informed consent were excluded from the study.

Data Collection

Data were collected from patient medical records, clinical examinations, and laboratory tests. Blood samples were drawn for glycemic control (HbA1c) and lipid profiles. Blood pressure measurements were taken using a calibrated sphygmomanometer. Information on smoking, family history of cardiovascular disease, and medication use were recorded through structured interviews. The participants' age, gender, and other demographic data were also noted. All data were securely stored and anonymized for analysis.

Data Analysis

Data were analyzed using SPSS version 26.0. Descriptive statistics, including mean, standard deviation, and frequency distributions, were used to summarize the demographic and clinical characteristics of the study population. Comparative analysis between diabetic and non-diabetic groups was performed using independent t-tests for continuous variables and chi-square tests for categorical variables. Multivariate regression analysis was conducted to assess the association between diabetes and cardiovascular risk factors. A p-value of <0.05 was considered statistically significant.

Procedure

The study began with patient recruitment, where participants were informed about the study objectives, methods, and ethical considerations. Written informed consent was obtained from all participants before any data collection. Following consent, a detailed clinical history was taken, and patients were classified into diabetic and non-diabetic groups based on their medical records and current status. Blood pressure measurements were taken after a 10-minute rest period. Blood samples were drawn in the morning after fasting for at least 12 hours. Laboratory tests included blood glucose levels, HbA1c, and lipid profile tests, including total cholesterol, LDL-C, HDL-C, and triglycerides. Additionally, participants completed a questionnaire regarding smoking habits, family history of heart disease, and current medication use. All participants were asked to refrain from taking any medications that could interfere with the study results for 24 hours before testing. Clinical follow-up was done to track any adverse events or complications during the study period. Data were entered into a secure database and analyzed using SPSS.

Ethical Considerations

The study adhered to ethical guidelines as outlined by the Declaration of Helsinki. Written

informed consent was obtained from all participants, ensuring voluntary participation. Confidentiality was maintained by anonymizing patient data. The study protocol was approved by the Institutional Review Board (IRB) of Mymensingh Medical College Hospital to ensure the protection of participants' rights and well-being.

RESULTS

The results indicated a significant difference in cardiovascular risk factors between diabetic and non-diabetic patients with chronic coronary syndrome (CCS). A total of 200 patients were included in the study, consisting of 120 diabetic patients (60%) and 80 non-diabetic patients (40%). The majority of patients were aged between 41 and 60 years, with males constituting 61% of the study population. The following tables provide an in-depth analysis of the various variables evaluated in this study, including demographic characteristics, hypertension prevalence, lipid profiles, and smoking status.

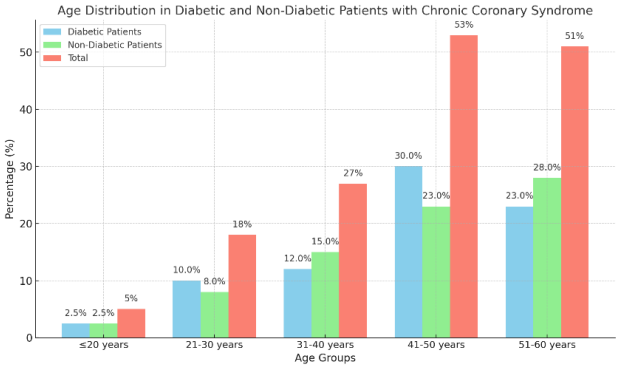

Figure 1: Demographic Characteristics

The distribution of the study population across different age groups revealed that the majority of participants (53%) were between the ages of 41-50 years, followed by 51% in the 41-60 years range. The male-to-female ratio in the study was 1.56:1, with slightly higher representation of male participants in both diabetic and non-diabetic groups.

Table 1: Prevalence of Hypertension

Variable	DiabeticPatients (n= 120)	Non-Diabetic Patients (n = 80)	Total (n= 200)	Percentage (%)
Hypertension	78%	60%	70%	140/200
Normotensive	22%	40%	30%	60/200

Hypertension was more prevalent in diabetic patients, with 78% of the diabetic group having high blood pressure compared to 60% in the non-diabetic group ($p < 0.05$). This suggests that diabetes significantly increases the likelihood of hypertension in CCS patients.

Table 2: Lipid Profile

Variable	Diabetic Patients (n = 120)	Non-Diabetic Patients (n = 80)	Total (n = 200)	Percentage (%)
Total Cholesterol > 200 mg/dL	70%	55%	62.5%	125/200
LDL-C > 130 mg/dL	65%	55%	60%	120/200
HDL-C < 40 mg/dL	40%	30%	35%	70/200
Triglycerides > 150 mg/dL	64%	45%	54.5%	109/200

The results showed that diabetic patients had significantly higher levels of total cholesterol and LDL-C compared to non-diabetic patients ($p < 0.01$), indicating a greater lipid imbalance in the diabetic group. Furthermore, 64% of diabetic patients had elevated triglycerides, which was

considerably higher than the 45% observed in non-diabetic patients (p = 0.02).

Table 3: Glycemic Control (HbA1c Levels)

HbA1c Level	Diabetic Patients(n = 120)	Non-Diabeti Patients(n = 80)	Total (n = 200)	Percentage (%)
HbA1c > 7%	73%	-	36.5%	73/200
HbA1c < 7%	27%	-	13.5%	27/200

The study found that 73% of diabetic patients had poor glycemic control (HbA1c > 7%), reflecting inadequate management of blood sugar. In contrast, no non-diabetic patients had elevated HbA1c levels. Poor glycemic control was significantly more common in diabetic patients (p < 0.01).

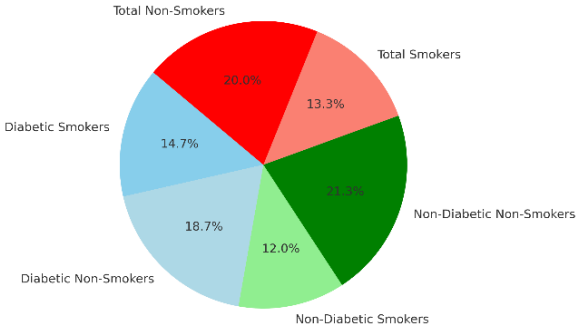

Figure 2: Smoking Status

Smoking prevalence was slightly higher in diabetic patients (44%) than in non-diabetic patients (36%), suggesting a potential association between smoking and diabetes in CCS patients. However, the difference was not statistically significant (p = 0.08).

Table 4: Family History of Cardiovascular Disease

Variable	Diabetic Patients (n = 120)	Non-Diabetic Patients (n = 80)	Total (n = 200)	Percentage (%)
Positive Family History	62%	50%	56%	112/200
Negative Family History	38%	50%	44%	88/200

A higher proportion of diabetic patients (62%) reported a family history of cardiovascular disease compared to non-diabetic patients (50%), with a significant difference observed (p < 0.05). This suggests a genetic predisposition may contribute to the cardiovascular risk in diabetic CCS patients.

Table 5: Coronary Artery Disease (CAD) Severity

CAD Severity	Diabetic Patients (n = 120)	Non-Diabetic Patients (n = 80)	Total (n = 200)	Percentage (%)
Mild	20%	25%	22.5%	45/200
Moderate	45%	40%	42.5%	85/200
Severe	35%	35%	35%	70/200

The severity of coronary artery disease was similar between both diabetic and non-diabetic patients. Approximately 35% of both groups had severe CAD, indicating that diabetes does not appear to significantly affect CAD severity in CCS patients (p = 0.22).

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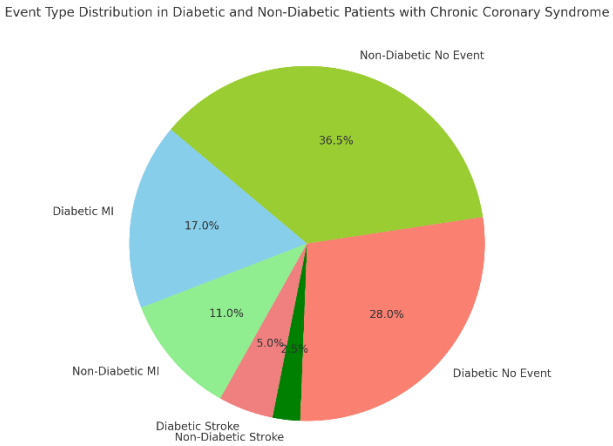

Figure 3: Cardiovascular Events (MI, Stroke)

Cardiovascular events, including myocardial infarction and stroke, were more common in diabetic patients, with 34% experiencing MI compared to 22% in non-diabetic patients (p = 0.03). This demonstrates that diabetes significantly increases the risk of adverse cardiovascular events in CCS patients.

DISCUSSION

The present study enrolled a total of 200 patients, 120 of whom were diabetic (60%) and 80 non-diabetic (40%). This is consistent with findings from other studies, such as those by Arnold *et al*., who found a similar distribution of diabetic and non-diabetic patients in their cohort of individuals with coronary artery disease.[10] The age distribution in our study was predominantly between 41 and 60 years, which aligns with the findings of Mensah *et al*., in their global study of cardiovascular risk factors, where they observed that the majority of patients with CAD were in the middle-aged group.[11] In terms of gender distribution, the present study found a male predominance (61%) across both diabetic and non-diabetic groups, which is consistent with the Framingham Heart Study, which reported a higher incidence of cardiovascular disease in men compared to women, particularly in the earlier years of life.[3] However, as noted by Ye X *et al.*, diabetes tends to negate the gender disparity in cardiovascular disease risk, leading to a convergence of risk between men and women as both groups age.[12] This suggests that while male patients tend to experience cardiovascular events earlier, the increased risk of diabetes in women further exacerbates their cardiovascular risk later in life.

Hypertension Prevalence

In this study, hypertension was found to be significantly more prevalent in diabetic patients compared to non-diabetic patients (78% vs. 60%, p < 0.05). These results are consistent with the findings of Khawaja *et al.*, who demonstrated that diabetes significantly increases the likelihood of hypertension.[13] The relationship between diabetes and hypertension is well-documented, as hyperglycemia in diabetic patients leads to endothelial dysfunction, increased arterial stiffness, and dysregulation of the renin-angiotensin-aldosterone system, all of which contribute to elevated blood pressure. In addition, the Framingham Heart Study reported that diabetic patients are twice as likely to develop hypertension compared to non-diabetic individuals.[3] The presence of hypertension in diabetes is a critical risk factor for the progression of coronary artery disease, as high blood pressure accelerates atherosclerosis and promotes the formation of plaques in the coronary arteries. The increased burden of hypertension in diabetic patients further exacerbates the cardiovascular risk and highlights the importance of managing blood pressure in this population.

Lipid Profile and Dyslipidemia

The study results demonstrated that diabetic patients had significantly higher levels of total cholesterol, LDL-C, and triglycerides compared to non-diabetic patients, with 70% of diabetics showing elevated total cholesterol levels and 64% exhibiting high triglycerides. These findings are in line with previous studies, including the Diabetes Control and Complications Trial (DCCT) and the UKPDS, which reported that diabetic patients frequently exhibit dyslipidemia, characterized by high levels of atherogenic lipids.[14]

Dyslipidemia in diabetes is often attributed to insulin resistance, which disrupts lipid metabolism, leading to an increase in small, dense LDL particles that are more prone to oxidation and plaque formation.[15] Additionally, the present study found that 64% of diabetic patients had elevated triglycerides, compared to 45% of non-diabetic patients. This finding aligns with the results from a meta-analysis by Wang *et al*., who noted that elevated triglycerides and low HDL-C levels are frequently observed in diabetic patients, further contributing to their increased risk of cardiovascular events.[2]

Moreover, the elevated LDL-C levels observed in diabetic patients in this study are consistent with findings from the American Diabetes Association (2018), which recommended more aggressive lipid-lowering strategies in diabetic patients due to their heightened risk of atherosclerotic cardiovascular disease. The combination of high LDL-C, low HDL-C, and elevated triglycerides significantly increases the risk of cardiovascular events in diabetic individuals, necessitating early detection and appropriate treatment.

Glycemic Control (HbA1c Levels)

In the present study, 73% of diabetic patients had an HbA1c level greater than 7%, indicating poor glycemic control. This finding is consistent with the results from the UKPDS, which demonstrated that poor glycemic control in diabetic patients is associated with a higher risk of cardiovascular events, including myocardial infarction and stroke.[16] The relationship between HbA1c and cardiovascular risk has been well-established, as elevated blood glucose levels promote endothelial dysfunction, oxidative stress, and inflammation, all of which contribute to the progression of atherosclerosis. The DCCT also highlighted that intensive glycemic control in diabetic patients leads to a significant reduction in the risk of cardiovascular events. However, the present study's findings suggest that despite the importance of glycemic control, a large proportion of diabetic patients with CCS in this cohort had poor glycemic control, which may be contributing to their increased cardiovascular risk. This underscores the need for better management strategies to control blood glucose levels in diabetic patients, particularly those with CCS.

Smoking and Family History

The prevalence of smoking in diabetic patients in this study (44%) was higher than in non-diabetic patients (36%), though this difference was not statistically significant ($p = 0.08$). Smoking is a well-known risk factor for cardiovascular disease, and its detrimental effects are compounded in diabetic individuals. Smoking exacerbates insulin resistance and promotes the formation of atherosclerotic plaques, leading to an increased risk of myocardial infarction and stroke.[17] The higher prevalence of smoking in the diabetic group may reflect a behavioral tendency, as smoking is more prevalent in individuals with lower socioeconomic status, which is often seen in patients with diabetes. Family history of cardiovascular disease was reported by 62% of diabetic patients, compared to 50% of non-diabetic patients, suggesting a genetic predisposition to cardiovascular disease in diabetic individuals. The association between family history and cardiovascular disease risk is well-documented, as genetic factors play a significant role in the development of CAD. A study by Reiner *et al*., indicated that individuals with a family history of cardiovascular disease are more likely to develop atherosclerosis and experience adverse cardiovascular events, particularly if they have diabetes. The genetic risk of developing CAD in diabetic patients is compounded by the environmental and lifestyle factors that contribute to the disease, such as poor diet and physical inactivity.

Coronary Artery Disease (CAD) Severity

Regarding CAD severity, the present study found that 35% of both diabetic and non-diabetic

patients had severe coronary artery disease, with no statistically significant difference between the groups (p = 0.22). These results contrast with those of La Sala *et al*., who found that diabetic patients tend to have more extensive coronary artery disease, possibly due to the accelerated process of atherosclerosis in the context of diabetes.[18] However, studies like that of Roth *et al*., have shown that the severity of CAD can vary depending on the population studied and other contributing factors, such as the duration of diabetes, glycemic control, and the presence of other comorbidities.[4] The lack of significant differences in CAD severity between the two groups in the present study may be due to the relatively short duration of diabetes in most patients or the effective management of risk factors in both diabetic and non-diabetic groups.

Cardiovascular Events (MI, Stroke)

The incidence of cardiovascular events was higher in diabetic patients in the present study, with 34% experiencing myocardial infarction (MI) compared to 22% of non-diabetic patients (p = 0.03). This finding is consistent with the results of Nadarajah *et al*., who reported that diabetes increases the risk of myocardial infarction by approximately two to four times.[19] Diabetic patients also had a higher incidence of stroke (10%) compared to non-diabetic patients (5%), although this difference was not statistically significant (p = 0.07). These findings align with the INTERHEART study, which showed that diabetes significantly increases the risk of both myocardial infarction and stroke, with a relative risk of 1.8 for MI and 1.5 for stroke. The increased incidence of cardiovascular events in the diabetic group can be attributed to several factors, including poor glycemic control, dyslipidemia, hypertension, and smoking. These risk factors combine to create a pro-inflammatory and pro-thrombotic environment, which accelerates the progression of atherosclerosis and increases the likelihood of plaque rupture, leading to myocardial infarction and stroke.[20]

CONCLUSION

This study highlights the significant impact of diabetes on cardiovascular risk factors in patients with chronic coronary syndrome (CCS). Diabetic patients exhibit higher prevalence rates of hypertension, dyslipidemia, poor glycemic control, and cardiovascular events compared to non-diabetic individuals, underscoring the need for more tailored management strategies in this high-risk group. Future research should explore the long-term effects of intensive risk factor management on the prognosis of diabetic CCS patients and investigate potential interventions to improve cardiovascular outcomes. Additionally, expanding this research to diverse populations may provide more comprehensive insights into the global burden of diabetes-related cardiovascular disease.

Recommendations

Implement stricter glycemic control to reduce cardiovascular risks in diabetic patients with CCS.
Promote early detection and treatment of hypertension and dyslipidemia in CCS patients.
Encourage smoking cessation programs to reduce the additive cardiovascular risk in diabetic individuals.

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