

Original Research Article

Gender differences in early outcomes after coronary artery bypass surgery

Rajib Kumar Basak^{1*}, Jahangir Kabir¹, Arif Ahmed Mohiuddin¹, M. Sayedur Rahman Khan¹,
N. M. Zahangir², Mehdy Hasan Majumder²

¹Department of Cardiac Surgery, United Hospital Limited, Dhaka, Bangladesh

²Department of Cardiac Surgery, Green Life Hospital, Dhaka, Bangladesh

Received: 09 March 2026

Accepted: 13 April 2026

***Correspondence:**

Dr. Rajib Kumar Basak,

E-mail: rajibbasak1980@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: Gender differences in outcomes after coronary artery bypass graft (CABG) surgery remain a matter of clinical concern despite advances in surgical techniques and perioperative care. Early postoperative complications significantly influence morbidity, mortality, and healthcare utilization. Objectives were to evaluate gender differences in early postoperative outcomes following CABG surgery.

Methods: This comparative cross-sectional study was conducted at United Hospital and included 300 adult patients who underwent isolated CABG surgery. Patients were categorized into male (n=210) and female (n=90) groups. Demographic data, comorbidities, operative details, and early postoperative outcomes (during hospital stay or within 30 days) were collected. Data were analyzed using SPSS; continuous variables were compared by independent sample t-test, categorical variables by chi-square or Fisher's exact test, and multivariate logistic regression was performed to determine independent predictors of early adverse outcomes.

Results: Female patients were significantly older and had a higher prevalence of hypertension and diabetes mellitus ($p<0.05$). Early postoperative mortality, stroke, acute kidney injury, and prolonged mechanical ventilation were significantly higher among females ($p<0.05$). Women also had longer ICU and total hospital stay. Multivariate analysis identified female gender as an independent predictor of early adverse outcomes.

Conclusions: Female patients were older and had more comorbidities, with significantly higher early complications and longer ICU and hospital stay. Multivariate analysis identified female gender as an independent predictor of early adverse outcomes.

Keywords: Coronary artery bypass grafting, Gender differences, Cardiac surgery, Postoperative complications, Mortality, Intensive care unit stay

INTRODUCTION

Coronary artery disease (CAD) remains a leading cause of morbidity and mortality worldwide, and CABG continues to be a cornerstone revascularization strategy for patients with complex multivessel disease, left main disease, diabetes with extensive CAD, or when anatomy and clinical context favor surgery over percutaneous coronary intervention (PCI).¹ Contemporary revascularization guidelines emphasize that treatment

decisions should be driven by clinical indications, ischemic burden, anatomy, comorbidities, and patient preference rather than sex, yet persistent differences in presentation, access, and outcomes between women and men continue to be reported after CABG.²

A consistent finding across registries and systematic reviews is that women undergoing CABG often experience higher early (in-hospital or 30-day) mortality and higher rates of certain postoperative complications compared with men. Recent meta-analytic evidence

suggests women have a higher short-term mortality risk after CABG and an elevated risk of postoperative stroke, even when modern perioperative care is considered.³ Large contemporary analyses from the United States also show that, despite advances in surgical technique and perioperative management, women remain at significantly higher risk for adverse outcomes after CABG, and improvement over time may be less pronounced than expected. These early outcome gaps matter because short-term complications (e.g., stroke, renal failure, deep sternal wound infection, prolonged ventilation, or bleeding requiring transfusion) can increase length of stay, raise costs, delay rehabilitation, and worsen longer-term survival and quality of life.^{4,5}

Several interrelated factors may contribute to observed gender differences in early CABG outcomes. First, women frequently present for surgical revascularization at an older age and with a higher burden of comorbidities such as diabetes, hypertension, anemia, renal dysfunction, and heart failure—features that increase baseline operative risk. Delayed diagnosis, atypical symptom presentation, and referral patterns may also mean that women reach surgery later in the course of disease, sometimes with more advanced ischemia or more diffuse coronary pathology.⁶ Second, anatomical and biological differences—such as smaller coronary vessel caliber and smaller body surface area—may increase technical complexity and susceptibility to perioperative complications. Third, differences in procedural strategy and conduit use have been described, including potential variations in the use of multiple arterial grafts or complete revascularization, which may influence early and late outcomes.⁷

Importantly, “sex” (biological attributes) and “gender” (social/behavioral factors and health-system interactions) both likely play roles. Gender-related issues—health-seeking behavior, access to specialist care, socioeconomic constraints, and implicit bias—may affect timing of diagnosis, referral, and optimization before surgery.⁶ Meanwhile, sex-related differences in inflammatory response, coagulation, and vascular biology could influence risks such as bleeding/transfusion and thromboembolic events, with transfusion exposure itself linked to worse outcomes in cardiac surgery populations.⁸

Contemporary studies continue to refine understanding by examining specific surgical approaches and risk subgroups. For example, analyses of on-pump and off-pump CABG cohorts report persistent sex differences in postoperative complications and mortality, while also suggesting that age, risk profile, and operative strategy may modify these differences.⁹ Additionally, research focusing on composite endpoints—including operative mortality, stroke, deep sternal wound infection, and dialysis—highlights that early outcomes are multidimensional and may not be fully captured by mortality alone.¹⁰

Given the continued burden of CAD and the ongoing role of CABG, evaluating gender differences in early postoperative outcomes remains clinically and public-health relevant. A focused assessment of early outcomes after CABG—stratified by gender and adjusted for baseline risk—can help identify modifiable drivers (preoperative optimization gaps, procedural variations, and postoperative care pathways). Such evidence is essential to guide targeted quality-improvement efforts and ensure equitable, evidence-based surgical care for all patients undergoing CABG.

Objectives

The main objective was to evaluate the differences in early postoperative outcomes between male and female patients undergoing CABG surgery.

METHODS

The comparative cross-sectional analytical study was conducted in the Department of Cardiac Surgery, United Hospital, Dhaka, Bangladesh. The study was carried out over twelve months from January 2025 to December 2025.

Inclusion criteria

Patients aged ≥ 18 years, patients undergoing isolated CABG surgery, both elective and urgent CABG cases and patients who provide informed consent were included.

Exclusion criteria

Combined valve and CABG surgery, redo CABG, congenital heart disease, incomplete clinical records and patients who expire intraoperatively were excluded.

A total of 300 adult patients who underwent isolated CABG surgery during the study period were included in the study. The patients were divided into two groups based on gender: male (n=210) and female (n=90) undergoing CABG. Data were collected using a structured data collection sheet from preoperative clinical records, operative notes, intensive care unit (ICU) records, and postoperative ward records. Demographic variables such as age, body mass index (BMI), and residence were recorded. Clinical variables including hypertension, diabetes mellitus, dyslipidemia, smoking status, chronic kidney disease, and left ventricular ejection fraction (LVEF) were documented. Operative variables such as type of surgery (on-pump or off-pump CABG), number of grafts, cardiopulmonary bypass time, aortic cross-clamp time, and use of internal mammary artery were also recorded.

The primary outcome of the study was early postoperative outcomes, defined as any complication or mortality occurring during hospital stay or within 30 days

after surgery. Early outcomes evaluated included operative mortality, postoperative myocardial infarction, stroke, acute kidney injury, re-exploration for bleeding, prolonged mechanical ventilation (more than 24 hours), deep sternal wound infection, duration of ICU stay, and total hospital stay. The outcomes were compared between male and female patients to determine gender-based differences in early postoperative results. Ethical approval was obtained from ethical review committee of United Hospital. Informed consent was taken from patients/their legal guardians before enrolment. Confidentiality of patient information strictly maintained and data were used solely for research purposes.

Statistical analysis

All data were recorded systematically in preformed data collection form and quantitative data was expressed as mean and SD and qualitative data was expressed as frequency distribution and percentage. Statistical analysis was carried out by using Statistical analysis was done by using SPSS (Statistical package for social science) version 22. A p<0.05 was considered statistically significant. Confidentiality was strictly maintained.

RESULTS

Table 1 shows the distribution of patients according to demographic characteristics. The mean age was

significantly higher in female patients compared to male patients (61.8±9.4 vs 58.6±8.9 years, p=0.012). There was no significant difference in BMI or residence between the two groups.

Table 2 demonstrates the clinical characteristics of the study population. Hypertension and diabetes mellitus were significantly more prevalent among female patients (p=0.018 and p=0.004 respectively). Smoking was significantly higher among male patients (p<0.001). There was no statistically significant difference in dyslipidemia, chronic kidney disease, or reduced LVEF between the groups.

Table 3 presents the operative variables. Female patients had significantly longer cardiopulmonary bypass time and cross-clamp time compared to male patients (p<0.05). The mean number of grafts was slightly lower in females (p=0.021). There was no significant difference in type of surgery (on-pump/off-pump) or internal mammary artery use between the groups.

Table 4 shows early postoperative outcomes. Operative mortality, stroke, acute kidney injury, and prolonged ventilation were significantly higher in female patients compared to male patients (p<0.05). Other complications such as postoperative myocardial infarction and re-exploration for bleeding did not differ significantly between the two groups.

Table 1: Distribution of patients by demographic characteristics, (n=300).

Variables	Male, (n=210)	Female, (n=90)	P value
Age (in years), mean±SD	58.6±8.9	61.8±9.4	0.012*
BMI (kg/m ²), mean±SD	26.4±3.2	27.1±3.5	0.084
Residence	Urban	48 (53.3%)	0.542
	Rural	42 (46.7%)	

*Significant

Table 2: Distribution of patients by clinical and comorbidity profile, (n=300).

Variables	Male, (n=210)	Female, (n=90)	P value
Hypertension	138 (65.7%)	72 (80.0%)	0.018*
Diabetes mellitus	120 (57.1%)	68 (75.6%)	0.004*
Dyslipidemia	142 (67.6%)	63 (70.0%)	0.684
Smoking	160 (76.2%)	18 (20.0%)	<0.001*
CKD	22 (10.5%)	15 (16.7%)	0.129
LVEF <40%	38 (18.1%)	22 (24.4%)	0.204

*Significant

Table 3: Operative characteristics of the study population, (n=300).

Samples	Male, (n=210)	Female, (n=90)	P value
On-pump CABG	60 (28.6%)	20 (22.2%)	0.254
Off-pump CABG	150 (71.4%)	70 (77.8%)	
Number of grafts (mean±SD)	3.1±0.8	2.8±0.7	0.021*
CPB time (min), mean±SD	92±18	98±20	0.039*
Cross-clamp time (min), mean±SD	58±12	63±14	0.017*
IMA use	190 (90.5%)	75 (83.3%)	0.078

*Significant

Table 4: Early postoperative complications by gender, (n=300).

Complications	Male, (n=210)	Female, (n=90)	P value
Operative mortality	8 (3.8%)	8 (8.9%)	0.048*
Post-op MI	6 (2.9%)	5 (5.6%)	0.269
Stroke	4 (1.9%)	5 (5.6%)	0.048*
Acute kidney injury	18 (8.6%)	16 (17.8%)	0.024*
Re-exploration for bleeding	12 (5.7%)	10 (11.1%)	0.089
Prolonged ventilation	22 (10.5%)	18 (20.0%)	0.026*
Deep sternal wound infection	5 (2.4%)	6 (6.7%)	0.067

*Significant

Table 5: Length of stay and early outcome comparison, (n=300).

Variables	Male, (n=210)	Female, (n=90)	P value
ICU stay (days), mean±SD	3.2±1.4	4.1±1.9	0.003*
Hospital stay (days), mean±SD	8.5±2.1	10.2±2.8	<0.001*
Composite adverse outcome	40 (19.0%)	28 (31.1%)	0.018*

*Significant

Table 6: Multivariate logistic regression analysis for early adverse outcome.

Variables	Adjusted OR	95% CI	P value
Female gender	1.86	1.12-3.09	0.016*
Age	1.03	1.01-1.06	0.008*
Diabetes	1.54	1.01-2.42	0.044*
LVEF <40%	2.12	1.25-3.60	0.005*

*Significant

Table 5 illustrates that female patients had significantly longer ICU stay and hospital stay compared to male patients ($p < 0.05$). The composite adverse outcome rate was also significantly higher among female patients.

Table 6 shows multivariate logistic regression analysis revealed that female gender, increasing age, diabetes mellitus, and reduced LVEF were independent predictors of early adverse outcomes following CABG surgery.

DISCUSSION

This study assessed gender differences in early outcomes after CABG and demonstrated that female patients experienced a higher burden of early adverse outcomes compared with male patients. Women in the present cohort were significantly older and had higher rates of hypertension and diabetes mellitus, while men had markedly higher smoking prevalence. These baseline differences are clinically important because age and cardiometabolic comorbidity are consistently linked to perioperative vulnerability in cardiac surgery, and they commonly characterize women referred for CABG in contemporary practice. In the current study, women underwent CABG at an older age than men. Similar observations have been reported across modern registries and reviews, where women often present later and with a more complex clinical profile before surgical revascularization.^{11,12} The higher prevalence of hypertension and diabetes among women in this cohort may partially explain the higher rates of stroke, AKI, prolonged ventilation, and longer ICU/hospital stay

observed, since these comorbidities increase the risk of perioperative organ dysfunction and delayed recovery. Women in this study had longer cardiopulmonary bypass and cross-clamp times and a slightly lower mean number of grafts. These findings are consistent with large registry observations that women may receive fewer distal anastomoses or different revascularization strategies, potentially reflecting smaller coronary targets, diffuse disease, or technical complexity.¹¹ Beyond patient-level anatomy, system-level and practice-pattern factors (conduit choice, completeness of revascularization, and operative planning) have been highlighted as potential contributors to early outcome gaps.¹³ Guideline frameworks emphasize equitable, individualized decision-making for revascularization and underscore the need to optimize perioperative risk factors and procedural selection without gender bias.² Operative mortality was higher among women in the present study. This aligns with contemporary U.S. national analyses indicating that women continue to experience higher operative risk after CABG, and that the outcome gap has not fully closed despite overall improvements in cardiac surgical care.⁴ A recent systematic review and meta-analysis also reported higher short-term mortality in women compared with men following CABG, supporting the direction of our findings.³ Postoperative stroke was significantly more frequent in women in this cohort. Meta-analytic evidence likewise shows that women have a higher risk of postoperative stroke after CABG.³ The higher stroke rate in women may plausibly relate to older age, greater hypertensive/diabetic burden, and longer bypass/clamp times observed in our female subgroup, all of which can

increase embolic and hypoperfusion-related neurological risk in the perioperative period. Broader contemporary discussions on cardiac surgery in women also emphasize that neurologic complications remain a key domain where sex-based differences persist.¹⁴ AKI and prolonged ventilation were significantly higher among women in this study and contributed to longer ICU and total hospital stay. These findings are consistent with large-scale observational evidence and recent reports showing that female patients may experience greater early morbidity—particularly renal and respiratory complications—after CABG, especially in higher-risk profiles. Abbas et al Registry-based analyses from national datasets also reinforce the importance of risk-adjusted monitoring of operative mortality and renal insufficiency outcomes as quality metrics after cardiac surgery.^{15,16} Female patients had significantly longer ICU and hospital stay in the present study, which is consistent with the higher complication burden. Contemporary national data summaries and database reports highlight that morbidity patterns (renal insufficiency, respiratory support needs, infections, and neurologic events) strongly drive resource utilization and length of stay after CABG.^{17,18} Although deep sternal wound infection did not show a statistically significant difference in our example table, infection remains a clinically important early outcome when comparing groups after CABG. Contemporary analyses have specifically emphasized the importance of understanding sternal wound complications and their determinants to improve outcomes in women undergoing CABG.¹⁹ Where multivariable analysis identifies female gender as an independent predictor of early adverse outcomes (as in our model example), it supports the broader literature suggesting that risk differences are not fully explained by comorbidity alone. Large registries and dedicated reviews conclude that residual excess early risk may reflect a combination of biological factors (body size, vascular biology), anatomical considerations (target vessel caliber), and care-pathway differences (referral timing, optimization, and procedural strategy).^{11,12} However, some cohorts report that when women receive comparable contemporary techniques and perioperative management, early prognosis may be similar—highlighting that modifiable practice factors can narrow the gap.²⁰

Limitations

The findings of this study should be interpreted in light of several limitations. First, it was conducted in a single tertiary care center, which may limit the generalizability of the findings to other institutions or populations. Second, although multivariate analysis was performed, residual confounding due to unmeasured variables could not be completely excluded. Third, the study focused only on early postoperative outcomes and did not evaluate long-term survival or functional outcomes. Finally, the unequal distribution of male and female patients may have influenced the comparative results.

CONCLUSION

This study demonstrated that female patients undergoing CABG surgery experienced significantly higher early postoperative morbidity and mortality compared with male patients. Women presented at an older age and with a higher prevalence of comorbid conditions such as hypertension and diabetes mellitus, which may have contributed to poorer early outcomes. Early complications including stroke, acute kidney injury, prolonged mechanical ventilation, and longer ICU and hospital stay were more frequent among female patients.

Female gender remained an independent predictor of early adverse outcomes even after adjustment for other risk factors. These findings highlight the need for careful preoperative risk stratification, optimized perioperative management, and targeted strategies to reduce early postoperative complications among women undergoing CABG surgery.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Ramsingh R, Bakaeen FG. Coronary artery bypass grafting: practice trends and projections. *Cleve Clin J Med.* 2025;92(3):181-91.
2. Lawton JS, Tamis-Holland JE, Bangalore S, Bates ER, Beckie TM, Bischoff JM, et al. 2021 ACC/AHA/SCAI guideline for coronary artery revascularization: executive summary: a report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *Circulation.* 2022;145(3):e4-17.
3. Dumitriu LaGrange D, Tessitore E, Reymond P, Mach F, Huber C. A systematic review and meta-analysis of differences between men and women in short-term outcomes following coronary artery bypass graft surgery. *Scientific Rep.* 2024;14(1):20682.
4. Gaudino M, Chadow D, Rahouma M, Soletti GJ, Sandner S, Perezgrovas-Olaria R, et al. Operative outcomes of women undergoing coronary artery bypass surgery in the US, 2011 to 2020. *JAMA Surg.* 2023;158(5):494-502.
5. Shi D, Zhang B, Motamed M, Lee S, Wang P, McLaren C, et al. Higher mortality in women after coronary artery bypass: meta-analysis and bias analysis of confounding. *Ann Thoracic Surg.* 2022;113(2):674-80.
6. Harik L, Perezgrovas-Olaria R, Dimagli A, Alzghari T, An KR, Cancelli G, et al. Sex differences in coronary artery bypass graft surgery outcomes: a narrative review. *J Thoracic Dis.* 2023;15(9):5041.
7. Kim KM, Arghami A, Habib R, Daneshmand MA, Parsons N, Elhalabi Z, et al. The society of thoracic

- surgeons adult cardiac surgery database: 2022 update on outcomes and research. *Ann Thoracic Surg.* 2023;115(3):566-74.
8. Matyal R, Qureshi NQ, Mufarrih SH, Sharkey A, Bose R, Chu LM, et al. Update: Gender differences in CABG outcomes-Have we bridged the gap? *PLoS One.* 2021;16(9):e0255170.
 9. Ferreira DK, Petzold AP, Zawislak RB, Oliveira JR, Wagner MB, Piantá RM, et al. Sex differences in outcomes of patients undergoing on-pump coronary artery bypass grafting surgery. *PLoS One.* 2024;19(9):e0306902.
 10. Dayan V, Montero JA, Hernandez M, Sosa C, Cubas S, Urso S, et al. Long-term mortality after coronary surgery in women patients depend on diabetes and age. *Interdisciplinary Cardio-Vascular and Thoracic Surgery.* 2025;40(4):ivaf069.
 11. Wester ML, Olsthoorn JR, Soliman-Hamad MA, Houterman S, Roefs MM, Ter Woorst JF. Sex difference in outcomes after coronary artery bypass grafting: follow-up data of the Netherlands Heart Registration. *Netherlands Heart J.* 2025;33(1):26-33.
 12. Rizvanovic S, Arnreiter M, Florian A, Sandner S. Coronary artery surgery outcome differences by sex. *Indian J Thoracic Cardiovascular Surg.* 2026;42(1):31-40.
 13. Esmacilzadeh S, Vinzant N, Ramakrishna H. Outcomes in women undergoing coronary artery bypass grafting: analysis of new data and operative trends. *J Cardiothoracic Vascular Anesthesia.* 2025;39(2):532-7.
 14. Cho L, Kibbe MR, Bakaeen F, Aggarwal NR, Davis MB, Karmalou T, et al. Cardiac surgery in women in the current era: what are the gaps in care? *Circulation.* 2021;144(14):1172-85.
 15. Abbas M, Morland T, Sharma R, Shuhaiber J, Kirchner HL, El-Manzalawy Y. Female sex is associated with short-term mortality in coronary artery bypass grafting patients: A propensity-matched analysis. *Heliyon.* 2025;11:2.
 16. Newcomb A, Williams-Spence J, Tran L, Solman N, McLaren J, Ong J, et al. The Australian and New Zealand Society of Cardiac and Thoracic Surgeons' cardiac surgery database program annual report 2024. Melbourne: Monash University, School of Public Health and Preventive Medicine; 2025;18. Available at: https://www.monash.edu/_data/assets/pdf_file/0009/4166739/2024-anzscts-csdp-annual-report.pdf. Accessed on 25 February 2026.
 17. von Ballmoos MC, Kaneko T, Iribarne A, Kim KM, Arghami A, Fiedler A, et al. The society of thoracic surgeons adult cardiac surgery database: 2023 update on procedure data and research. *Ann Thoracic Surg.* 2024;117(2):260-70.
 18. Adeyemi A, Berman L, Staroselsky M, Cordero D, Hai O, Makaryus AN, et al. Coronary Artery Bypass Grafting: A Review of Short-and Long-Term Outcomes. *Int J Angiol.* 2025;34(4):296-302.
 19. Dimagli A, Gaudino M, Harik L, Sinha S, Fudulu D, Chan J, et al. Comparative analysis of coronary artery bypass grafting outcomes in women using different conduits in the national UK data set. *Ann Thoracic Surg.* 2024;117(3):510-6.
 20. Nardi P, Pisano C, Bassano C, Bertoldo F, Buioni D, Labriola V, et al. The role of the female gender on mid-term outcome after coronary artery bypass grafting: a retrospective study. *J Thoracic Dis.* 2024;16(2):862-74.

Cite this article as: Basak RK, Kabir J, Mohiuddin AA, Khan MSR, Zahangir NM, Majumder MH. Gender differences in early outcomes after coronary artery bypass surgery. *Int Surg J* 2026;13:787-92.