ORIGINAL ARTICLE https://doi.org/10.3329/jmcwh.v22i2.90184

COMPARATIVE ANALYSIS OF POSTOPERATIVE OUTCOMES BETWEEN OVERWEIGHT AND OBESE PATIENTS UNDERGOING OFF-PUMP CORONARY ARTERY BYPASS GRAFTING

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Received: 04.05.2026
Accepted: 09.06.2026
Published: July 2026

Cite this article:
Ahmed T, Rahman MM, Bappu MMH, Sajib MAQ, Alauddin M, Sunny MSA.Comparative Analysis of Postoperative Outcomes Between Overweight and Obese Patients Undergoing Off-Pump Coronary Artery Bypass Grafting. J Med Coll Women Hosp. 2026; 22(2):177-185.

ABSTRACT

Background: Obesity is a major risk factor in patients undergoing coronary artery bypass graft (CABG) surgery. In Bangladesh, overweight and obesity are increasing due to high intake of processed foods and sedentary lifestyles. However, comparative data on postoperative outcomes between overweight and obese patients after off-pump CABG are limited. **Objective:** The objective of the study was to compare the postoperative outcomes between overweight and obese patients undergoing off-pump coronary artery bypass grafting (CABG). **Materials and Method:** Following institutional approval, this cross-sectional study was carried out over one year period in the Department of Cardiac Surgery, Bangladesh Medical University. Fifty overweight (Body Mass Index 25.0–29.9 kg/m², Group A) and 50 obese (BMI ≥30 kg/m², Group B) patients who underwent off-pump CABG, a total of 100 patients were enrolled in the study. Chi-square test was performed for qualitative data, Student's t-test for quantitative data, and a p-value ≤0.05 was considered significant. SPSS version 27 was used for data analysis. **Results:** Group B patients were younger (41.74 ± 9.61 vs. 49.94 ± 9.00 years, p<0.001). Gender distribution was not significantly different (male 80% vs. 88%, p=0.275). Postoperative complications were higher in obese patients, including arrhythmia (46% vs. 24%, p=0.021), sternal wound infection (20% vs. 6%, p=0.037), vein harvest site infection (16% vs. 4%, p=0.046), and respiratory tract infection (24% vs. 8%, p=0.029). In group B, postoperative bleeding, mechanical ventilation time, ICU stay, and hospital stay were all significantly higher (p<0.001 for each). Differences in acute kidney injury, neurological complications, and mortality were not statistically significant. **Conclusion:** Higher rates of postoperative complications, longer recovery times, and greater resource utilization found in obese patients compared to overweight patients after off-pump CABG. These findings underscore the significant impact of obesity on perioperative outcomes in ischemic heart disease.

Keywords: Obesity, Coronary artery bypass grafting, Body mass index, Off-pump CABG, Postoperative complications.

INTRODUCTION

Among non-communicable diseases, cardiovascular conditions impose the greatest global burden, responsible for roughly 17.7 million annual deaths– nearly one-third of all deaths worldwide – of which ischemic events constitute the majority[1].

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In Bangladesh, it is also a major cause of morbidity and mortality. Progressive urbanization, physical inactivity, and shifts toward calorie-dense dietary habits have collectively driven a steady rise in obesity prevalence nationally. Currently, about 21.5% of adults have a body mass index (BMI) above 25 kg/m², with increased waist circumference particularly evident among women (33.7%)[2]. For cardiovascular disease, obesity is a well-established risk factor that adversely affects functional capacity and quality of life and is a main global health issue, with nearly 0.5 billion adults classified as overweight, defined as BMI 25.0–29.9 kg/m², while obesity is defined as BMI ≥30 kg/m²[1,3]. It promotes endothelial dysfunction, atherosclerosis, myocardial remodeling, and systemic inflammation, increasing the risk of coronary artery disease (CAD)[4].

Increased BMI represents a clinically significant perioperative risk variable in patients undergoing surgical coronary revascularization[5,6]. Although some risk models assign higher surgical risk to obese patients, evidence regarding worse outcomes after CABG remains inconsistent[7]. While mortality may be similar, obese patients have increased rates of wound infection, atrial fibrillation, and other postoperative complications[8]. Additionally, obesity increases perioperative risk through impaired respiratory mechanics, difficult airway management, prolonged mechanical ventilation, and extended Intensive Care Unit (ICU) stay[9-11].

In obese patients, reduced end-expiratory lung volume and decreased chest wall compliance contribute to ventilation-perfusion mismatch, hypoxemia, hypercapnia, and atelectasis, often extending into the postoperative period and increasing the need for respiratory support and prolonged hospitalization[12]. Moreover, obesity is associated with multiple comorbidities, including diabetes, dyslipidemia, hypertension, and a prothrombotic state[13]. Postoperative complications, for instances, sternal wound infection, leg infections, and atrial dysrhythmias have been found to be significantly higher in overweight and obese patients[8,14].

Increased left atrial pressure and atrial enlargement have been identified in obese individuals, while obesity-related diastolic dysfunction has been shown to improve following weight reduction. An arrhythmogenic effect on the adjacent myocardium has also been demonstrated to result from pericardial fat[15]. Overweight patients are reportedly less frequently selected for surgical intervention compared to normal-weight individuals, whereas obese patients often experience longer postoperative hospital stays as a precaution[16]. Higher BMI is linked with increased operative difficulty, blood loss, and postoperative complications including renal failure and mediastinitis[4,17].

CABG is the definitive surgical treatment for CAD and may be performed using on-pump or off-pump techniques[16]. CABG may be performed using either conventional on-pump technique with cardiopulmonary bypass (CPB) or off-pump coronary artery bypass (OPCAB). On-pump CABG is associated with CPB-related complications, including neurological injury, renal dysfunction, respiratory impairment, myocardial injury, and increased postoperative bleeding. In contrast, OPCAB avoids the adverse effects of cardiopulmonary bypass and is considered more advantageous in selected patients[18,19].Hence, this study aimed to compare postoperative outcomes between overweight and obese patients who undergo off-pump coronary artery bypass grafting.

MATERIALS AND METHOD

Study Design and Setting

This comparative study was conducted in the Department of Cardiac Surgery at Bangladesh Medical University (BMU), Shahbag, Dhaka, Bangladesh. The study period extended from 1 July 2022 to 30 June 2024**.** Institutional Review Board (IRB) was obtained prior to the commencement of the study.

Study Population and Sample Size

Patients diagnosed with CAD who underwent off-pump coronary artery bypass grafting (OPCABG) at the study center during the study period were included in the study.

C**onvenience sampling technique was followed for enrolling 100 patients** and divided into two groups based on BMI:

- Group A (Overweight): BMI 25.0–29.9 kg/m² (n = 50)
- Group B (Obese): BMI ≥30.0 kg/m² (n = 50)

The sample size was initially estimated using standard statistical formula based on previous literature, which recommended a minimum of 60 participants per group[18]. However, due to time and logistical constraints, 50 patients were included in each group. Despite this, key outcome variables demonstrated statistically significant differences.

Eligibility Criteria

Inclusion Criteria

- Patients undergoing elective OPCABG
- Patients with BMI ≥25 kg/m² (overweight or obese)
- Patients with informed written consent

Exclusion Criteria

- Patients undergoing combined cardiac procedures
- Conversion from off-pump to on-pump CABG
- Redo CABG
- Emergency surgery
- Patients with significant comorbidities, including:
    - Chronic obstructive pulmonary disease (COPD)
    - Peripheral vascular disease
    - Renal impairment
    - Preoperative atrial fibrillation
    - Left ventricular ejection fraction ≤35%

Data Collection Procedure

A pre-tested semi-structured questionnaire and checklist were developed in English in accordance with the study objectives and variables for data collection. Pre-testing was conducted on 10 patients to ensure clarity, relevance, and completeness of the data collection tool, and necessary modifications were made prior to final data collection. Information was obtained through face-to-face interviews with the patients, as well as from review of medical records, including history sheets, operative notes, investigation reports, and hospital documentation. Anthropometric measurements, for instances, height and weight were recorded using standard procedures, and BMI was calculated accordingly. For completeness and consistency, data collection was checked daily, and any discrepancies were resolved promptly to ensure data quality.

Perioperative and Postoperative Assessment

Perioperative and postoperative outcomes were prospectively assessed throughout the hospital stay. Postoperative arrhythmias were monitored by serial electrocardiography up to the fourth postoperative day. Acute kidney injury was evaluated using serum creatinine measurements obtained on the 1st, 3rd, and 7th postoperative days.Surgical site infections, including sternal wound infection and vein harvest site infection, were assessed clinically

during dressing changes on the 3rd and 7th postoperative days. Diagnosed respiratory tract infections based on clinical evaluation and confirmed with chest radiography when indicated. Additional postoperative outcomes, including duration of mechanical ventilation, postoperative bleeding, length of ICU stay, hospital stay, and in-hospital mortality, were recorded until discharge from the hospital. Overall recovery was categorized as eventful or uneventful grounded on the presence or absence of postoperative complications during the hospital stay.

Statistical Analysis

All statistical analysis was performed suing IBM SPSS (version 27) following data entry and verification. Expressed asmean ± SD for presenting normally distributed continuous data, while categorical data are expressed as counts with percentages. Normality of continuous data was assessed prior to applying parametric tests.To compare continuous variables between the two groups, unpaired Student's t-test was used.Pearson's Chi-square or Fisher's exact test for comparing categorical outcomes, depending on expected cell frequencies. Statistical significance was defined at the two-tailed α level of 0.05.

Ethical Considerations

Institutional Review Board clearance was obtained from BMU (Memo No: BSMMU/2024/6028). Signed written consent was taken from all enrolled patients before participation. Data were managed anonymously and kept confidential throughout all phases of the study in accordance with institutional guidelines.

RESULTS

Age profiles differed significantly across the two groups, with Group B comprising a higher proportion of younger participants aged 30–49 years (68% vs. 46%), while Group A had a greater proportion in the 50–65 years category (50% vs. 18%) (p<0.001). Group A was significantly older than Group B (49.94 ± 9.00 vs. 41.74 ± 9.61 years; p<0.001), while gender distribution remained comparable between the two cohorts, with males predominating in both (p=0.275). Despite this age difference, Group B carried a notably higher burden of modifiable cardiovascular risk factors. The prevalence of both diabetes mellitus (78% vs. 58%; p=0.032) and dyslipidemia (64% vs. 40%; p=0.016) was significantly greater in Group B. Hypertension followed a similar trend, being more frequent in Group B (68% vs. 54%), though this difference did not attain statistical significance (p=0.151). Collectively, these findings highlight that Group B, while younger, presented with a more adverse cardiometabolic risk profile.

Table 1: Comparison of Baseline Characteristics between two groups of the Study Population

Variable	Category	Group A (n=50)	Group B (n=50)	*p* value
Age Group (years)	18–29	2 (4%)	7 (14%)	
	30–49	23 (46%)	34 (68%)	<0.001
	50–65	25 (50%)	9 (18%)	
Age (years)	Mean ± SD	49.94 ± 9.00	41.74 ± 9.61	<0.001
Gender	Male	44 (88%)	40 (80%)	0.275
	Female	6 (12%)	10 (20%)	
Risk Factors for CAD	Diabetes mellitus	29 (58%)	39 (78%)	0.032
	Hypertension	27 (54%)	34 (68%)	0.151
	Dyslipidemia	20 (40%)	32 (64%)	0.016

n=number of patients in each group

Table 2 presents the comparison of per-operative characteristics between the two groups, with neither of them showing a meaningful between-group variation. Surgical duration did not vary significantly across the study groups (5.09±0.55 vs. 5.14±0.59 hours; p=0.334), indicating that intraoperative workload was evenly distributed regardless of BMI category. Similarly, the distribution of the number of grafts did not vary significantly between the groups (p=0.128), although a higher proportion of patients in Group A underwent ≥3 grafts (74% vs. 62%), while single graft procedures were slightly more frequent in Group B (14% vs. 6%). Overall, the findings indicate that both groups were well balanced in terms of operative complexity and surgical exposure.

Table 2: Comparison of per-operative Characteristics between two groups

Per-operative Characteristics	Group A (n=50) Mean±SD	Group B (n=50) Mean±SD	*p* value
[a]Duration of surgery (hours)	5.09±0.55	5.14±0.59	0.334
[b]**Number of grafts**			
1	3 (6%)	7 (14%)	
2	10 (20%)	12 (24%)	0.128
≥3	37 (74%)	31 (62%)	

n=number of patients in each group

Table 3 indicates a higher incidence of adverse postoperative outcomes in Group B compared to Group A, with several differences reaching statistical significance. The occurrence of arrhythmias was significantly higher in Group B compared to Group A (46% vs. 24%; p=0.021). Likewise, sternal wound infection (20% vs. 6%, p=0.037) and vein harvest site infection (16% vs. 4%, p=0.046) occurred more recurrently in Group B. Respiratory tract infections also found to be significantly higher in Group B (24% vs. 8%, p=0.029).Although acute kidney injury (24% vs. 14%, p=0.203) and neurological complications (8% vs. 4%, p=0.400) were observed more often in Group B, these differences did not vary significantly. Notably, postoperative recovery was significantly more complicated in Group B (72% vs. 44%, p=0.004), suggesting a less favorable recovery trajectory. Mortality rates were low and comparable between the two groups (p=0.558), however.Overall, despite similar operative characteristics, Group B demonstrated a substantially higher burden of postoperative complications.

Table 3: Comparison of postoperative outcomes

Postoperative outcomes		Group A (n=50)	Group B (n=50)	p value
Arrhythmias		12 (24%)	23 (46%)	0.021
Acute kidney injury (AKI)		7 (14%)	12 (24%)	0.203
Sternal wound infection		3 (6%)	10 (20%)	0.037
Vein harvest site infection		2 (4%)	8 (16%)	0.046
Neurological complications		2 (4%)	4 (8%)	0.400
Respiratory tract infection		4 (8%)	12 (24%)	0.029
Post-operative recovery	Eventful	22 (44%)	36 (72%)	0.004
	Uneventful	28 (56%)	14 (28%)	
Mortality		1 (2%)	2 (4%)	0.558

n=number of patients in each group

CABG outcome comparism between over weight snd obese patient

Table 4 demonstrates significant differences in key postoperative recovery indicators between the two groups, with Group B consistently showing poorer outcomes. Postoperative bleeding was significantly higher in Group B compared to Group A (429.80 ± 176.93 ml vs. 327.45 ± 118.25 ml, $p< 0.001$). Similarly, the duration of mechanical ventilation was markedly longer in Group B (8.83 ± 2.86 hours vs. 6.19 ± 1.61 hours, $p< 0.001$), reflecting delayed respiratory recovery. In addition, both ICU stay and total hospital stay were significantly prolonged in Group B. The mean ICU stay was 7.47 ± 2.16 days versus 5.43 ± 1.83 days, while the overall hospital stay was 11.88 ± 2.55 days compared to 8.86 ± 1.64 days (all $p< 0.001$).Overall, these findings indicate a substantially higher postoperative burden and greater resource utilization in Group B compared to Group A.

Table 4: Comparison of postoperative recovery parameters between two group.

Variable	Group A (n=50) Mean ± SD	Group B (n=50) Mean ± SD	*p* value
Postoperative bleeding (ml)	327.45 ± 118.25	429.80 ± 176.93	<0.001
Mechanical ventilation time (hours)	6.19 ± 1.61	8.83 ± 2.86	<0.001
ICU stay (days)	5.43 ± 1.83	7.47 ± 2.16	<0.001
Hospital stay (days)	8.86 ± 1.64	11.88 ± 2.55	<0.001

DISCUSSION

Patients' mean age in Group A was 49.94 ± 9.00 years, and in Group B it was 41.74 ± 9.61 years, showing a statistically significant difference. A notable age disparity was observed between the two groups, with overweight patients generally being older. Most Group A patients were concentrated in the 50–65 year bracket, while Group B was predominantly composed of younger individuals aged 30–49 years, with 14% falling within the 18–29 year range. This suggests obesity may be associated with earlier CAD onset, consistent with previous studies[16,18].Male predominance was observed in both groups (88% in Group A, 80% in Group B), with a relatively higher proportion of females in the obese group. CAD prevalence remains higher in males, but obesity may increase risk in females[20,21].

Obese patients demonstrated a higher prevalence of comorbid conditions compared to their overweight counterparts, with significantly higher diabetes and dyslipidemia, while hypertension did not reach significance. This pattern is consistent with the established metabolic sequelae of obesity documented across the surgical literature[13].

Perioperative findings showed comparable surgery duration and number of grafts between groups.Postoperative outcomes revealed higher complication rates among obese patients. Arrhythmia, sternal wound infection, vein harvest site infection, and respiratory infection were more recurrent in Group B. Obese patients also experienced greater blood loss, prolonged ventilation, longer ICU stay, and extended hospital stay. Acute kidney injury and neurological complications were more recurrentbut not found significant. A higher rate of eventful recovery was found in obese patients, consistent with earlier studies by Sabzi et al. and Krasivskyi et al. reporting greater postoperative morbidity among obese patients[18,20]. Contrasting results exist, such as Song et al., who observed no significant differences[21].

Notable constraints include the single-institutional design, which may limit broader applicability of these findings, along with a modest sample that reduces statistical power for detecting differences in infrequent outcomes, and team variability across surgical procedures.

RECOMMENDATIONS

Findings suggest routine preoperative assessment should include BMI-based risk stratification to identify high-risk patients. Given the higher incidence of postoperative complications, prolonged mechanical ventilation, and increased ICU and hospital stay observed in obese patients, enhanced perioperative monitoring and targeted management strategies should be implemented for this group. Preoperative weight optimization through structured weight reduction programs may improve surgical outcomes. Furthermore, customized perioperative care pathways and dedicated postoperative rehabilitation programs should be developed for obese patients undergoing off-pump CABG. Future large-scale, multicenter studies with long-term follow-up are recommended to further validate these findings and assess long-term outcomes.

CONCLUSSION

Obese patients undergoing off-pump CABG experienced significantly higher postoperative morbidity, including increased complications, prolonged ventilation, and longer ICU and hospital stay. In contrast, overweight patients demonstrated comparatively better short-term postoperative outcomes. These findings highlight the adverse impact of obesity on perioperative recovery and resource utilization in OPCABG.

AUTHOR STATEMENTS

Ethical Approval

Ethical approval secured for this study by the Institutional Review Board of Bangladesh Medical University (BMU) (Memo No: BSMMU/2024/6028).

Funding

No specific funding was received for this study from public, commercial, or not-for-profit funding bodies.
Competing interests
None declared.

Acknowledgements

The authors would like to convey their sincere gratitude to the Department of Cardiac Surgery, BSMMU, for their support and cooperation during the study period. We are also thankful to all the patients who contributed in this study. Additionally, we acknowledge the contributions of the nursing staff, ICU personnel, and data collection team for their assistance in patient management and data acquisition. In addition, we are deeply grateful to the research consultancy firm 'Health Science Research Center (HSRC)' for their professional English language editing and manuscript formatting services, which helped enhance the quality of our manuscript.

CONFLICT OF INTEREST

There is no conflict of interest.

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