ORIGINAL INVESTIGATION

Access this article online
Quick Response Code:

Website:
www.jcritintensivecare.org
DOI:
10.14744/dcybd.2025.91478

Impact of Obesity on Postoperative Intensive Care Unit Outcomes After Elective Surgery: A Retrospective Study

Ozkul Yilmaz Colak,[1] Melda Isevi,[1] Caner Isevi,[2] Neslihan Unal Akdemir,[1] Fatma Ulger[1]

Abstract

Aim: Obesity is traditionally associated with increased perioperative risk and complex intensive care unit (ICU) management. However, its prognostic significance in surgical ICU patients remains controversial. This study aimed to evaluate the impact of obesity on postoperative ICU outcomes in patients undergoing elective surgery.

Study Design: This retrospective cohort study analyzed adult patients who were intubated and admitted to the ICU after elective surgery between January 1 and December 31, 2023. Patients were classified as non-obese (Body Mass Index [BMI] <30 kg/m²) or obese (BMI ≥30 kg/m²). Demographic, clinical, and perioperative characteristics were recorded. Primary outcomes included ICU mortality, duration of mechanical ventilation, and ICU length of stay. Hemodynamic parameters and fluid balance were also assessed.

Results: A total of 294 patients were included, 57.8% of whom were male. There were no significant differences between obese and non-obese patients in terms of ICU mortality (3.7% overall), mechanical ventilation duration, or ICU length of stay. Hemodynamic stability, including incidence of hypotension and use of vasoactive agents, was similar across groups. Notably, non-obese patients had a significantly higher rate of positive cumulative fluid balance (≥5%, p=0.003), despite comparable total fluid volumes.

Conclusions: Obesity, as defined by BMI, was not associated with increased ICU mortality, prolonged mechanical ventilation, or extended ICU stay following elective surgery. These findings suggest that BMI alone may not be a reliable predictor of adverse postoperative ICU outcomes, highlighting the importance of individualized risk assessment.

Keywords: Fluid therapy; Hemodynamics; Intensive care units; Mechanical ventilation; Obesity; Postoperative complications.

[1]Department of Anesthesiology, Division of Intensive Care, Ondokuz Mayis University, School of Medicine, Samsun, Türkiye
[2]Department of Thoracic Surgery, Ondokuz Mayis University, School of Medicine, Samsun, Türkiye

Address for correspondence:
Caner Isevi, MD.
Department of Thoracic Surgery, Ondokuz Mayis University, School of Medicine, Samsun, Türkiye.
E-mail:
drcanerisevi@gmail.com

Received: 01-08-2025
Accepted: 24-09-2025
Published: 02-10-2025

How to cite this article: *Colak OY, Isevi M, Isevi C, Unal Akdemir N, Ulger F. Impact of Obesity on Postoperative Intensive Care Unit Outcomes After Elective Surgery: A Retrospective Study. J Crit Intensive Care 2025;16(2):83—92.*

This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.

For reprints contact: kare@karepb.com

© 2025 Journal of Critical and Intensive Care by Kare Media

Introduction

Surgical interventions remain a cornerstone of modern medical practice, with millions of procedures performed annually. Among these, postoperative management in the intensive care unit (ICU) is critical, particularly after complex or high-risk surgeries. ICU admission is typically guided by surgical complexity and baseline health status. In this setting, intensive care supports both short- and long-term recovery by maintaining hemodynamic stability, ensuring effective pain control, and preventing complications such as respiratory failure, infections, and organ dysfunction.[1]

Obesity has become a major concern in postoperative ICU care due to its association with increased morbidity and complex clinical management. Obese patients often present airway challenges and a higher risk of respiratory complications, which may prolong mechanical ventilation (MV) and ICU stay. Several studies have also reported increased use of ventilatory support and renal replacement therapy in this group. However, the impact of obesity on mortality remains controversial, with some evidence suggesting a paradoxical protective effect—commonly termed the "obesity paradox."[2, 3]

Despite extensive research, the prognostic significance of obesity in surgical ICU patients remains unclear. While some studies report no association with ICU mortality, others describe improved survival in obese patients under specific conditions. These inconsistencies highlight the need for further investigation to guide individualized management strategies.[3–5]

Therefore, this study aimed to compare postoperative ICU outcomes between obese and non-obese patients undergoing elective surgery, focusing on mortality, MV duration, ICU length of stay, and hemodynamic parameters. By identifying obesity-related differences, we aim to contribute to a more personalized and evidence-based approach to managing this growing patient population.

Materials and Methods

This retrospective study was approved by the Ondokuz Mayıs University Clinical Research Ethics Committee (Approval Number: B.30.2.ODM.0.20.08/281, Date: 17.04.2025). Due to the retrospective design, the requirement for informed consent was waived. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Description and Operation of the Intensive Care Unit

Our tertiary university hospital provides comprehensive healthcare services to a large population in the Black Sea region. The ICU is officially accredited by the Ministry of Health of the Republic of Türkiye as a Level III ICU with a total capacity of 20 beds. The majority of our nursing staff are certified in intensive care nursing. According to standard practice, each nurse is responsible for two intubated patients, or one intubated and two extubated patients.

The ICU also serves as a training center for subspecialty education in intensive care medicine and for rotation programs from various core specialties. Two full-time consultant physicians provide intensive care services, collaborating with five intensive care medicine fellows and four anesthesiology and reanimation residents. Although the unit admits patients with a wide range of critical care needs, most of the patient population consists of surgical cases.

As part of the ICU workflow, patients anticipated to require postoperative intensive care, based on preoperative assessments conducted by the Anesthesiology and Reanimation team, are identified in advance. Information such as age, comorbidities, planned surgical intervention, and the reason for anticipated ICU need is communicated by the surgical team to the ICU the day before surgery and documented.

In this study, all ICU admissions were prospectively planned preoperatively by the anesthesiology and surgical teams. Patients were evaluated prior to surgery and identified as candidates for ICU care based on comorbidities, anticipated surgical complexity, and perioperative risk. No patients were admitted due to intraoperative or post-anesthesia complications.

The decision to admit patients to the ICU postoperatively was based on predefined institutional criteria applied consistently across all patients, regardless of Body Mass Index (BMI). These criteria included the presence of significant comorbidities (e.g., cardiovascular disease, diabetes, chronic respiratory disease), advanced age (typically >70 years), high perioperative risk (American Society of Anesthesiologists [ASA] Physical Status score >2), anticipated prolonged surgical duration (>3 hours), and the need for postoperative mechanical ventilation. All patients were evaluated preoperatively by the anesthesiology and surgical teams using the same protocol to ensure uniformity in triage decisions across both obese and non-obese groups.

During the study period, approximately 15% of elective surgical patients were preoperatively scheduled for ICU admission based on standardized criteria, including advanced age, significant comorbidities, high ASA score, or anticipated need for postoperative mechanical ventilation. The remaining patients were transferred directly to surgical wards. These rates reflect institutional practice and may differ across healthcare systems.

Potential discharges and ward transfers are planned following daily multidisciplinary rounds, and bed availability is assessed accordingly. These beds are then allocated based on clinical priorities among the pre-notified patients. If the need for intensive care is no longer present (e.g., due to surgery cancellation or absence of complications), the reserved bed is reassigned to another patient.

Data Collection

This retrospective study obtained data from the hospital's electronic medical record system. Inclusion criteria were as follows: patients over 18 years of age who were admitted to the intensive care unit and intubated following elective surgery between January 1, 2023 and December 31, 2023, with complete data available for analysis. Exclusion criteria included patients not meeting these conditions, pregnant patients, and those who underwent unplanned but elective surgical procedures following trauma.

A total of 1,327 patient records within the specified date range were reviewed. Among these, 43 records were excluded because they represented repeated admissions. Of the remaining 1,284 patients, 974 were followed in the intensive care unit during the postoperative period. Among them, 730 had undergone elective surgery. However, 45 patients were excluded due to unplanned elective surgery following trauma, and 147 were excluded because they were admitted to the ICU after having already been extubated. Accordingly, 192 patients were excluded from the study, and data from the remaining 538 patients were screened using the electronic medical record system.

The variables collected included age, sex, height, weight, comorbidities, APACHE II (Acute Physiology and Chronic Health Evaluation II) and SOFA (Sepsis-related Organ Failure Assessment) scores, anatomical site of surgery, duration of surgery, arterial blood tests at ICU admission, presence of hypotension, need for positive inotropic support, 24-hour perioperative fluid balance, duration of MV, length of ICU stay, and mortality status. After excluding patients with missing data in any of these variables, 294 patients with complete records were included in the final analysis (Fig. 1).

Body weight and height were obtained from standardized preoperative assessments performed by the anesthesia team and recorded in the electronic medical record system. These measured values were used for BMI calculations. BMI was calculated as body weight (kg) divided by height squared (m²). Patients were classified as non-obese (BMI <30 kg/m²) or obese (BMI ≥30 kg/m²) according to World Health Organization criteria.[6]

The ASA score was used to assess surgical risk and was categorized into two groups: ASA 1–2 was defined as low risk, while ASA >2 was considered moderate to high risk. This classification was based on commonly used clinical groupings in the literature.[7] The burden of comorbid conditions was evaluated using the Charlson Comorbidity Index (CCI).[8]

Patients were categorized into five groups based on the anatomical region of surgery: neurological (brain and neurosurgical procedures), head and neck (non-neuro-

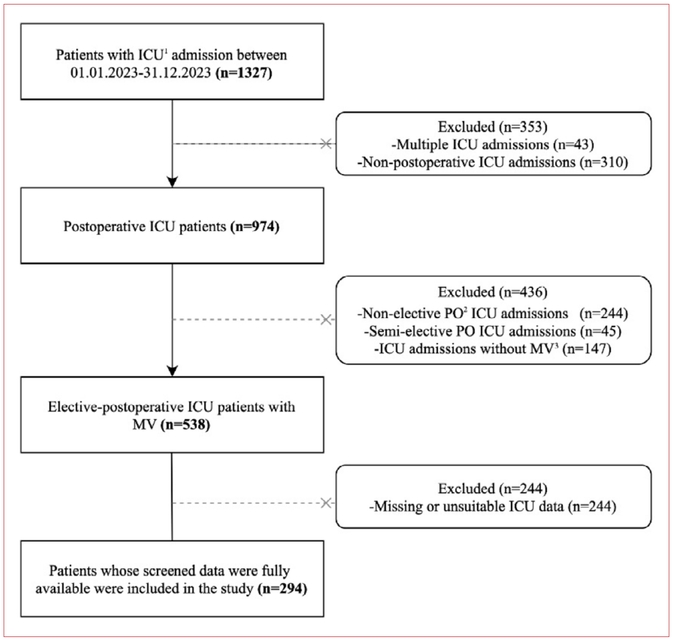

Figure 1. Flowchart of the patient selection process for inclusion in the study.
ICU: Intensive care unit; PO: Postoperative; MV: Mechanical ventilation.

logical surgeries of the head and neck), extremity (musculoskeletal system), thoracic (lungs and mediastinal organs), and abdominopelvic (abdominal and pelvic organs). This classification was based on the anatomical target of the operation and the potential risk of complications.

Surgical duration was defined as the time from the patient's placement on the operating table to transfer onto the stretcher. This variable was categorized into two groups to reflect surgical complexity: procedures lasting ≤240 minutes were considered short- to moderate-duration, while those lasting >240 minutes were classified as long-duration surgeries.

The severity of physiological illness was assessed using the APACHE II and SOFA scores, based on the worst values recorded during the first 24 hours of ICU admission.[9, 10] For patients whose ICU stay was shorter than 24 hours, the worst values recorded during their entire ICU stay were used. Patients with a mean arterial pressure <60 mmHg were classified as hypotensive. The need for vasoactive support was defined as the continuous infusion of any vasoactive or inotropic agent (adrenaline, noradrenaline, dobutamine, or dopamine) to maintain adequate blood pressure. Patients receiving noradrenaline at a dose ≥0.3 mcg/kg/min or requiring more than one vasoactive agent were categorized as requiring high-dose vasoactive support.

The perioperative 24-hour fluid balance was calculated as the difference between the total fluid administered and the total fluid lost (including urine output, drainage, bleeding, and excised tissue) from the morning of surgery to the morning of the first postoperative day. This value was normalized to the patient's body weight, and the cumulative fluid balance was expressed as a percentage. Patients with a cumulative fluid balance ≥5% were classified as having a positive fluid balance, while those below this threshold were considered to have a normal or negative balance.[11]

The study was approved by the hospital administration and received ethical approval from the Ethics Committee of our university before data collection.

Fluid Management Protocols

Perioperative and early postoperative fluid therapy was standardized according to institutional protocols. In line with international recommendations, crystalloids—preferably balanced solutions such as Ringer's lactate—were used as first-line fluids, while colloids were reserved for selected indications. Infusion rates were adjusted according to body weight, generally corresponding to 25–30 mL/kg/day (≈1–1.5 mL/kg/h) for maintenance, as recommended in international guidelines, and supplemented according to intraoperative losses.[12] Resuscitation was goal-directed, aiming for a mean arterial pressure ≥65 mmHg and urine output ≥0.5 mL/kg/h. When either of these targets could not be achieved, additional crystalloid boluses (250–500 mL) were administered, and vasopressors were titrated as required.

Albumin was not used routinely but was restricted to specific clinical scenarios: patients with suspected capillary leak syndrome and cases in which adequate crystalloid resuscitation failed to restore hemodynamic stability.[12]

In selected patients, fluid responsiveness was evaluated using dynamic tests such as respiratory variation of the inferior vena cava, passive leg raising, end-expiratory occlusion, or a fluid challenge. These approaches are supported by evidence as more reliable than static preload markers and allow clinicians to titrate fluids while limiting the risk of fluid overload.[13]

These protocols were consistently applied across both obese and non-obese patients. For all weight-based calculations, actual body weight was used, in line with our institutional practice.

Statistical Analysis

All statistical analyses were conducted using IBM SPSS Statistics version 25.0 (IBM Corp., Armonk, NY, USA). The normality of distribution for continuous variables was assessed using the Shapiro–Wilk test. As none of the continuous variables followed a normal distribution ($p<0.05$), they were summarized using median and interquartile range (IQR), and group comparisons were performed using the Mann–Whitney U test. Categorical variables were expressed as frequencies and percentages, and group comparisons were made using the Pearson chi-square test or Fisher's exact test, as appropriate.

To evaluate the independent predictors of intensive care outcomes, multivariable regression analyses were conducted. A multivariable linear regression model was used to identify factors associated with ICU length of stay, and a logistic regression model was applied to determine independent predictors of ICU mortality. The following covariates were included in both models:

obesity status (BMI ≥30 kg/m²), sex, age, ASA score, APACHE II score, surgical duration, positive fluid ratio, serum lactate level, and mechanical ventilation duration.

All statistical tests were two-tailed, and a p-value of less than 0.05 was considered statistically significant.

Artificial intelligence (AI)-assisted technologies, including large language models (LLMs), were used in the preparation and language editing of the submitted manuscript. However, all clinical data analyses, interpretations, and final content were thoroughly reviewed and approved by the authors.

Results

A total of 294 patients undergoing elective surgery and postoperative ICU admission were included in the study. Of these, 57.8% were male (n=170), and the median age was 64.5 years (IQR: 17). The median BMI was 27.0 kg/m² (IQR: 6.4), and the median surgical duration was 245 minutes (IQR: 120).

In terms of clinical scores, the median ASA score was 3 (IQR: 1), the APACHE II score was 12 (IQR: 6), the SOFA score was 1 (IQR: 0), and the CCI was 5 (IQR: 3). The thoracic region was the most common surgical site (36.4%), followed by neurosurgery (26.2%), head and neck surgery (22.1%), abdominopelvic surgery (8.5%), and extremity procedures (6.8%).

Regarding perioperative fluid status, the median fluid balance was 2890 mL (IQR: 2200), and the total fluid ratio was 4% (IQR: 4). During the ICU stay, the median MV duration was 400 minutes (IQR: 270), the median ICU length of stay was one day (IQR: 0), and the overall ICU mortality rate was 3.7% (n=11). Baseline characteristics of the study population are summarized in Table 1.

Table 1. General patient characteristics

Variable	Value (Median [IQR] or n [%])
General Patient Characteristics (n=294)	
Sex	
Female	124 (42.2)
Male	170 (57.8)
Age, years	64.5 (17)
Body Mass Index, kg/m²	27 (6.39)
Surgical Duration, min	245 (120)
Clinical Scores	
ASA Score	3 (1)
APACHE II Score	12 (6)
SOFA Score	1 (0)
Charlson Comorbidity Index	5 (3)
Surgical Site	
Neurosurgery	77 (26.2)
Head and Neck	65 (22.1)
Thoracic	107 (36.4)
Abdominopelvic	25 (8.5)
Extremities	20 (6.8)
Fluids	
Fluid Balance, mL	2890 (2200)
Fluid Ratio, %	4 (4)
ICU Outcomes	
MV Duration, min	400 (270)
ICU Length of Stay, days	1 (0)
ICU Mortality, n (%)	11 (3.7)

Continuous variables are presented as median (IQR); categorical variables as n (%). APACHE II: Acute Physiology and Chronic Health Evaluation II; ASA: American Society of Anesthesiologists; BMI: Body Mass Index; ICU: Intensive Care Unit; IQR: Interquartile range; MV: Mechanical ventilation; SOFA: Sequential Organ Failure Assessment.

Stratification by obesity status revealed several differences between groups (Table 2). As expected, the median BMI was significantly higher in the obese group [33 (IQR: 5) vs. 25.3 (IQR: 4.1), p<0.001]. Although the non-obese group had a slightly longer surgical duration and higher APACHE II score, these differences were not statistically significant (p=0.114 and p=0.828, respectively).

There were no statistically significant differences in most laboratory parameters between the two groups, including white blood cell count, hemoglobin, sodium, potassium, calcium, liver enzymes, and acid–base markers. Notably, the PaO_2/FiO_2 ratio was significantly lower in obese patients [360 (IQR: 90) vs. 400 (IQR: 110), p=0.013], suggesting reduced oxygenation. While total fluid balance did not differ significantly between groups (p=0.274), the fluid ratio was significantly lower in the obese group [3% (IQR: 2) vs. 4% (IQR: 3), p<0.001]. No significant differences were observed between the two groups in MV duration or ICU length of stay.

In the analysis of categorical variables (Table 3), no significant differences were found between obese and non-obese patients regarding ASA-based perioperative risk classification. The distribution of patients categorized as low risk (ASA 1–2) versus moderate-to-high risk (ASA >2) was similar across groups (p=0.191). Likewise, when

Table 2. Comparison of continuous variables between obese and non-obese patients

Variable	Value (Median [IQR])		p
	Obese (n=85) (BMI ≥30 kg/m²)	Non-obese (n=209) (BMI <30 kg/m²)	
General Patient Characteristics			
Age, years	61 (15)	65 (18)	0.071
Body Mass Index, kg/m²	33 (5)	25.3 (4.1)	<0.001
Surgical Duration, min	240 (100)	250 (150)	0.114
Clinical Scores			
ASA Score	3 (1)	3 (1)	0.240
APACHE II Score	12 (6)	13 (7)	0.828
SOFA Score	1 (2)	1 (1)	0.510
Charlson Comorbidity Index	5 (3)	5 (3)	0.654
Laboratory			
White blood cell, $\times 10^3/\mu L$	12 (4.9)	11.6 (6.29)	0.413
Hemoglobin, g/dL	11 (2.7)	11 (3.1)	0.853
Sodium, mmol/L	138 (5)	138 (5)	0.899
Potassium, mmol/L	4.3 (0.639)	4.4 (0.73)	0.514
Ionized calcium, mg/dL	4.2 (0.4)	4.2 (0.4)	0.550
Alanine aminotransferase, U/L	19 (34)	15 (21)	0.38
pH	7.34 (0.1)	7.35 (0.1)	0.792
$PaCO_2$, mmHg	41 (12)	42 (9)	0.916
HCO_3-, mmol/L	22 (4)	22 (4)	0.20
Base excess, mmol/L	-2.6 (4.6)	-2.5 (3.7)	0.617
Lactate, mmol/L	1.78 (1.3)	1.65 (1.2)	0.568
PaO_2/FiO_2 ratio	360 (90)	400 (110)	0.013
Fluids			
Fluid balance, mL	2610 (2200)	2990 (2340)	0.274
Fluid ratio, %	3 (2)	4 (3)	<0.001
ICU Outcomes			
MV duration, min	390 (240)	420 (290)	0.270
ICU length of stay, days	1 (1)	1 (1)	0.825

Continuous variables are presented as median (IQR). Statistical comparisons were performed using the Mann–Whitney U test for continuous variables. ALT: Alanine aminotransferase; APACHE II: Acute Physiology and Chronic Health Evaluation II; ASA: American Society of Anesthesiologists; BMI: Body Mass Index; FiO_2: Fraction of inspired oxygen; HCO_3-: Bicarbonate; ICU, Intensive Care Unit; IQR: Interquartile range; MV: Mechanical ventilation; $PaCO_2$: Partial pressure of arterial carbon dioxide; SOFA: Sequential Organ Failure Assessment.

surgical procedures were stratified by complexity—short-to-moderate duration (≤240 minutes) versus long duration (>240 minutes)—no significant difference was observed (p=0.625).

Hemodynamic parameters, including hypotension at ICU admission and during ICU stay, were not significantly different between the groups (p=0.368 and p=0.276, respectively). The need for vasoactive support was also comparable between obese and non-obese patients during ICU admission (p=0.603) and throughout the ICU stay (p=0.316). Additionally, the proportion of patients requiring high-dose vasoactive support was similar between groups at ICU entry (p=0.739) and during ICU follow-up (p=0.404).

Regarding fluid status, a significantly greater proportion of non-obese patients exhibited a positive cumulative fluid balance (≥5%) compared to obese patients (p=0.003). Other ICU outcomes—including prolonged Post-Anesthesia Care Unit (PACU) stay (p=0.445), ICU stay longer than one day (p=0.692), and ICU mortality

Table 3. Comparison of categorical variables between obese and non-obese patients

Variable	Value (n [%])		p
	Obese (n=85) (BMI ≥30 kg/m²)	Non-obese (n=209) (BMI <30 kg/m²)	
Clinical Scores			
ASA Score ≤2	31 (24.4%)	96 (75.6%)	0.175
ASA Score >2	54 (32.3%)	113 (67.7%)	
Surgical Duration			
Short to Moderate (≤240 min)	46 (31.3%)	101 (68.7%)	0.386
Long (>240 min)	39 (26.5%)	108 (73.5%)	
Hemodynamics			
Hypotension			
ICU Admission	16 (34.8%)	30 (65.2%)	0.339
ICU Course	9 (37.5%)	15 (62.5%)	0.333
Vasoactive Drug Requirement			
ICU Admission	16 (34%)	30 (65.2%)	0.339
ICU Course	9 (37.5%)	15 (62.5%)	0.333
High-Dose Vasoactive Drug Requirement			
ICU Admission	1 (25%)	3 (75%)	0.862
ICU Course	2 (100%)	0 (0%)	0.083
Fluid Ratio			
Positive (≥5%)	20 (18.2%)	90 (81.8%)	0.002
Normal or Negative (<5%)	65 (35.3%)	119 (64.7%)	
ICU Outcomes			
Prolonged ICU Stay (>1 Day)	18 (27.3%)	48 (72.7%)	0.739
ICU Mortality	5 (45.5%)	6 (54.5%)	0.217

Categorical variables are presented as number (%). Statistical comparisons were performed using the chi-square test or Fisher's exact test, as appropriate. ASA: American Society of Anesthesiologists; BMI: Body Mass Index; ICU: Intensive Care Unit; IQR: Interquartile range; MV: Mechanical ventilation.

(p=0.414)—were not significantly associated with obesity status.

To further investigate the independent predictors of ICU-related outcomes, multivariable regression analyses were conducted. In the linear regression model assessing predictors of ICU length of stay, the ASA score was found to be independently associated with longer ICU stay (β=0.69, p<0.001), while other covariates, including obesity, sex, age, APACHE II score, surgical duration, fluid ratio, lactate, and MV duration, were not statistically significant (Table 4). Although the association between MV duration and ICU length of stay did not reach statistical significance, a trend toward significance was observed (β=0.0003, p=0.060). In the logistic regression model evaluating predictors of ICU mortality, the ASA score again emerged as a significant independent risk factor (odds ratio [OR]=6.68, 95% confidence interval [CI]: 1.44–30.90, p=0.015). Other covariates—including obesity (OR=2.06, p=0.364), age, APACHE II score, lactate, MV duration, and fluid balance—did not show statistically significant associations with mortality (Table 5).

Obesity was not associated with postoperative outcomes such as mortality, MV duration, ICU stay, or hemodynamic instability.

Discussion

This retrospective study evaluated the impact of obesity on postoperative ICU outcomes in elective surgical patients. Comparing obese and non-obese patients, we found no significant differences in ICU mortality, MV duration, or ICU length of stay. Hemodynamic stability—including the need for vasoactive support and the occurrence of hypotension—was also comparable. Interestingly, a greater proportion of non-obese patients exhibited a positive cumulative fluid balance, suggesting

Table 4. Multivariable linear regression analysis for predictors of intensive care unit (ICU) length of stay

Variable	β Coefficient	Std. Error	p	95% CI (Lower–Upper)
Obesity	0.08	0.24	0.735	–0.39 to 0.55
Female sex	0.04	0.21	0.850	–0.37 to 0.45
Age	0.01	0.01	0.543	–0.01 to 0.03
ASA Score	0.69	0.16	<0.001	0.38 to 1.00
APACHE II Score	0.02	0.02	0.402	–0.03 to 0.06
Surgical Duration	0.0003	0.0006	0.619	–0.0009 to 0.0014
Positive Fluid Ratio	0.01	0.05	0.777	–0.08 to 0.10
Lactate	0.05	0.03	0.074	–0.01 to 0.12
MV Duration	0.0003	0.0002	0.060	–0.00001 to 0.0006

A multivariable linear regression model was constructed to identify independent predictors of intensive care unit (ICU) length of stay among postoperative surgical patients. Continuous variables are presented as β coefficients with corresponding standard errors and 95% confidence intervals. ASA: American Society of Anesthesiologists; APACHE II: Acute Physiology and Chronic Health Evaluation II; ICU: Intensive Care Unit; MV: Mechanical ventilation.

Table 5. Multivariable logistic regression analysis for predictors of intensive care unit (ICU) mortality

Variable	Odds Ratio	95% CI (Lower–Upper)	p
Obesity	2.06	0.43–9.79	0.364
Female sex	1.72	0.38–7.23	0.486
Age	0.97	0.91–1.04	0.430
ASA Score	6.68	1.44–30.90	0.015
APACHE II Score	1.06	0.98–1.14	0.156
Surgical Duration	1.00	0.99–1.01	0.651
Positive Fluid Ratio	1.02	0.75–1.39	0.770
Lactate	1.31	0.97–1.77	0.077
MV Duration	1.00	1.00–1.00	0.060

A multivariable logistic regression model was used to evaluate independent predictors of intensive care unit (ICU) mortality. Results are presented as odds ratios (OR) with corresponding 95% confidence intervals. ASA: American Society of Anesthesiologists; APACHE II: Acute Physiology and Chronic Health Evaluation II; ICU: Intensive Care Unit; MV: Mechanical ventilation.

possible differences in fluid responsiveness or management strategies.

Previous studies on obesity and ICU outcomes have yielded inconsistent results. While obesity is traditionally linked to increased perioperative risk, many large cohorts have not shown a significant association between elevated BMI and ICU mortality.[3, 14] The "obesity paradox," proposing a survival benefit in obese patients, has also been reported in critical care.[15, 16]

We found no evidence that obesity prolongs MV duration, consistent with data from elective surgery populations.[17] The low frequency of abdominal surgery—typically riskier in obese patients—may have contributed to the lack of respiratory complications. Additionally, the limitations of BMI in capturing fat distribution or sarcopenia may weaken its prognostic utility.[18]

Despite known renal changes in obesity, our data showed no differences in hypotension or vasopressor need.[19, 20] Notably, fluid overload (≥5%) was more common in non-obese patients, possibly reflecting more conservative fluid strategies in obese individuals.[21-23]

A large database analysis reported no mortality difference between obese and non-obese septic patients receiving early aggressive fluid therapy.[24] Adjusted body weight-based fluid dosing was associated with improved survival, reinforcing the need for individualized fluid protocols.

Our results also suggest that fluid balance may be better preserved in obese patients, possibly due to modified distribution volumes, renal adaptations, or greater clinical caution. While adipose tissue is pro-inflammatory, it may also exhibit immunomodulatory properties that provide protection during acute illness.[25, 26] Higher circulating volume in obese individuals may act as a reserve against hypovolemia, possibly reducing vasopressor requirements.[16]

Consistent with prior data, obesity was not an independent risk factor for ICU mortality or length of stay after adjusting for key confounders (age, sex, ASA, APACHE II, surgical duration, fluid balance, lactate, MV duration).

[27, 28] Some studies even describe an "L-shaped" BMI-mortality curve, with lower mortality around BMI 30–32.[28] However, extreme obesity (BMI ≥40) remains associated with worse outcomes in some cohorts.[27, 29]

This study has several strengths, including a well-defined cohort of elective surgical patients, the use of standardized ICU admission criteria, and comprehensive data collection. Nonetheless, important limitations should be acknowledged. First, the single-center and retrospective design restricts generalizability. Second, although body weight and height were obtained from standardized preoperative measurements rather than estimations, residual misclassification cannot be completely excluded. Third, we did not include measures of body composition or frailty, which may provide a more accurate assessment of obesity-related risk than BMI alone. Fourth, the relatively small number of obese patients and the low overall ICU mortality rate reduced statistical power, thereby increasing the risk of type II error. As such, the absence of significant associations should be interpreted with caution, and larger multicenter studies are needed to confirm our findings. Finally, the short ICU length of stay in our cohort may have limited the ability to detect subtle differences in postoperative outcomes.

Our findings suggest that BMI alone may not be a reliable marker of adverse ICU outcomes. Instead, risk-based and individualized management approaches should be prioritized over generalized assumptions based on body habitus.

Conclusion

Obesity was not associated with increased ICU mortality, mechanical ventilation duration, or ICU stay in elective surgical patients. These results challenge conventional assumptions and support individualized, risk-based perioperative management. Further prospective studies using advanced adiposity metrics are warranted to refine critical care strategies for this growing patient population.

Ethics Committee Approval: Ethics committee approval was obtained from Ondokuz Mayıs University Clinical Research Ethics Committee (Approval Number: B.30.2.ODM.0.20.08/281, Date: 17.04.2025).

Informed Consent: Due to the retrospective design, the requirement for informed consent was waived.

Conflict of Interest: The authors have no conflicts of interest to declare.

Funding: The authors declared that this study received no financial support.

Use of AI for Writing Assistance: Artificial intelligence (AI)-assisted technologies, including large language models (LLMs), were used in the preparation and language editing of the submitted manuscript. However, all clinical data analyses, interpretations, and final content were thoroughly reviewed and approved by the authors.

Author Contributions: Concept – O.Y.C.; Design – O.Y.C., N.U.A.; Supervision – C.I., F.U.; Resource – F.U.; Materials – M.I., N.U.A.; Data Collection and/or Processing - O.Y.C., M.I.; Analysis and/or Interpretation - O.Y.C., C.I.; Literature Review – N.U.A.; Writing – O.Y.C., F.U.; Critical Review – C.I., N.U.A.

Peer-review: Externally peer-reviewed.

References

1. Rohrig SAH, Lance MD, Faisal Malmstrom M. Surgical intensive care - current and future challenges? Qatar Med J 2020;2019(2):3. [CrossRef]
2. Jalilvand A, Ireland M, Collins C, Kellett W, Strassel S, Tamer R, et al. Obesity is associated with improved early survival but increased late mortality in surgical patients with Sepsis: A propensity matched analysis. J Trauma Acute Care Surg 2024;97(2):233-41. [CrossRef]
3. Akinnusi ME, Pineda LA, El Solh AA. Effect of obesity on intensive care morbidity and mortality: a meta-analysis. Crit Care Med 2008;36(1):151-8. [CrossRef]
4. Chavda MP, Pakavakis A, Ernest D. Does Obesity Influence the Outcome of the Patients Following a Cardiac Arrest? Indian J Crit Care Med 2020;24(11):1077-80. [CrossRef]
5. De Jong A, Wrigge H, Hedenstierna G, Gattinoni L, Chiumello D, Frat JP, et al. How to ventilate obese patients in the ICU. Intensive Care Med 2020;46(12):2423-35. [CrossRef]
6. Gadzik J. "How much should I weigh?"—Quetelet's equation, upper weight limits, and BMI prime. Conn Med 2006;70(2):81–8.
7. Sankar A, Johnson SR, Beattie WS, Tait G, Wijeysundera DN. Reliability of the American Society of Anesthesiologists physical status scale in clinical practice. Br J Anaesth 2014;113(3):424-32. [CrossRef]
8. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. J Chronic Dis 1987;40(5):373-83. [CrossRef]
9. Knaus WA, Draper EA, Wagner DP, Zimmerman JE. APACHE II: a severity of disease classification system. Crit Care Med 1985;13(10):818-29. [CrossRef]
10. Vincent JL, Moreno R, Takala J, Willatts S, De Mendonça A, Bruining H, et al. The SOFA (Sepsis-related Organ Failure Assessment) score to describe organ dysfunction/failure. On behalf of the Working Group on Sepsis-Related Problems of the European Society of Intensive Care Medicine. Intensive Care Med 1996;22(7):707-10. [CrossRef]
11. O'Connor ME, Prowle JR. Fluid Overload. Crit Care Clin 2015;31(4):803-21. [CrossRef]
12. Malbrain MLNG, Langer T, Annane D, Gattinoni L, Elbers P, Hahn RG, et al. Intravenous fluid therapy in the perioperative and critical care setting: Executive summary of the International Fluid Academy (IFA). Ann Intensive Care 2020;10(1):64. [CrossRef]

13. Monnet X, Marik PE, Teboul JL. Prediction of fluid responsiveness: an update. Ann Intensive Care 2016;6(1):111. [CrossRef]
14. Martino JL, Stapleton RD, Wang M, Day AG, Cahill NE, Dixon AE, et al. Extreme obesity and outcomes in critically ill patients. Chest 2011;140(5):1198-206. [CrossRef]
15. Lin GM. The "obesity-mortality paradox" in severely traumatic patients in intensive care unit. Injury 2014;45(11):1799. [CrossRef]
16. Schetz M, De Jong A, Deane AM, Druml W, Hemelaar P, Pelosi P, et al. Obesity in the critically ill: a narrative review. Intensive Care Med 2019;45(6):757-69. [CrossRef]
17. Dindo D, Muller MK, Weber M, Clavien PA. Obesity in general elective surgery. Lancet 2003;361(9374):2032-5. [CrossRef]
18. Gažarová M, Galšneiderová M, Mečiarová L. Obesity diagnosis and mortality risk based on a body shape index (ABSI) and other indices and anthropometric parameters in university students. Rocz Panstw Zakl Hig 2019;70(3):267-75. [CrossRef]
19. Moriconi D, Mengozzi A, Duranti E, Cappelli F, Taddei S, Nannipieri M, et al. The renal resistive index is associated with microvascular remodeling in patients with severe obesity. J Hypertens 2023;41(7):1092-9. [CrossRef]
20. Hall JE, Brands MW, Dixon WN, Smith MJ Jr. Obesity-induced hypertension. Renal function and systemic hemodynamics. Hypertension 1993;22(3):292-9. [CrossRef]
21. Benes J. Cumulative Fluid Balance: The Dark Side of the Fluid. Crit Care Med 2016;44(10):1945-6. [CrossRef]
22. de Louw EJ, Sun PO, Lee J, Feng M, Mark RG, Celi LA, et al. Increased incidence of diuretic use in critically ill obese patients. J Crit Care 2015;30(3):619-23. [CrossRef]
23. Zhang Y, Wang M, Lu Z, Yang M. Effect of Fluid Resuscitation Strategies for Obese Patients with Sepsis and Septic Shock: A Systematic Review. Intensive Care Res 2023;3(1):61-8. [CrossRef]
24. Taylor SP, Karvetski CH, Templin MA, Heffner AC, Taylor BT. Initial fluid resuscitation following adjusted body weight dosing is associated with improved mortality in obese patients with suspected septic shock. J Crit Care 2018;43:7-12. [CrossRef]
25. Larabee CM, Neely OC, Domingos AI. Obesity: a neuroimmunometabolic perspective. Nat Rev Endocrinol 2020;16(1):30-43. [CrossRef]
26. Anderson MR, Shashaty MGS. Impact of Obesity in Critical Illness. Chest 2021;160(6):2135-45. [CrossRef]
27. Rodríguez A, Martín-Loeches I, Moreno G, Díaz E, Ferré C, Salgado M, et al.; on behalf COVID-19/SEMCYUC Working group. Association of obesity on the outcome of critically ill patients affected by COVID-19. Med Intensiva (Engl Ed) 2024;48(3):142-54. [CrossRef]
28. Yu W, Jiang W, Yuan J, Fan T, Xiao H, Sun L, et al. Association between BMI and outcomes in critically ill patients: an analysis of the MIMIC-III database. Sci Rep 2024;14(1):31127. [CrossRef]
29. Li S, Fu Z, Zhang W, Liu H. Impact of obesity on intensive care unit outcomes in older patients with critical illness: A cohort study. PLoS One 2024;19(2):e0297635. [CrossRef]