

Effects of Preoperative Anemia On Advanced Healthcare Utilization Following Cardiac Surgery

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INTRODUCTION

- Preoperative anemia affects **20–50% of cardiac surgery** patients and is **exacerbated** by inflammation and hemodilution associated with cardiopulmonary bypass [1].
- Preoperative anemia** increases risks of organ dysfunction, kidney injury, infections, and higher transfusion rates [2].
- Identifying **severity thresholds** could improve perioperative risk stratification and guide optimization strategies in **early detection and management of anemia**.

RESEARCH QUESTION

Is **preoperative anemia** and its **severity** associated with **postoperative healthcare utilization** (HCU) in patients undergoing cardiac surgery?

METHODS

EXPOSURE

- Anemia 3 days** prior to the procedure, defined by the last hemoglobin value within this range
- Anemia severity** (Figure 1), per WHO criteria [3]
 - Mild anemia: <12 g/dL (women), <13 g/dL (men)
 - Moderate/severe anemia: <11 g/dL

OUTCOMES

- Primary:** Composite of unplanned ICU admission, hospital readmission within 30 days, non-home discharge, or in-hospital mortality
- Secondary:**
 - Postoperative hospital length of stay
 - Acute kidney injury
 - Perioperative neurocognitive impairment (composite of new onset delirium, mild cognitive impairment, or stroke) [4]

STATISTICAL ANALYSIS

- Multivariable **logistic and negative binomial regression** analysis **adjusted** for demographics, comorbidities and operative characteristics (**Table 1**)

TABLE 1 – PATIENT CHARACTERISTICS

	No anemia 3 days prior to surgery N=2,904	Anemia 3 days prior to surgery N=2,320	Abs Std Diff
DEMOGRAPHICS			
Age, years	66 (59 - 73)	70 (62 - 77)	0.265
Sex, female	680 (23.4%)	774 (33.4%)	0.222
Body mass index, kg/m²	28.7 (25.5 - 32.3)	27.8 (24.6 - 31.7)	0.113
Ethnicity			0.164
Asian	73 (2.5%)	58 (2.5%)	
Black	108 (3.7%)	162 (7.0%)	
Hispanic	101 (3.5%)	92 (4.0%)	
Other	538 (18.5%)	358 (15.4%)	
Two or more	11 (0.4%)	12 (0.5%)	
White	2,073 (71.4%)	1,638 (70.6%)	
SOCIOECONOMIC FACTORS			
Estimated household income (USD)	107,067 (86,721 – 128,320)	103,714 (82,847 – 124,325)	0.097
Federal insurance	1,425 (49.1%)	1,416 (61.0%)	0.242
PREOPERATIVE CHARACTERISTICS			
ASA physical status classification			0.252
I	2 (0.1%)	0 (0.0%)	
II	15 (0.5%)	8 (0.3%)	
III	773 (26.6%)	381 (16.4%)	
IV	2,114 (72.8%)	1,931 (83.2%)	
Elixhauser score	7 (2 - 14)	13 (6 - 21)	0.565
History of (1 year prior)			
Coronary artery disease	2,262 (77.9%)	1,851 (79.8%)	0.046
Cardiac arrest	1,568 (54.0%)	1,448 (62.4%)	0.171
Chronic kidney disease	277 (9.5%)	719 (31.0%)	0.554
Peripheral vascular disease	515 (17.7%)	498 (21.5%)	0.094
Stroke	70 (2.4%)	145 (6.2%)	0.189
Hypertension	1,898 (65.4%)	1,336 (57.6%)	0.160
Diabetes	876 (30.2%)	1,042 (44.9%)	0.308
Frailty	399 (13.7%)	673 (29.0%)	0.379
Causes of anemia			
Nutritional deficiencies	178 (6.1%)	320 (13.8%)	0.258
Infections and chronic diseases	223 (7.7%)	321 (13.8%)	0.200
Bone marrow disorders	18 (0.6%)	44 (1.9%)	0.115
Hemolytic anemias	6 (0.2%)	18 (0.8%)	0.081
Gastrointestinal bleeding	15 (0.5%)	67 (2.9%)	0.184
Admission type			0.223
Same-day	432 (14.9%)	182 (7.8%)	
Inpatient	2,472 (85.1%)	2,138 (92.2%)	
Year of surgery	2017 (2014 - 2020)	2017 (2014 - 2020)	0.999
INTRAOPERATIVE CHARACTERISTICS			
Duration of bypass, min	86.5 (68.0 - 110.0)	90.0 (70.0 - 117.0)	0.150
Surgery type			0.217
Coronary Artery Bypass Graft (CABG)	1,684 (58.0%)	1,153 (49.7%)	
Valve surgery	692 (23.8%)	545 (23.5%)	
CABG & valve surgery	353 (12.2%)	401 (17.3%)	
Other	175 (6.0%)	221 (9.5%)	
Transfusion products			
Autologous blood transfusion, mL	420 (300 - 550)	400 (300 - 500)	0.096
Crystalloid and colloid infusion, mL	2700 (2200 - 3200)	2700 (2200 - 3275)	0.038
Red blood cell transfusion, mL	0 (0 - 0)	0 (0 - 500)	0.596
Cryoprecipitate transfusion, mL	0 (0 - 0)	0 (0 - 0)	0.097
Fresh frozen plasma transfusion, mL	0 (0 - 0)	0 (0 - 0)	0.186
Platelet transfusion, mL	0 (0 - 0)	0 (0 - 0)	0.150

REFERENCES

- [1] Warner M et. al. Anesth Analg. 2024
- [2] Ranucci M et. al. J Cardiothorac Vasc Anesth. 2021
- [3] Geneva: World Health Organization. 2024
- [4] Eckenhoﬀ R et. al. Anesthesiology. 2020

Figure 1. Preoperative anemia severity in cardiac patients over the years

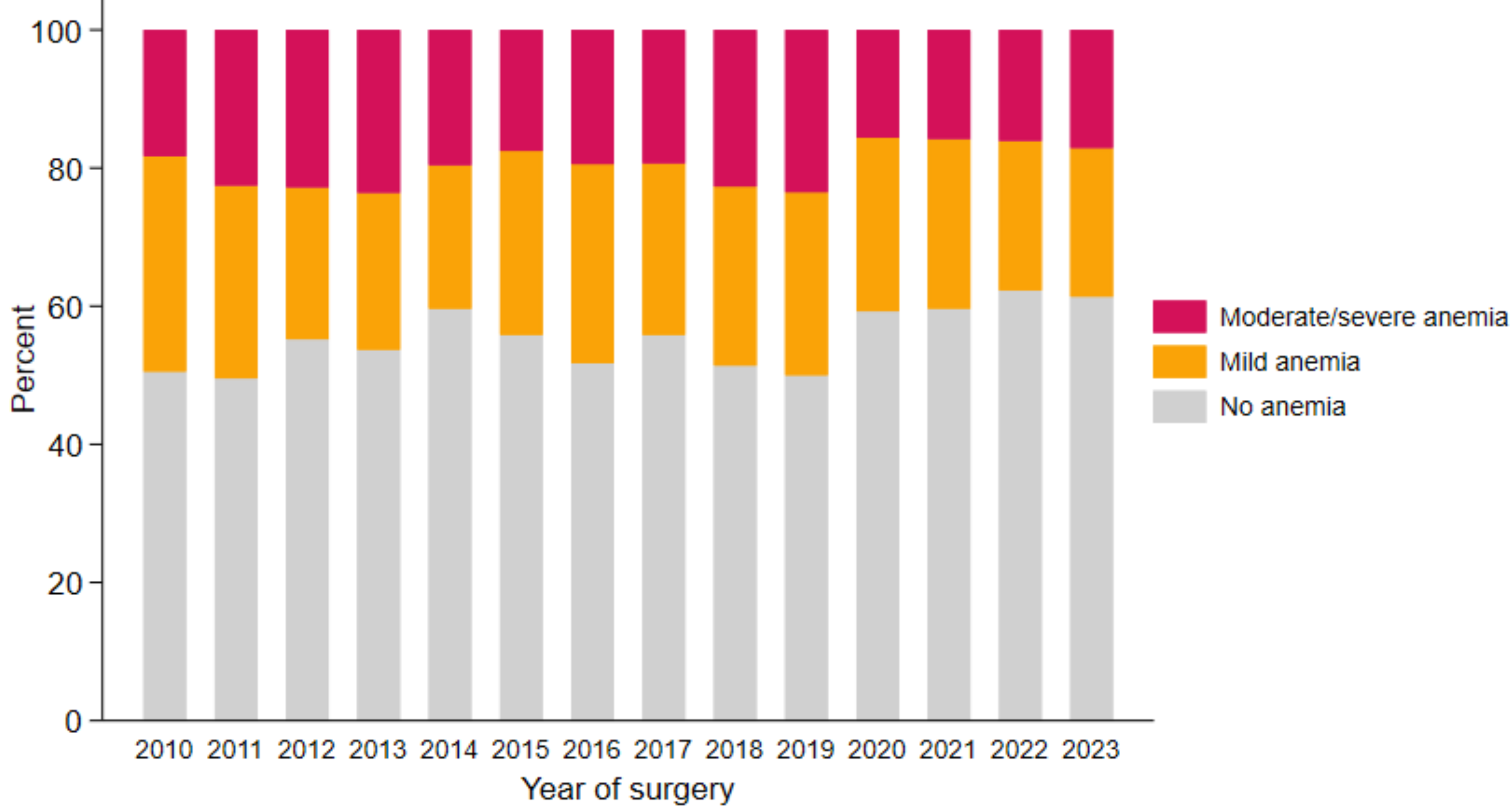
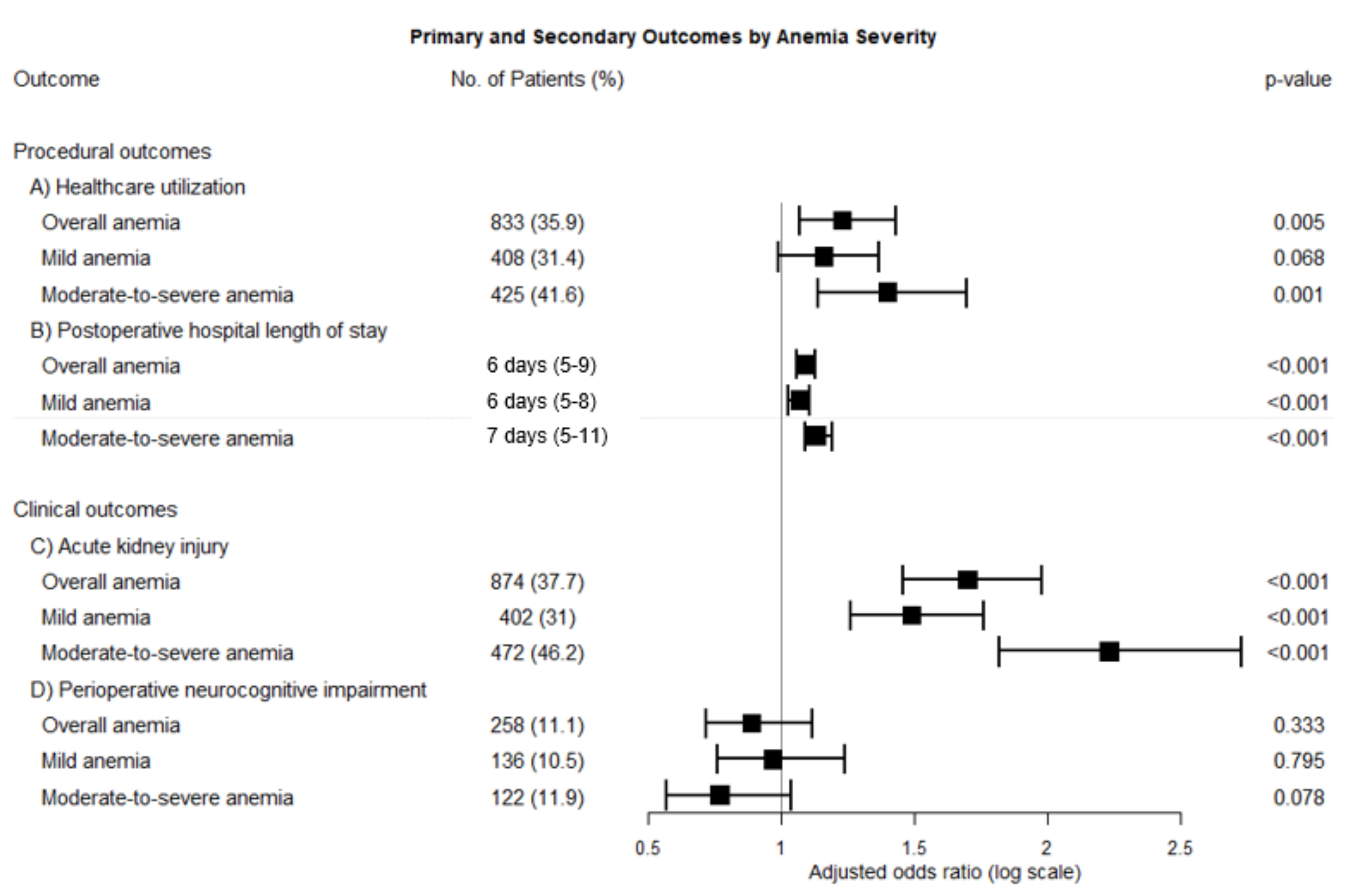


Figure 2. Results of Primary and Secondary Analysis



RESULTS

Of 2,320 patients (44.4%) with preoperative anemia, 833 (35.9%) required advanced postoperative care following cardiac surgery

PRIMARY ANALYSIS

- Preoperative anemia** was associated with higher odds of advanced HCU (OR_{adj} 1.23, 95% CI 1.07–1.43, p=0.005),
- Moderate-to-severe anemia** showed a significant increased risk (OR_{adj} 1.40, 95% CI 1.14–1.70, p=0.001),
- Mild anemia showed a numerical increase (OR_{adj} 1.16, 95% CI 0.99–1.37, p=0.068).

SECONDARY ANALYSIS

- Postoperative hospital stay*: increased with anemia (IRR 1.09, 95% CI 1.06–1.13, p=<0.001) and showed a stepwise increase with greater anemia severity
- AKI*: incidence increased progressively with anemia severity (OR_{adj} 1.7, 95% CI 1.46–1.98, p=<0.001)
- Neurocognitive impairment: no significant association with anemia or anemia severity

CONCLUSION

- Preoperative anemia was associated with a **higher likelihood** of advanced postoperative healthcare utilization after cardiac surgery
- This association was **severity-dependent**, driven primarily by moderate–severe anemia
- Further evidence is needed to determine whether incorporating anemia severity into preoperative evaluation could help **reduce complications** and **high-intensity resource use**.

CONTACT US

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