

# Racial disparities and risk factors for blood transfusion in patients undergoing myomectomy for uterine fibroids: insights from a national surgical database

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## ABSTRACT

**Background:** Uterine fibroids are common among reproductive-aged women, with notable racial disparities in disease burden and outcomes. Myomectomy is a fertility-sparing surgical treatment associated with variable transfusion risk.

**Objectives:** To evaluate racial disparities and identify risk factors for blood transfusion in patients undergoing myomectomy, and to develop a predictive model for high-risk patients.

**Methods:** This retrospective cohort study used the American College of Surgeons National Surgical Quality Improvement Project (2018–2022) to identify women aged 18–55 years who underwent myomectomy. Patients with malignancy or bleeding disorders were excluded. Multivariable logistic regression was used to assess transfusion predictors and racial disparities.

**Main Outcome Measures:** Incidence and predictors of perioperative blood transfusion; model performance for transfusion prediction.

**Results:** Among 6,154 patients, 604 (9.8%) required transfusion. Non-Hispanic Black patients accounted for 74.3% of transfusion cases (vs. 52.0%,  $P < 0.001$ ) and had over twice the adjusted odds of transfusion compared to Non-Hispanic White patients [adjusted odds ratio (aOR): 2.1, 95% confidence interval: 1.6–2.7]. Preoperative anaemia (aOR: 8.5), abdominal approach (aOR: 4.7), and fibroid burden (>250 grams) (aOR: 2.0) were also significant. The predictive model demonstrated excellent discrimination (area under the receiver operating characteristic curve: 0.79).

**Conclusions:** Non-Hispanic Black patients face higher transfusion risks during myomectomy, even after adjusting for clinical factors. Interventions targeting anaemia and prioritising minimally invasive approaches may reduce these disparities.

**What is New?** This study explores recent racial disparities in blood transfusion among myomectomy patients and assesses how these patterns have evolved in recent years using a nationally representative surgical dataset.

**Keywords:** Myomectomy, uterine fibroids, blood transfusion, minimally invasive surgery

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## Introduction

Uterine leiomyomas, commonly known as fibroids, are the most prevalent benign tumours in women of reproductive age, affecting approximately 20-25% of this population.<sup>1</sup> The cumulative incidence rises dramatically with age, with up to 70% of White women and over 80% of Black women developing fibroids by age 50.<sup>2</sup> Symptoms are diverse, including heavy menstrual bleeding, pelvic pain, and pressure-related issues, all of which can significantly impair quality of life. Management of fibroids ranges from medical to surgical options, tailored to symptom severity and patient preferences.<sup>1</sup>

Larger fibroids or refractory symptoms often require surgery.<sup>3</sup> While hysterectomy is definitive, myomectomy is preferred for those desiring fertility or uterine preservation, with minimally invasive laparoscopic techniques offering faster recovery and fewer complications than open surgery.<sup>4</sup>

Despite these advantages, data from the American College of Surgeons National Surgical Quality Improvement Project (ACS-NSQIP) reveal that only 42% of myomectomies are performed minimally invasively.<sup>5</sup> Furthermore, Black women are disproportionately more likely to undergo both abdominal myomectomies and hysterectomies compared to White women, with relative risks of 2.4 and 6.8, respectively.<sup>6</sup> Myomectomy procedures, particularly when performed abdominally, present unique challenges, including increased intraoperative bleeding due to tumour-related neovascularization and anatomical distortion.<sup>7,8</sup> The size, number, and location of fibroids, as well as the surgical approach, are critical factors influencing the risk of excessive bleeding and subsequent blood transfusion.<sup>9</sup>

Previous studies reported variable transfusion rates for abdominal myomectomies, ranging from 8% to 28%, reflecting outdated practices from two decades ago.<sup>10-13</sup> More recent data from a tertiary centre reported an overall transfusion rate of 4.7%, with rates of 6.4% for abdominal and 2.2% for laparoscopic myomectomies.<sup>14</sup> Disparities in the burden and clinical outcomes of fibroids are evident, with Black women presenting with larger, more numerous, and rapidly growing leiomyomas at younger ages, contributing to greater perioperative morbidity and higher transfusion rates.<sup>15</sup>

Our study evaluates risk factors for blood transfusion during myomectomy and examines the impact of evolving health policies on reducing racial disparities. Additionally, we developed a predictive model to identify

high-risk patients, supporting clinicians in optimising perioperative management and improving outcomes.

## Methods

This retrospective analysis of a publicly available database did not require institutional ethical approval or patient consent. The ACS-NSQIP serves as a nationally validated database aimed at assessing and enhancing surgical outcomes across various specialties. This programme collects preoperative, intraoperative, and 30-day postoperative data directly from patient medical records, with specially trained personnel overseeing the abstraction process at more than 600 participating hospitals nationwide.<sup>16</sup>

Data were collected from 6154 premenopausal women between the age of 18 to 55 years from 2018 to 2022 who underwent myomectomy procedure. The study period (2018-2022) was selected to capture contemporary surgical practices following the widespread adoption of minimally invasive techniques and to reflect current health policy environments. This timeframe represents the most recent complete data available at the time of analysis whilst providing sufficient sample size for robust statistical modelling. The primary outcome was perioperative blood transfusion, defined as any allogeneic red blood cell transfusion occurring intraoperatively or within 72 hours postoperatively (NSQIP variable). Blood transfusion was selected as the primary outcome due to its clinical significance as both an indicator of surgical complexity and a modifiable target for quality improvement. Transfusion represents a common, measurable complication with direct implications for patient safety, cost, and disparities in surgical care. Preoperative transfusions were analysed as an independent predictor variable but were not included in the primary outcome count.

### **Preoperative Anaemia Definition**

Preoperative anaemia was defined using the NSQIP variable for preoperative haematocrit <30%, consistent with moderate anaemia thresholds used in surgical risk assessment. This represents a clinically significant degree of anaemia associated with increased perioperative transfusion risk.

Myomectomy procedure was identified using one of the following current procedure terminology (CPT) codes: 58140,<sup>17</sup> 58146, 58545, and 58546. Women with underlying malignancy or bleeding disorders were excluded.

(CPT) codes 58545 and 58140 were considered low fibroid burden (one to four fibroids or total weight 250 g or less), and 58146 and 58546 were considered high fibroid burden (more than five fibroids or fibroid weight greater than 250 g).

### **Statistical Analysis**

Unadjusted analysis of categorical baseline characteristics, surgical approach, medical comorbidities by patients' race and ethnicity using chi-square test. Age and body mass index (BMI) were evaluated for normality and compared using two-sample t-tests. Patients with missing data on race and ethnicity or blood transfusion were excluded from the analysis to ensure the integrity and completeness of the dataset. Adjusted odds ratios (aORs) and 95% confidence intervals (CIs) were calculated using multivariable logistic regression. A multivariable model adjusted for age, BMI, preoperative anaemia, preoperative blood transfusion, hypertension, surgical approach, fibroids burden was used to examine the race and ethnicity association with postoperative blood transfusion.

The goodness-of-fit for the logistic regression model was evaluated using the Hosmer-Lemeshow test. The data were grouped into 10 quantiles based on predicted probabilities, and observed versus expected frequencies of the outcome were compared across these groups. A *P* value greater than 0.05 was considered indicative of adequate model fit.

Model selection was guided by information criteria, specifically the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC). After comparing models, the model with the better fit, based on lower AIC and BIC values, was selected for the final analysis. Similarly, we evaluated all predictors for their contribution to model performance and parsimony. The variables for diabetes and smoking status were excluded from the final model due to lack of improvement in model fit as determined by AIC and BIC criteria. To enhance clinical interpretability, absolute transfusion rates were calculated and presented as descriptive statistics stratified by race and ethnicity, surgical approach, fibroid burden, and their combinations. These unadjusted rates were provided to complement the multivariable regression analyses.

Then the discriminative ability of the logistic regression model was assessed using the area under the receiver operating characteristic (ROC) curve (AUC). To assess the robustness of model discrimination and ensure that

predictive performance was not disproportionately influenced by patients who received preoperative transfusion, a sensitivity analysis was performed excluding these individuals. The multivariable logistic regression model was re-estimated in the restricted cohort, and model discrimination was reassessed using the ROC-AUC. All analyses were completed using STATA 14.2 with two-sided *P* values of <0.05 considered statistically significant.

## **Results**

### **Patient Characteristics and Blood Transfusion Incidence**

Of the 6,154 patients included in the study, 604 (9.8%) required a blood transfusion. The mean age was similar between the two groups, at 37 years (*P*=0.2). However, significant differences were observed in race and ethnicity distribution (*P*<0.001). Non-Hispanic Black patients comprised the majority of those requiring transfusions (74.3%), compared to 52.0% in the non-transfusion group (Table 1). Figure 1 illustrates the annual incidence of blood transfusions by race and ethnicity between 2018 and 2022, with Non-Hispanic Black patients consistently exhibiting the highest rates of transfusion compared to Non-Hispanic White and Hispanic patients throughout the study time.

### **Preoperative and Surgical Characteristics**

Preoperative anaemia (*P*<0.001) and preoperative transfusion (*P*<0.001) were significantly more frequent among those who required a transfusion. A higher proportion of patients in the transfusion group had fibroid weight greater than 250 grams (59.8% vs. 38.8%, *P*<0.001). Furthermore, the surgical approach differed significantly between the groups (*P*<0.001). Abdominal approach was predominant in the transfusion group (80.3%), while laparoscopic and vaginal approaches were more frequent in the non-transfusion group (Table 1).

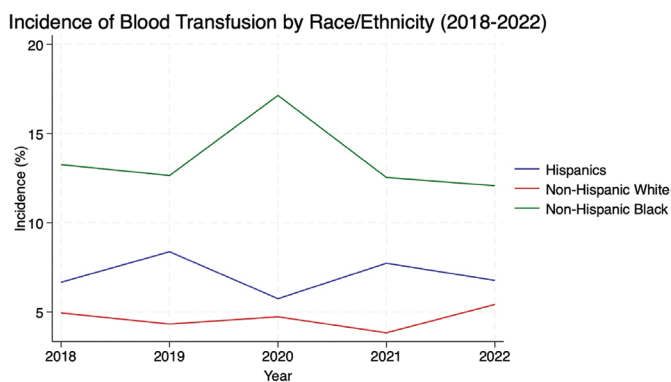
### **Association of Demographic, Preoperative, and Surgical Factors with Blood Transfusion**

After adjusting for clinically significant variables—including age, BMI, hypertension, preoperative anaemia, preoperative transfusion, surgical approach, and fibroid burden—Non-Hispanic Black race remained strongly associated with increased odds of requiring a blood transfusion (aOR: 2.1, 95% CI: 1.6–2.7, *P*<0.001). Notably, the association between Hispanic ethnicity and

**Table 1.** Demographics, medical, and surgical characteristics of the study cohort stratified by blood transfusion status.

	Transfusion (n=604)	No transfusion (n=5550)	P value
<b>Age</b>	37±5.7	37±5.9	0.2
<b>Race/ethnicity</b>			<0.001
Non-Hispanic White	85 (14.07%)	1746 (31.46%)	
Non-Hispanics Black	449 (74.34%)	2888 (52.04%)	
Hispanics	70 (11.59%)	916 (16.50%)	
Smoking	45 (7.45%)	431 (7.77%)	0.7
<b>BMI</b>			0.9
Underweight	2 (0.33%)	30 (0.54%)	
Normal	138 (22.85%)	1211 (21.82%)	
Overweight	172 (28.48)	1589 (28.63%)	
Obese	211 (34.93%)	1966 (35.42%)	
Morbidly obese	69 (11.42%)	637 (11.48%)	
<b>HTN</b>	57 (9.44%)	615 (11.08%)	0.2
<b>DM</b>	19 (3.15%)	204 (3.68%)	0.5
<b>Preoperative transfusion</b>	45 (7.45%)	64 (1.15%)	<0.001
<b>Anemia</b>	163 (26.99%)	231 (4.16%)	<0.001
<b>Fibroid burden</b>			<0.001
≤250 grams	243 (40.23%)	3394 (61.15%)	
>250 grams	361 (59.77%)	2156 (38.85%)	
<b>Surgical approach</b>			<0.001
Laparoscopic	79 (13.08%)	2587 (46.61%)	
Abdominal	485 (80.30%)	2640 (47.57%)	
Vaginal	40 (6.62%)	323 (5.82%)	
<b>Prolonged operative time (&gt;180 minutes)</b>	268 (44.37%)	1393 (25.10%)	<0.001

BMI: Body mass index, HTN: Hypertension, DM: Diabetes mellitus.



**Figure 1.** Shows the incidence rate of blood transfusion among myomectomy patients by race/ethnicity during the study period.

transfusion was attenuated and no longer significant in the adjusted model (aOR: 1.1, 95% CI: 0.7–1.6,  $P=0.5$ ).

Preoperative transfusion was independently associated with a higher likelihood of requiring a transfusion (aOR: 2.4, 95% CI: 1.3–3.9,  $P=0.001$ ). Fibroid burden, defined as fibroid weight greater than 250 grams, also showed a strong association with transfusion risk (aOR: 2.0, 95% CI: 1.9–2.7,  $P<0.001$ ). Among surgical approaches, abdominal surgery had the strongest independent association with transfusion (aOR: 4.7, 95% CI: 3.6–6.1,  $P<0.001$ ), while vaginal surgery remained significantly associated with transfusion, though to a lesser degree (aOR: 1.7, 95% CI: 1.0–2.9,  $P=0.04$ ). The presence of preoperative anaemia was the strongest independent predictor of transfusion, with an aOR of 8.5 (95% CI: 6.4–11.1,  $P<0.001$ ) (Table 2).

Additionally, absolute transfusion rates stratified by race and ethnicity, surgical approach, and fibroid burden are presented in Supplementary Table 1.

Overall transfusion rates were highest among Non-Hispanic Black patients (13.46%) compared with Hispanic (7.10%) and Non-Hispanic White patients (4.64%). Within surgical approaches, abdominal myomectomy was associated with the highest transfusion rates across all racial/ethnic groups; however, disparities persisted within each approach. For example, among laparoscopic procedures, transfusion occurred in 4.63% of Non-Hispanic Black patients compared with 1.72% of Non-Hispanic White patients. Similar patterns were observed for abdominal and vaginal approaches, demonstrating that racial disparities were present even within comparable surgical techniques.

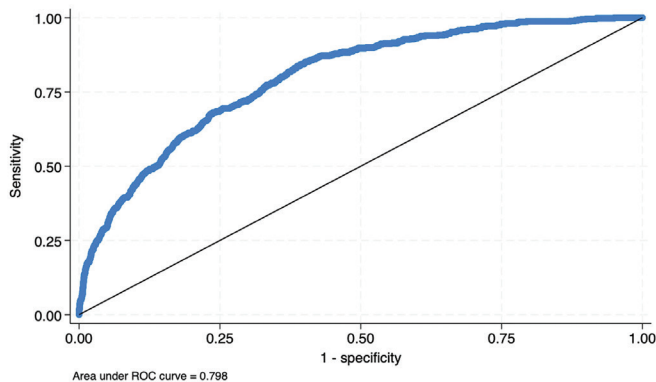
**Model Performance and Goodness of Fit**

The final model was evaluated for goodness of fit using the Hosmer-Lemeshow test, which indicated no evidence of poor fit ( $P=0.34$ ), suggesting that the model adequately represents the data. The predictive performance of the model was assessed using the AUC-ROC, which yielded a value of 0.79, indicating excellent discrimination (Figure 2). Additionally, a sensitivity analysis was conducted excluding patients who received preoperative transfusion to assess the robustness of model discrimination. In the restricted cohort ( $n=5,576$ ), the model demonstrated similar performance, with an AUC of 0.79 (0.7937).

**Table 2.** Factors associated with blood transfusion among patients undergoing myomectomy: racial disparities and other predictors.

	Univariate analysis			Multivariable analysis		
	Odds ratio	Confidence interval 95%	P value	Odds ratio	Confidence interval 95%	P value
<b>Race/ethnicity</b>						
Non-Hispanic Whites	-	-	-	-	-	-
Non-Hispanic Blacks	3.1	2.5-4	<0.001	2.1	1.6-2.7	<0.001
Hispanics	1.5	1.1-2.1	0.007	1.1	0.7-1.6	0.5
<b>BMI</b>						
Normal	-	-	-	-	-	-
Underweight	0.5	0.1-2.4	0.4	0.4	0.07-2.4	0.3
Obese	0.9	0.7-1.2	0.6	0.8	0.6-1	0.1
Overweight	0.9	0.7-1.1	0.6	0.7	0.5-0.9	0.02
Morbidly Obese	0.9	0.7-1.2	0.7	0.7	0.5-1.1	0.1
<b>HTN</b>						
No	-	-	-	-	-	-
Yes	0.8	0.6-1.1	0.2	0.7	0.5-1	0.06
<b>Preoperative transfusion</b>						
No	-	-	-	-	-	-
Yes	6.9	4.6-10.2	<0.001	2.4	1.3-3.9	0.001
<b>Fibroid burden</b>						
Fibroids ≤250g	-	-	-	-	-	-
Fibroids >250g	2.3	1.9-2.7	<0.001	2	1.9-2.7	<0.001
<b>Surgical approach</b>						
Laparoscopic	-	-	-	-	-	-
Abdominal	1.7	1.5-2	<0.001	4.7	3.6-6.1	<0.001
Vaginal	1.4	1-1.7	<0.001	1.7	1-2.9	0.04
<b>Prolonged operative time</b>						
<180 min	-	-	-	-	-	-
≥180 min	2.3	2-2.8	<0.001	3.6	2.9-4.5	<0.001
<b>Anemia</b>						
Hct <30	-	-	-	-	-	-
Hct ≥30	8.2	6.5-10.2	<0.001	8.5	6.4-11.1	<0.001

BMI: Body mass index, HTN: Hypertension, Hct: Hematocrit, min: Minutes.



**Figure 2.** Receiver operating characteristic (ROC) curve for predicting blood transfusion among myomectomy patients.

These findings suggest that the predictive ability of the model was not substantially influenced by the inclusion of patients who received preoperative transfusion. The corresponding receiver operating characteristic curve is presented in Supplementary Figure 1.

## Discussion

### Main Findings

Our study revealed that approximately 1 in 10 patients undergoing myomectomy for uterine fibroids required a postoperative blood transfusion. We developed a predictive model incorporating clinical and demographic variables, including race and ethnicity, BMI, preoperative anaemia, surgical approach, and fibroid burden, which demonstrated excellent discrimination (AUC-ROC: 0.79). Notably, racial disparities in transfusion rates were persistent and pronounced: Non-Hispanic Black patients had over twice the odds of receiving a transfusion compared to Non-Hispanic White patients, even after adjusting for clinical risk factors. This underscores the multifactorial and systemic nature of racial inequities in surgical outcomes.

Our findings highlight both modifiable and structural risk factors that contribute to transfusion risk and racial disparities. Modifiable factors amenable to clinical intervention include preoperative anaemia (aOR: 8.5), which can be addressed through iron supplementation or gonadotropin-releasing hormone (GnRH) agonist therapy; surgical approach (abdominal aOR: 4.7 vs. laparoscopic), which can be mitigated through expanded access to minimally invasive techniques; and fibroid burden >250g (aOR: 2.0), potentially reducible through preoperative medical management.<sup>18</sup> Structural factors beyond individual patient optimisation include race and ethnicity (Non-Hispanic Black aOR: 2.1), which likely

reflects systemic inequities in access to high-volume surgical centres, experienced minimally invasive surgeons, and timely specialist referral—variables not captured in NSQIP but known to influence outcomes. Effective reduction of transfusion disparities requires simultaneous intervention at both levels: optimising individual patient factors through standardised preoperative protocols whilst addressing system-level barriers through policy initiatives that ensure equitable access to advanced surgical care and subspecialty expertise.

### Study Limitations

A major strength of this study is its use of a large, contemporary, and nationally representative surgical dataset (ACS-NSQIP), enhancing the generalisability of our findings. We applied rigorous model-building and statistical approaches, including AIC/BIC criteria and the Hosmer-Lemeshow test, to ensure robustness and model fit.

However, the study has limitations. As with all retrospective analyses using administrative databases, unmeasured confounders may exist. The ACS-NSQIP does not capture details on intraoperative blood loss, use of hemostatic agents, or preoperative medical optimisation strategies (e.g., GnRH agonists), which could affect transfusion risk. Additionally, although fibroid burden was categorized using CPT codes, this may not fully reflect fibroid complexity (e.g., location or vascularity). Several factors may limit the generalisability of our findings. The ACS-NSQIP database does not capture important confounders including surgeon experience, hospital volume, insurance status, or access to subspecialty care—all of which may mediate the observed racial disparities. The nature of the US insurance-based healthcare system, with its documented access barriers and fragmented care delivery, may amplify racial inequities compared to universal healthcare systems such as those in Europe. Additionally, provider-level factors (e.g., implicit bias, differential referral patterns) and patient-level factors (e.g., health literacy, medical mistrust) that contribute to disparities cannot be fully adjusted for in this analysis. Additionally, the NSQIP database does not distinguish between intraoperative and postoperative transfusions. This limitation prevents analysis of whether racial disparities are driven primarily by intraoperative bleeding versus postoperative anaemia management. Understanding this timing distinction could inform targeted interventions. Lastly, causality cannot be established due to the observational nature of the study.

### **Strengths and Limitations Compared to Other Studies**

Our findings are consistent with prior studies reporting increased perioperative risks for patients with larger fibroids. For instance, Casarin et al.<sup>20</sup> and Vargas et al.<sup>19</sup> linked greater fibroid burden to higher complication rates during myomectomy. Our data extend these findings by confirming that fibroid weight greater than 250 g is an independent risk factor for transfusion. Furthermore, our findings also showed that Non-Hispanic Blacks and Hispanic patients were disproportionately more likely to require blood transfusions. These disparities are consistent with older studies, including an analysis by Stentz et al.<sup>21</sup> of 8,438 myomectomy patients from 2012 to 2015, which found that African American women had a 50% higher likelihood of morbidity following abdominal myomectomy, while no significant differences in morbidity were observed among Hispanic patients.

Compared to earlier work by Stentz et al.<sup>21</sup> and Kim et al.<sup>22</sup> which highlighted disparities and transfusion-related morbidity, our study reflects more recent surgical practice patterns and includes predictive modelling. Unlike some previous studies limited to single centres or older data, our study uses a national dataset from 2018 to 2022, capturing evolving surgical practices and racial trends.

Our predictive model builds upon and improves prior tools by integrating both modifiable (e.g., anaemia, surgical approach) and non-modifiable (e.g., race) risk factors. This holistic approach enhances its clinical utility for perioperative risk stratification.

### **Clinical and Policy Implications**

Our findings have immediate clinical relevance. The strong association between preoperative anaemia and transfusion risk (aOR: 8.5) supports the need for early screening and optimisation prior to elective myomectomy. Interventions such as iron supplementation or hormonal suppression (e.g., GnRH agonists) could significantly reduce transfusion needs, particularly in high-risk populations. From a surgical standpoint, the abdominal approach was associated with a nearly five-fold increased transfusion risk. Where feasible, prioritising minimally invasive methods may reduce complications and improve recovery. Potential applications include preoperative risk calculators integrated into electronic health record systems, standardised protocols for identifying and optimising high-risk patients, and decision support for surgical planning and resource allocation (e.g., cross-match requirements, postoperative monitoring intensity).

Future work should focus on external validation of the model in diverse practice settings, development of user-friendly clinical tools (such as web-based calculators or mobile applications), and prospective evaluation of whether model-guided risk stratification and targeted interventions improve patient outcomes and reduce racial and ethnic disparities in transfusion rates.

The observed racial disparities reflect deeper systemic issues. Structural inequities—such as differential access to high-resource hospitals, experienced surgeons, and minimally invasive technologies—likely contribute to worse outcomes for minority patients. Policy efforts should focus on improving access to advanced surgical care, addressing institutional biases, and implementing protocols that promote equity in preoperative optimisation and referral patterns.

### **Unanswered Questions and Future Research**

Our study raises several important questions. Why do racial and ethnic disparities persist even after adjustment for clinical risk factors? Our findings demonstrate that Non-Hispanic Black patients have over twice the odds of requiring transfusion (aOR: 2.1, 95% CI: 1.6-2.7) even after controlling for preoperative anaemia, fibroid burden, surgical approach, and other measurable clinical factors. This persistent disparity suggests that traditional risk adjustment may not fully capture the complexity of racial inequities in surgical outcomes.

One important alternative perspective to consider is whether fibroid disease itself differs fundamentally across racial and ethnic groups. As noted by recent research, uterine fibroid disease may represent fundamentally different pathophysiological entities across racial and ethnic groups. Beyond epidemiological differences in tumour size, number, and age at presentation, emerging evidence demonstrates distinct molecular and genetic profiles.<sup>17,23,24</sup> Black women show higher prevalence of certain fibroid molecular subtypes, different patterns of genetic variants, and potentially divergent pathways involving vitamin D metabolism and environmental exposures. These biological differences—including variations in molecular characteristics, growth kinetics, and recurrence patterns—may partly explain the persistent racial disparities observed in our study even after adjustment for clinical factors. Future research should prioritise investigation of the underlying mechanisms driving these disparities, including genetic, epigenetic, hormonal, and environmental contributors, to

develop targeted therapeutic interventions that address root biological causes rather than merely documenting outcome inequalities.

Beyond biological mechanisms, future studies should investigate patient-level, provider-level, and hospital-level contributors to inequities in myomectomy outcomes. Prospective studies are also needed to assess the impact of targeted interventions—such as standardised anaemia screening protocols or referral to high-volume minimally invasive surgeons—on reducing transfusion rates and promoting equitable surgical care.

Additionally, refinement and external validation of our predictive model in diverse populations and practice settings are warranted. Incorporating additional variables, such as intraoperative estimated blood loss, surgical skill level, and postoperative haemoglobin levels, could enhance its accuracy and clinical application.

## Conclusion

This study highlights persistent racial disparities in transfusion risk during myomectomy, particularly affecting Non-Hispanic Black women. By identifying key clinical and demographic predictors, we developed a robust risk stratification model with high predictive accuracy. These findings underscore the urgent need for targeted interventions—such as anaemia optimisation and broader access to minimally invasive surgery—to promote equitable surgical outcomes in reproductive health.

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**Competing interests:** No conflict of interest was declared by the authors.

**Ethical approval:** This retrospective analysis used a publicly available database and did not require institutional ethical approval.

**Informed consent:** Patient consent was not required because the study was based on a publicly available database containing de-identified data.

**Data sharing:** The datasets used and analysed during the current study are available from the corresponding author upon reasonable request.

**Transparency:** The authors affirm that this manuscript is an accurate, and transparent account of the study being reported; no important aspects have been omitted.

**Supplementary Table:** <https://d2v96fxpocvxx.cloudfront.net/580eb5e7-1480-44a6-9404-b8b7446acbc/c/content-images/5691e298-2780-4661-a412-cff1aa2563be.pdf>

**Supplementary Figure:** <https://d2v96fxpocvxx.cloudfront.net/cf9d60d6-523c-458a-a2e6-78728d3ffbb0/content-images/4e25b601-7757-4375-98f8-31ec61221294.pdf>

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