

Disparities in Access to Endoscopic and Open Approaches to the Surgical Management of Craniosynostosis: A Large, National Cohort Evaluation

Daniel Y. Kwon, BS¹; Allison Choe, BS¹; Dillan F. Villavisanis, MD¹; Olachi Oleru, MD¹; Nargiz Seyidova, MD¹; Peter Shamamian, BS¹; Carol Wang, BA¹; Alex Sarosi, MD¹; Peter Taub, MD, MS¹

1.Division of Plastic and Reconstructive Surgery, Icahn School of Medicine, New York, New York



Icahn School
of Medicine at
Mount
Sinai

BACKGROUND

- Craniosynostosis is a congenital condition with potential long-term neurodevelopmental consequences.
- Endoscopic repair offers a minimally invasive alternative to traditional open surgery but requires early intervention (before 3–6 months of age).
- Timely access to care is often limited for socioeconomically and racially marginalized populations.
- Delays in diagnosis and referral may result in exclusion from endoscopic repair despite clinical eligibility.
- This study investigates demographic, socioeconomic, and institutional factors influencing access to endoscopic vs. open repair using a national inpatient dataset.

METHODS

- Design:** Retrospective cohort study using the Healthcare Cost and Utilization Project (HCUP) National Inpatient Sample (2018–2021).
- Population:** Pediatric patients undergoing craniosynostosis repair stratified into endoscopic vs. open surgery.
- Variables:**
- Demographics (age, sex, race/ethnicity).
 - Socioeconomic indicators (insurance type, zip-code income quartile).
 - Hospital characteristics (bed size, ownership, teaching status).

TABLES

Table 1. Demographic Variables for Craniosynostosis Groups

Variables	Total	Endoscopic	Open	P-Value
N	1,099	183	916	
Sex				
Female (%)	386 (35.1%)	57 (31.1%)	329 (35.9%)	0.217
Age (years)				
<1 (%)	746 (67.9%)	183 (100%)	563 (61.5%)	<0.001
1 (%)	154 (14.0%)	0 (0%)	154 (16.8%)	<0.001
2 (%)	51 (4.6%)	0 (0%)	51 (5.6%)	<0.001
3 (%)	44 (4.0%)	0 (0%)	44 (4.8%)	0.002
4 (%)	34 (3.1%)	0 (0%)	34 (3.7%)	0.008
≥5 (%)	70 (6.4%)	0 (0%)	70 (7.6%)	<0.001
Race				
White (%)	569 (51.8%)	124 (67.8%)	445 (48.6%)	<0.001
Black (%)	71 (6.5%)	10 (5.5%)	61 (6.7%)	0.548
Hispanic (%)	255 (23.2%)	36 (19.7%)	219 (23.9%)	0.215
Asian or Pacific Islander (%)	30 (2.7%)	0 (0%)	30 (3.3%)	0.013
Native American (%)	6 (0.5%)	0 (0%)	6 (0.7%)	0.272
Other (%)	76 (6.9%)	9 (4.9%)	67 (7.3%)	0.243
Missing (%)	92 (8.4%)	4 (2.2%)	88 (9.6%)	-
Primary Payer				
Medicare (%)	2 (0.2%)	0 (0%)	2 (0.2%)	0.527
Medicaid (%)	550 (50.0%)	63 (34.4%)	487 (53.2%)	<0.001
Private (%)	455 (41.4%)	110 (60.1%)	345 (37.7%)	<0.001
Self-pay (%)	25 (2.3%)	1 (0.5%)	24 (2.6%)	0.086
Missing (%)	67 (6.1%)	9 (4.9%)	58 (6.3%)	-
Median Household Income for Patient Zip Code				
Q1: 0-25th Percentile (%)	225 (20.5%)	23 (12.6%)	202 (22.1%)	0.004
Q2: 26th-50th Percentile (%)	311 (28.3%)	46 (25.1%)	265 (28.9%)	0.298
Q3: 51st-75th Percentile (%)	260 (23.7%)	44 (24.0%)	216 (23.6%)	0.893
Q4: 76th-100th Percentile (%)	293 (26.7%)	68 (37.2%)	225 (24.6%)	<0.001

Table 2. Hospital Characteristics for Craniosynostosis Groups (Univariate)

Variables	Total	Endoscopic	Open	P-Value
N	1,099	183	916	
Hospital Bedsize				
Small (%)	176 (16.0%)	21 (11.5%)	155 (16.9%)	0.067
Medium (%)	235 (21.4%)	44 (24.0%)	191 (20.9%)	0.336
Large (%)	688 (62.6%)	118 (64.5%)	570 (62.2%)	0.565
Hospital Location / Teaching Status				
Rural (%)	1 (0.1%)	0 (0%)	1 (0.1%)	0.655
Urban Nonteaching (%)	13 (1.2%)	0 (0%)	13 (1.4%)	0.105
Urban Teaching (%)	1,085 (98.7%)	183 (100%)	902 (98.5%)	0.092
Hospital Control				
Government, nonfederal (%)	82 (7.5%)	8 (4.4%)	74 (8.1%)	0.081
Private, not-for-profit (%)	976 (88.8%)	171 (93.4%)	805 (87.9%)	0.029
Private, investor owned (%)	41 (3.7%)	4 (2.2%)	37 (4.0%)	0.227

Table 3. Hospital Characteristics for Craniosynostosis Groups (Binary Logistic)

Variables	β	95% CI	P-Value
Hospital Bedsize			
Small	-0.430	0.389-1.089	0.102
Medium	0.087	0.727-1.637	0.675
Large	0.160	0.822-1.673	0.379
Hospital Location / Teaching Status			
Rural	-0.091	-	1.0
Urban Nonteaching	-16.988	-	0.994
Urban Teaching	17.022	-	0.995
Hospital Control			
Government, nonfederal	-0.793	0.206-0.994	0.048
Private, not-for-profit	0.813	1.188-4.334	0.013
Private, investor owned	-0.800	0.153-1.324	0.147

RESULTS

- 1,099 patients treated for craniosynostosis from 2018–2021: 183 (16.6%) with endoscopic repair and 916 (83.4%) with open repair.
- Endoscopic group: more likely to be **White** (67.8% vs. 48.6%, p<0.001), **privately insured** (60.1% vs. 37.7%, p<0.001), and from **high-income areas** (37.2% vs. 24.6%, p<0.001).
- Endoscopic procedures more likely at **private, not-for-profit hospitals** (93.4% vs. 87.9%, p=0.029).
- Disparities in race, insurance, and income persisted despite equivalent age eligibility.

CONCLUSION

- **Significant racial, socioeconomic, and institutional disparities exist in access to endoscopic repair.**
- These disparities persist even in clinically eligible infants (<1 year), **suggesting systemic barriers** in diagnosis and referral.
- Addressing healthcare inequities—including insurance coverage, specialty access, and early screening—is **critical to improving equitable treatment for craniosynostosis.**

REFERENCES

1. Shlobin NA et al. Global Epidemiology of Craniosynostosis: A Systematic Review and Meta-Analysis. World Neurosurgery. 2022.
2. Goyal A et al. Endoscopic versus open approach in craniosynostosis repair: a systematic review and meta-analysis. Childs Nerv Syst. 2018.
3. Mozaffari MA et al. Socioeconomic Disparities in the Surgical Management of Craniosynostosis. J Craniofac Surg. 2022.
4. Amin SC et al. Scoping Review of Healthcare Disparities in Treatment of Craniosynostosis. FACE. 2024.
5. Kwon DY et al. Complication Rates and Cost of Endoscopic and Open Surgical Approaches... Cleft Palate-Craniofac J. 2025.