Racial Disparities in Thyroidectomy Outcomes: An Analysis of Mortality, Complications, and Costs in U.S. Inpatient Care

Analysis for RCOP NIS Sep Endo1

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## Overview:

* Reference Papers:
* **Study Objective**: Investigate the association between race and postoperative outcomes in patients undergoing thyroidectomy across U.S. hospitals from 2018 to 2020, adjusting for demographic and clinical factors.
* **Data Source**: Cross-sectional analysis using the National Inpatient Sample (NIS) from 2018 to 2020.
* **Patient Selection**: Included all inpatient admissions for thyroidectomy procedures, categorized by race (White, Asian or Pacific Islander, Black, Hispanic, Other).
* **Outcomes of Interest**:
  + In-hospital Mortality
  + Length of Stay (days)
  + Inflation-Adjusted Total Charge ($) [inflation adjusted to 2020 dollars, using CPI data by the U.S. Bureau of Labor Statistics]
  + Hypocalcemia
  + Hypoparathyroidism
  + Postoperative Bleeding
* **Statistical Analysis**: Logistic and linear regression analyses were conducted to evaluate the independent associations of race with each outcome, adjusting for:
  + **Demographics and Clinical Factors:** Age, sex, type of thyroidectomy (open or laparoscopic), admission type (elective or non-elective), Elixhauser comorbidity index, residential income quartile, hospital region, bed size, and teaching status.
* **Software**: All analyses were conducted using the R Statistical Language (Version 4.4.1; R Foundation for Statistical Computing, Vienna, Austria).

## Baseline Table:

| **Characteristic** | **White** N = 33,140*1* | **Asian or Pacific Islander** N = 2,925*1* | **Black** N = 10,665*1* | **Hispanic** N = 8,420*1* | **Other** N = 2,720*1* | **p-value***2* |
| --- | --- | --- | --- | --- | --- | --- |
| Age, y | 58 (17) | 52 (18) | 56 (16) | 50 (18) | 53 (19) | <0.001 |
| Sex |  |  |  |  |  | <0.001 |
| Female | 20,195 (61%) | 2,080 (71%) | 7,350 (69%) | 6,270 (74%) | 1,845 (68%) |  |
| Male | 12,940 (39%) | 840 (29%) | 3,315 (31%) | 2,150 (26%) | 875 (32%) |  |
| Thyroidectomy type |  |  |  |  |  | <0.001 |
| Open | 28,795 (87%) | 2,545 (87%) | 8,805 (83%) | 7,360 (87%) | 2,430 (89%) |  |
| Laparoscopic | 4,345 (13%) | 380 (13%) | 1,860 (17%) | 1,060 (13%) | 290 (11%) |  |
| Admission type |  |  |  |  |  | <0.001 |
| Elective | 24,265 (73%) | 2,020 (69%) | 6,235 (59%) | 5,715 (68%) | 1,805 (67%) |  |
| Non-elective | 8,830 (27%) | 905 (31%) | 4,420 (41%) | 2,665 (32%) | 895 (33%) |  |
| No. of comorbidities |  |  |  |  |  | <0.001 |
| No comorbidities | 6,865 (21%) | 620 (21%) | 2,975 (28%) | 1,880 (22%) | 610 (22%) |  |
| One comorbidity | 3,550 (11%) | 245 (8.4%) | 1,745 (16%) | 930 (11%) | 315 (12%) |  |
| Two or more comorbidities | 22,725 (69%) | 2,060 (70%) | 5,945 (56%) | 5,610 (67%) | 1,795 (66%) |  |
| Residential income |  |  |  |  |  | <0.001 |
| $1 - $51,999 | 7,380 (23%) | 295 (10%) | 5,255 (50%) | 3,010 (36%) | 690 (26%) |  |
| $52,000 - $65,999 | 8,790 (27%) | 500 (17%) | 2,485 (24%) | 2,085 (25%) | 580 (22%) |  |
| $66,000 - $87,999 | 8,635 (26%) | 860 (30%) | 1,610 (15%) | 1,865 (23%) | 700 (26%) |  |
| $88,000 or more | 7,820 (24%) | 1,235 (43%) | 1,080 (10%) | 1,305 (16%) | 680 (26%) |  |
| Insurance payer |  |  |  |  |  | <0.001 |
| Medicaid | 3,765 (11%) | 590 (20%) | 2,415 (23%) | 2,520 (30%) | 710 (26%) |  |
| Medicare | 14,500 (44%) | 770 (26%) | 4,310 (41%) | 2,040 (24%) | 820 (30%) |  |
| Other | 1,620 (4.9%) | 165 (5.7%) | 925 (8.7%) | 980 (12%) | 215 (7.9%) |  |
| Private | 13,190 (40%) | 1,395 (48%) | 2,970 (28%) | 2,880 (34%) | 975 (36%) |  |
| Hospital region |  |  |  |  |  | <0.001 |
| Midwest | 7,695 (23%) | 200 (6.8%) | 1,860 (17%) | 530 (6.3%) | 315 (12%) |  |
| Northeast | 6,215 (19%) | 695 (24%) | 1,880 (18%) | 1,430 (17%) | 960 (35%) |  |
| South | 12,355 (37%) | 395 (14%) | 5,660 (53%) | 2,935 (35%) | 735 (27%) |  |
| West | 6,875 (21%) | 1,635 (56%) | 1,265 (12%) | 3,525 (42%) | 710 (26%) |  |
| Hospital bedsize |  |  |  |  |  | 0.3 |
| Large | 21,870 (66%) | 2,080 (71%) | 6,890 (65%) | 5,420 (64%) | 1,830 (67%) |  |
| Medium | 7,055 (21%) | 560 (19%) | 2,485 (23%) | 1,980 (24%) | 575 (21%) |  |
| Small | 4,215 (13%) | 285 (9.7%) | 1,290 (12%) | 1,020 (12%) | 315 (12%) |  |
| Hospital location/teaching |  |  |  |  |  | <0.001 |
| Rural | 1,135 (3.4%) | 15 (0.5%) | 295 (2.8%) | 70 (0.8%) | 75 (2.8%) |  |
| Urban, non-teaching | 3,435 (10%) | 380 (13%) | 1,155 (11%) | 1,070 (13%) | 210 (7.7%) |  |
| Urban, teaching | 28,570 (86%) | 2,530 (86%) | 9,215 (86%) | 7,280 (86%) | 2,435 (90%) |  |
| *1*Mean (SD); n (%) | | | | | | |
| *2*Design-based KruskalWallis test; Pearson's X^2: Rao & Scott adjustment | | | | | | |

## Outcomes Table:

| **Characteristic** | **White** N = 33,140*1* | **Asian or Pacific Islander** N = 2,925*1* | **Black** N = 10,665*1* | **Hispanic** N = 8,420*1* | **Other** N = 2,720*1* | **p-value***2* |
| --- | --- | --- | --- | --- | --- | --- |
| Died during hospitalization | 320 (1.0%) | 35 (1.2%) | 160 (1.5%) | 85 (1.0%) | 40 (1.5%) | 0.3 |
| Length of stay (days) | 2 (1, 7) | 2 (1, 4) | 4 (1, 9) | 2 (1, 6) | 2 (1, 5) | <0.001 |
| Inflation-adjusted total charge ($) | 63,939 (38,613, 114,371) | 65,154 (40,721, 115,713) | 70,493 (41,580, 138,520) | 63,764 (41,137, 114,466) | 59,139 (38,174, 110,724) | <0.001 |
| Hypocalcemia | 4,310 (13%) | 420 (14%) | 1,065 (10.0%) | 1,545 (18%) | 400 (15%) | <0.001 |
| Hypoparathyroidism | 1,125 (3.4%) | 95 (3.2%) | 150 (1.4%) | 425 (5.0%) | 140 (5.1%) | <0.001 |
| Postoperative bleeding | 335 (1.0%) | 30 (1.0%) | 145 (1.4%) | 55 (0.7%) | 15 (0.6%) | 0.2 |
| *1*n (%); Median (Q1, Q3) | | | | | | |
| *2*Pearson's X^2: Rao & Scott adjustment; Design-based KruskalWallis test | | | | | | |

## Multivariable Logistic Regression:

### In-Hospital Mortality:

| **Characteristic** | **OR***1* | **95% CI***1* | **p-value** |
| --- | --- | --- | --- |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 1.52 | 0.67, 3.47 | 0.3 |
| Black | 1.12 | 0.71, 1.79 | 0.6 |
| Hispanic | 1.08 | 0.56, 2.06 | 0.8 |
| Other | 1.30 | 0.55, 3.06 | 0.6 |
| Age, y | 1.02 | 1.00, 1.04 | 0.066 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.23 | 0.84, 1.82 | 0.3 |
| Thyroidectomy type |  |  |  |
| Open | — | — |  |
| Laparoscopic | 0.90 | 0.59, 1.37 | 0.6 |
| Admission type |  |  |  |
| Elective | — | — |  |
| Non-elective | 6.13 | 3.43, 11.0 | <0.001 |
| Elixhauser comorbidity index | 1.45 | 1.35, 1.56 | <0.001 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 1.04 | 0.62, 1.75 | 0.9 |
| $66,000 - $87,999 | 1.08 | 0.64, 1.82 | 0.8 |
| $88,000 or more | 1.04 | 0.59, 1.84 | 0.9 |
| Insurance payer |  |  |  |
| Medicaid | — | — |  |
| Medicare | 1.04 | 0.54, 2.04 | 0.9 |
| Other | 1.20 | 0.45, 3.21 | 0.7 |
| Private | 0.87 | 0.44, 1.73 | 0.7 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 2.09 | 1.10, 3.95 | 0.024 |
| South | 0.91 | 0.52, 1.59 | 0.7 |
| West | 1.48 | 0.84, 2.61 | 0.2 |
| Hospital bedsize |  |  |  |
| Large | — | — |  |
| Medium | 1.62 | 1.04, 2.52 | 0.033 |
| Small | 0.87 | 0.45, 1.70 | 0.7 |
| Hospital location/teaching |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 0.96 | 0.29, 3.25 | >0.9 |
| Urban, teaching | 0.63 | 0.20, 1.95 | 0.4 |
| *1*OR = Odds Ratio, CI = Confidence Interval | | | |

### Hypocalcemia:

| **Characteristic** | **OR***1* | **95% CI***1* | **p-value** |
| --- | --- | --- | --- |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 1.09 | 0.84, 1.42 | 0.5 |
| Black | 0.72 | 0.61, 0.86 | <0.001 |
| Hispanic | 1.34 | 1.13, 1.59 | <0.001 |
| Other | 1.08 | 0.81, 1.43 | 0.6 |
| Age, y | 0.98 | 0.97, 0.98 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 0.85 | 0.75, 0.96 | 0.009 |
| Thyroidectomy type |  |  |  |
| Open | — | — |  |
| Laparoscopic | 0.13 | 0.09, 0.19 | <0.001 |
| Admission type |  |  |  |
| Elective | — | — |  |
| Non-elective | 0.76 | 0.65, 0.90 | <0.001 |
| Elixhauser comorbidity index | 1.17 | 1.14, 1.20 | <0.001 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 0.97 | 0.83, 1.13 | 0.7 |
| $66,000 - $87,999 | 1.04 | 0.89, 1.22 | 0.6 |
| $88,000 or more | 1.13 | 0.94, 1.35 | 0.2 |
| Insurance payer |  |  |  |
| Medicaid | — | — |  |
| Medicare | 0.91 | 0.76, 1.09 | 0.3 |
| Other | 1.04 | 0.82, 1.32 | 0.7 |
| Private | 0.89 | 0.76, 1.04 | 0.13 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 0.67 | 0.54, 0.83 | <0.001 |
| South | 0.80 | 0.66, 0.97 | 0.026 |
| West | 0.73 | 0.60, 0.90 | 0.002 |
| Hospital bedsize |  |  |  |
| Large | — | — |  |
| Medium | 1.08 | 0.93, 1.27 | 0.3 |
| Small | 1.03 | 0.85, 1.25 | 0.7 |
| Hospital location/teaching |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 0.63 | 0.43, 0.91 | 0.014 |
| Urban, teaching | 0.64 | 0.46, 0.89 | 0.008 |
| *1*OR = Odds Ratio, CI = Confidence Interval | | | |

### Hypoparathyroidism:

| **Characteristic** | **OR***1* | **95% CI***1* | **p-value** |
| --- | --- | --- | --- |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 1.03 | 0.61, 1.75 | >0.9 |
| Black | 0.38 | 0.26, 0.58 | <0.001 |
| Hispanic | 1.38 | 1.04, 1.82 | 0.025 |
| Other | 1.33 | 0.74, 2.39 | 0.3 |
| Age, y | 0.98 | 0.97, 0.99 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 0.94 | 0.75, 1.17 | 0.6 |
| Thyroidectomy type |  |  |  |
| Open | — | — |  |
| Laparoscopic | 0.10 | 0.04, 0.29 | <0.001 |
| Admission type |  |  |  |
| Elective | — | — |  |
| Non-elective | 0.53 | 0.37, 0.76 | <0.001 |
| Elixhauser comorbidity index | 1.20 | 1.14, 1.26 | <0.001 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 0.98 | 0.73, 1.33 | >0.9 |
| $66,000 - $87,999 | 1.08 | 0.81, 1.45 | 0.6 |
| $88,000 or more | 1.14 | 0.82, 1.58 | 0.4 |
| Insurance payer |  |  |  |
| Medicaid | — | — |  |
| Medicare | 0.58 | 0.40, 0.84 | 0.005 |
| Other | 1.08 | 0.74, 1.58 | 0.7 |
| Private | 0.74 | 0.55, 1.00 | 0.049 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 0.56 | 0.37, 0.82 | 0.004 |
| South | 0.96 | 0.70, 1.32 | 0.8 |
| West | 0.59 | 0.42, 0.83 | 0.003 |
| Hospital bedsize |  |  |  |
| Large | — | — |  |
| Medium | 0.60 | 0.44, 0.82 | 0.001 |
| Small | 0.71 | 0.48, 1.03 | 0.074 |
| Hospital location/teaching |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 0.45 | 0.19, 1.05 | 0.063 |
| Urban, teaching | 0.99 | 0.51, 1.91 | >0.9 |
| *1*OR = Odds Ratio, CI = Confidence Interval | | | |

### Postoperative bleeding:

| **Characteristic** | **OR***1* | **95% CI***1* | **p-value** |
| --- | --- | --- | --- |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 1.48 | 0.59, 3.73 | 0.4 |
| Black | 1.46 | 0.89, 2.37 | 0.13 |
| Hispanic | 0.90 | 0.47, 1.74 | 0.8 |
| Other | 0.70 | 0.22, 2.28 | 0.6 |
| Age, y | 1.00 | 0.98, 1.01 | 0.9 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.34 | 0.91, 1.97 | 0.14 |
| Thyroidectomy type |  |  |  |
| Open | — | — |  |
| Laparoscopic | 0.08 | 0.02, 0.35 | <0.001 |
| Admission type |  |  |  |
| Elective | — | — |  |
| Non-elective | 1.17 | 0.71, 1.92 | 0.5 |
| Elixhauser comorbidity index | 1.01 | 0.93, 1.11 | 0.8 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 1.10 | 0.67, 1.82 | 0.7 |
| $66,000 - $87,999 | 1.05 | 0.60, 1.85 | 0.9 |
| $88,000 or more | 1.06 | 0.59, 1.90 | 0.9 |
| Insurance payer |  |  |  |
| Medicaid | — | — |  |
| Medicare | 2.60 | 1.28, 5.28 | 0.008 |
| Other | 1.82 | 0.70, 4.73 | 0.2 |
| Private | 1.47 | 0.73, 2.94 | 0.3 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 0.54 | 0.28, 1.05 | 0.069 |
| South | 0.68 | 0.42, 1.09 | 0.11 |
| West | 0.63 | 0.35, 1.13 | 0.12 |
| Hospital bedsize |  |  |  |
| Large | — | — |  |
| Medium | 1.38 | 0.89, 2.15 | 0.15 |
| Small | 1.73 | 1.02, 2.92 | 0.042 |
| Hospital location/teaching |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 0.60 | 0.27, 1.33 | 0.2 |
| Urban, teaching | 0.24 | 0.12, 0.48 | <0.001 |
| *1*OR = Odds Ratio, CI = Confidence Interval | | | |

## Multivariable Linear Regression:

### Length of Stay:

| **Characteristic** | **Beta** | **95% CI***1* | **p-value** |
| --- | --- | --- | --- |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | -0.40 | -1.0, 0.21 | 0.2 |
| Black | 1.3 | 0.73, 1.8 | <0.001 |
| Hispanic | 0.32 | -0.27, 0.90 | 0.3 |
| Other | 0.06 | -0.90, 1.0 | >0.9 |
| Age, y | 0.00 | -0.01, 0.02 | 0.6 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.6 | 1.2, 2.0 | <0.001 |
| Thyroidectomy type |  |  |  |
| Open | — | — |  |
| Laparoscopic | -2.1 | -3.1, -1.1 | <0.001 |
| Admission type |  |  |  |
| Elective | — | — |  |
| Non-elective | 6.6 | 5.8, 7.4 | <0.001 |
| Elixhauser comorbidity index | 1.5 | 1.3, 1.6 | <0.001 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | -0.31 | -0.84, 0.22 | 0.3 |
| $66,000 - $87,999 | -0.01 | -0.57, 0.54 | >0.9 |
| $88,000 or more | -0.28 | -0.86, 0.31 | 0.4 |
| Insurance payer |  |  |  |
| Medicaid | — | — |  |
| Medicare | -2.2 | -2.9, -1.4 | <0.001 |
| Other | -1.5 | -2.4, -0.60 | <0.001 |
| Private | -1.9 | -2.6, -1.3 | <0.001 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 0.09 | -0.62, 0.81 | 0.8 |
| South | 0.30 | -0.23, 0.83 | 0.3 |
| West | -0.39 | -0.95, 0.18 | 0.2 |
| Hospital bedsize |  |  |  |
| Large | — | — |  |
| Medium | -0.27 | -0.81, 0.28 | 0.3 |
| Small | -0.48 | -1.1, 0.11 | 0.11 |
| Hospital location/teaching |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | -0.36 | -1.4, 0.72 | 0.5 |
| Urban, teaching | 0.19 | -0.73, 1.1 | 0.7 |
| *1*CI = Confidence Interval | | | |

### Inflation-Adjusted Total Charge:

| **Characteristic** | **Beta** | **95% CI***1* | **p-value** |
| --- | --- | --- | --- |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | -4,088 | -15,950, 7,774 | 0.5 |
| Black | 15,421 | 5,714, 25,128 | 0.002 |
| Hispanic | 5,044 | -5,029, 15,116 | 0.3 |
| Other | 15,886 | -5,690, 37,461 | 0.15 |
| Age, y | -127 | -359, 104 | 0.3 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 30,451 | 22,963, 37,938 | <0.001 |
| Thyroidectomy type |  |  |  |
| Open | — | — |  |
| Laparoscopic | -69,815 | -86,646, -52,984 | <0.001 |
| Admission type |  |  |  |
| Elective | — | — |  |
| Non-elective | 84,589 | 70,987, 98,191 | <0.001 |
| Elixhauser comorbidity index | 23,020 | 20,693, 25,346 | <0.001 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | -1,144 | -10,659, 8,371 | 0.8 |
| $66,000 - $87,999 | 662 | -9,202, 10,525 | 0.9 |
| $88,000 or more | -5,787 | -16,374, 4,800 | 0.3 |
| Insurance payer |  |  |  |
| Medicaid | — | — |  |
| Medicare | -14,744 | -26,932, -2,556 | 0.018 |
| Other | -9,005 | -24,486, 6,475 | 0.3 |
| Private | -14,273 | -24,081, -4,466 | 0.004 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 19,708 | 5,991, 33,425 | 0.005 |
| South | 11,830 | 2,207, 21,454 | 0.016 |
| West | 40,067 | 28,018, 52,115 | <0.001 |
| Hospital bedsize |  |  |  |
| Large | — | — |  |
| Medium | -6,847 | -16,844, 3,150 | 0.2 |
| Small | -22,705 | -32,376, -13,034 | <0.001 |
| Hospital location/teaching |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 25,162 | 6,160, 44,164 | 0.009 |
| Urban, teaching | 25,521 | 10,966, 40,075 | <0.001 |
| *1*CI = Confidence Interval | | | |