



## Racial disparities in surgical outcomes for benign thyroid disease

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### ARTICLE INFO

#### Article history:

Received 15 February 2020

Received in revised form

22 April 2020

Accepted 25 June 2020

#### Keywords:

Benign thyroid disease

Endocrine surgery

Racial disparities

Neck hematoma

Recurrent laryngeal nerve injury

Hypocalcemia

### ABSTRACT

**Introduction:** Previous studies have shown racial disparities in surgical outcomes in malignant thyroid disease. We hypothesize that minority groups have a higher incidence of postoperative complications following surgery for benign thyroid disease.

**Methods:** Using NSQIP (2016–2017), patients (>17 years) undergoing thyroid surgery for benign disease were identified. Outcomes included neck hematoma, recurrent laryngeal nerve (RLN) injury, and hypocalcemia. Multivariate analysis was performed controlling for patient factors.

**Results:** 6817 patients were identified. Postoperative outcomes were neck hematoma (2.0%), RLN injury (5.2%), and significant hypocalcemia (4.9%). Compared to White patients, Black patients had higher chance of neck hematoma (OR 2.32, 95% CI 1.51–3.55) and RLN injury (OR 1.97, 95% CI 1.53–2.55) while Asian patients had significantly greater odds of RLN injury (OR 1.88, 95% CI 1.15–3.06).

**Conclusion:** Minority compared to White patients are more likely to have significant postoperative complications which indicates racial disparities in the surgical treatment for benign thyroid disease.

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### Introduction

Benign thyroid disorders such as symptomatic goiter, benign adenoma and Graves' disease, are common indications for partial and total thyroidectomy. The incidence of these conditions increases with patient age, female sex, history of iodine deficiency, presence of other autoimmune disorders, and after radiation exposure.<sup>1</sup> With widespread use of sensitive imaging and laboratory diagnostics, thyroid diseases are being discovered with increasing frequency.<sup>1</sup> Surgical management via resection is common, and when performed at high volume centers postoperative complications are rare.<sup>2–6</sup> However, it has been shown that differences in clinical outcomes among patients of low socioeconomic status and minority racial groups after thyroid surgery do exist.<sup>7–10</sup>

In general, racial disparities related to access and quality of health care has been well documented. Consistently, data show worse outcomes in minority populations for diseases with previously defined treatment approaches.<sup>11–14</sup> Surgery is no exception, and despite increased awareness, an incomplete understanding of the underlying mechanisms allows these inequities to persist. The issues are likely multifactorial, including delays in diagnosis,

advanced disease at presentation, poor health literacy, mistrust of health care personnel, and other less obvious factors stemming from implicit biases of health care providers.<sup>11–14</sup>

Previous studies have shown that there are significant gender, socioeconomic and racial disparities in both negative outcomes and survival after thyroid surgery when specifically performed for malignancy.<sup>15</sup> Non-white patients have higher postoperative mortality rates when compared with white patients.<sup>16</sup> Radowski et al. demonstrates a greater incidence of self-reported negative voice outcomes among black patients following thyroid and parathyroid surgery.<sup>17</sup> Dehal et al. identified black race as an independent risk factor for development of neck hematoma after thyroid and parathyroid surgery.<sup>18</sup> Comparative analysis of peri/postoperative clinical outcomes for minority groups undergoing surgery for benign thyroid disease has not been previously described in the literature. Considering this, in our study we aimed to characterize the clinical outcomes of racial groups following total and partial thyroidectomy for nonmalignant disease. We hypothesize that when compared to white patients, minority groups have a higher incidence of postoperative complications.

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## Methods

The American College of Surgeons National Surgical Quality Improvement Program (NSQIP) was utilized for this study. NSQIP is a retrospective, multi-institutional database that collects surgery specific outcomes. The NSQIP Thyroidectomy targeted database that collects thyroidectomy specific variables and outcomes was utilized. This study was deemed exempt from International Review Board review from the Yale Human Investigations Committee.

All adult patients (>17 years) undergoing either total or partial thyroidectomy for an indication other than malignancy between 2016 and 2017 were included. Surgical indications of benign thyroid disease included Graves' disease, goiter, adenoma, and "other benign nodule" (Hashimoto's thyroiditis, hyperplastic nodule, colloid nodule, pseudo-nodule, trabecular adenoma). Race was categorized as white, black, hispanic, and asian. Patients included in the NSQIP database without a documented race were sorted in an other/unknown category and included in the final analysis. Other demographics evaluated included gender (male or female), age group ( $\leq 40$ , 41–65, 66–79,  $\geq 80$ ), BMI (underweight [ $\leq 18.5$ ], normal weight [18.5–24.9], overweight [25–29.9], obese [ $\geq 30$ ], unknown), previous neck surgery (including any and all neck surgery, regardless of side) and surgical indication.

Outcomes of interest include neck hematoma, recurrent laryngeal nerve (RLN) injury, clinically significant hypocalcemia as well as any surgical complications not including the previous. Clinically significant postoperative neck hematoma is defined as a patient developing a cervical hematoma that resulted in increased length of stay, readmission, or intervention including open evacuation or bedside aspiration. Injury or dysfunction of the RLN is defined as evidence of persistent hoarseness or vocal cord dysfunction beyond the first postoperative day. Including only cases beyond the first postoperative day is an effort to minimize the misclassification of patients who may have soreness or hoarseness immediately after postoperative extubation. Data for this outcome is only recorded for the first 30 days postoperatively and no further. Clinically severe postoperative hypocalcemia is defined as if the patient was evaluated in the emergency department or in an office setting because of signs and symptoms potentially related to low calcium levels; admitted to a health care facility for the signs, symptoms, or treatment of low calcium levels; or was prescribed intravenous calcium. Data for this outcome is collected for the first 30 days postoperatively and no further. And lastly, surgical complications is a cumulative outcome that includes the incidence of all wound infections, cardiac events, deep venous thrombosis and pulmonary embolism, respiratory complications such as pneumonia, postoperative bleeding, neurologic complications such as stroke and transient ischemic attack, renal failure, urinary tract infections, and sepsis. The incidence of each postoperative outcome was recorded as the (n) number and cumulative percentages in each category.

Univariate and multivariate logistic regression models were performed to analyze the association between these complications and patient race. In the univariate model, the occurrence rate of neck hematoma, RLN injury, hypocalcemia and surgical complications was compared between each patient race and chi-square analysis was used for determination of statistical significance. Multivariate models controlled for patient age, gender, BMI, indication for surgery, history of neck surgery, renal disease requiring dialysis, ASA class, and type of operation (partial thyroidectomy, total thyroidectomy, or thyroidectomy with extended dissection). In the final multivariate model, race was a covariate independently associated with each of the post thyroidectomy outcomes of interest. Using white race as a baseline, odds ratios with 95% confidence intervals were determined.

## Results

From 2016 to 2017, there was a total 6187 patients from the NSQIP Thyroidectomy targeted database included in the study who had undergone partial or total thyroidectomy for an indication other than malignancy. As seen in [Table 1](#), the most common age group was 40–65 years (56.5%) and 5584 (81.3%) were female. The largest percentage of patients were classified as obese, defined as a BMI  $>30$  (48%). Most patients (92.4%) did not have a history of previous neck surgery. Among the included patients, 3780 (55%) were non-hispanic white, 1376 (20%) were black, 316 (4.6%) hispanic, 283 (4.1%) asian, and 1129 (16.4%) were designated as other/unknown. The most common indications for surgery were goiter with 4475 (65%), followed by adenoma with 764 (11.1%), other benign nodule with 722 (10.5%), Graves' disease with 664 (9.7%), and severe goiter with 259 (3.8%). Race specific outcomes of interest include.

Overall postoperative outcomes for all patients revealed 135 (2.0%) who suffered a postoperative neck hematoma, 357 (5.2%) who sustained RLN injury, and 336 (4.9%) who developed significant hypocalcemia ([Table 2](#)). 128 (1.9%) patients had a surgical complication not specific to thyroid operations and 178 (2.6%) patients were readmitted to the hospital within 30 days of their operation. Two patients died within 30 days of their operation. When evaluating by race, black patients had the highest incidence of neck hematoma (3.1%), which was significantly higher when compared with white patients ([Fig. 1](#)). Hispanic (1.0%) and asian (1.8%) race had similar incidence of neck hematoma to white patients (1.3%). Black patients had a higher incidence of RLN injury within 30 days (8.7%), followed closely by asian patients (7.1%). The higher incidence with both race groups were statistically significant when compared to white patients. Hispanic patients (4.1%) had similar incidence of RLN injury when compared to white patients (4.3%). Hispanic patients had a higher incidence of hypocalcemia within 30 days (7.3%), although not statistically significant when compared to white (4.3%), black (5.2%), and asian patients (4.2%). Black patients had a higher incidence of surgical complications (2.5%) which was statistically significant from white (1.4%), hispanic (0.6%) and asian (1.4%) patients. No significant difference was seen between the race groups when comparing the rates of readmission within 30 days of surgery.

When controlling for demographics and clinical factors ([Table 3](#)) black race was associated with greater odds of postoperative neck hematoma (OR 2.46, 95% CI 1.61–3.77) when compared with white race. Black race was associated with greater odds of RLN injury (OR 1.93, 95% CI 1.50–2.49) when compared to white race. Black race was associated with greater odds of surgical complications (OR 1.82, 95% CI 1.17–2.83) when compared to white race. Asian patients also had significantly greater odds of RLN injury (OR 1.83, 95% CI 1.12–2.97) when compared to white patients. Hispanic patients had similar outcomes to white patients; however, they trended towards greater odds of postoperative hypocalcemia (OR 1.38, 95% CI 0.86–2.22).

## Discussion

This study demonstrates that after controlling for other demographic and clinical variables, patient race is significantly associated with specific outcomes after partial and total thyroidectomy. Our data highlight that there is an increased incidence of significant neck hematoma among black patients after partial and total thyroidectomy. There is increased incidence of recurrent laryngeal nerve injury among both black and asian patients. There is a trend showing increasing cases of postoperative hypocalcemia among hispanic patients when compared to white patients, although not

**Table 1**

Demographics of patients categorized by race group as well as overall values. Adenoma (\*) includes follicular adenoma and Hurtle Cell variant. Other benign disease (\*\*) includes hyperplastic nodule, colloid nodule, Hashimoto's thyroiditis, pseudo-nodule and trabecular adenoma.

Table 1: Patient Demographics						
	Overall (%)	White (%)	Black (%)	Hispanic (%)	Asian (%)	p
<b>Gender</b>						0.08
Female	5594 (81.3)	3042 (80.5)	1152 (83.7)	262 (82.9)	232 (82.0)	
Male	1290 (18.7)	738 (19.5)	224 (16.3)	54 (17.1)	51 (18.0)	
<b>Age Group</b>						<0.01
<40	1444 (21.0)	715 (18.9)	306 (22.2)	106 (33.5)	71 (25.1)	
40-65	3892 (56.5)	2118 (56.0)	825 (60.0)	167 (52.9)	147 (51.9)	
66-79	1414 (20.5)	868 (23.0)	230 (16.7)	34 (10.8)	63 (22.3)	
>80	134 (2.0)	79 (2.1)	15 (1.1)	9 (2.8)	2 (0.7)	
<b>BMI</b>						<0.01
Underweight	64 (0.9)	34 (0.9)	8 (0.6)	1 (0.3)	6 (2.1)	
Normal Weight	1510 (22.1)	833 (22.1)	162 (11.9)	49 (15.6)	148 (52.3)	
Overweight	1983 (29.0)	1108 (29.4)	319 (23.3)	108 (34.4)	86 (30.4)	
Obese	3288 (48.0)	1790 (47.5)	878 (64.2)	156 (49.7)	43 (15.2)	
<b>Surgical Indication</b>						<0.01
Graves' Disease	664 (9.7)	273 (7.2)	184 (13.4)	67 (21.2)	37 (13.1)	
Goiter	4475 (65.0)	2551 (67.5)	978 (71.1)	178 (56.3)	202 (71.4)	
Severe Goiter	259 (3.8)	118 (3.1)	77 (5.6)	12 (3.8)	4 (1.4)	
Adenoma*	764 (11.1)	417 (11.0)	64 (4.6)	38 (12.0)	20 (7.1)	
Other Benign Disease**	722 (10.5)	421 (11.1)	73 (5.3)	21 (6.6)	20 (7.1)	
<b>History of Neck Surgery</b>						0.42
Yes	6362 (92.4)	3477 (92.0)	1270 (92.3)	296 (93.7)	266 (94.0)	
No	522 (7.6)	303 (8.0)	106 (7.7)	20 (6.3)	17 (6.0)	
<b>Total</b>	6884	3780 (54.9)	1376 (20.0)	316 (4.6)	283 (4.1)	

found to be statistically significant. And lastly, we see that black race is a significant risk factor for combined postoperative surgical complications not specific to thyroidectomy such as venous thromboembolism and urinary tract infections when compared to white race. These findings are congruent with other studies that have looked at similar clinical outcomes for cases of partial and total thyroidectomy for malignancy.<sup>16,19–22</sup>

When trying to understand why these disparities exist, it is first important to look critically at how regulating bodies in medicine approach standardization of care. There have been studies that have analyzed the temporal trends of appropriate surgical care for thyroid cancer, utilizing the American Thyroid Association (ATA) and National Comprehensive Cancer Network (NCCN) guidelines

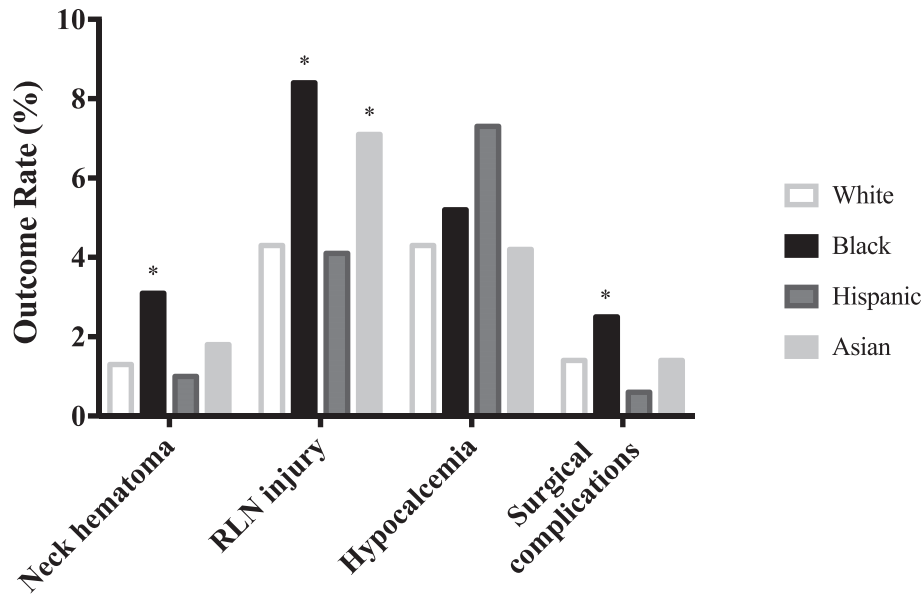
for the use of total thyroidectomy versus partial thyroidectomy, and use of adjuvant radioactive iodine (RAI).<sup>20</sup> Sosa et al. showed that more blacks and hispanics underwent partial thyroidectomy (57% for both) when compared to whites (43%) which arguably may not have been appropriate for malignancy of intermediate and high risk.<sup>23</sup> Shah et al. illustrated that there was a higher likelihood of RAI undertreatment in minority groups when compared to white patients, and a lower likelihood of RAI overtreatment in minority groups in comparison to white patients.<sup>20,24</sup> Notably, the data show that the rates of inappropriate management have decreased over time for both white and minority populations, however, the rate of change has been significantly slower for minorities.<sup>20,23,24</sup>

When referred to a surgeon, many minority patients have

**Table 2**

Incidence of negative postoperative outcomes in the population of patients studied. Surgical complications is a cumulative outcome that includes incidence of all wound infections, cardiac events, deep venous thrombosis and pulmonary embolism, respiratory complications such as pneumonia, postoperative bleeding, neurologic complications such as stroke and transient ischemic attack, renal failure, urinary tract infections, and sepsis.

Table 2: Overall Postoperative Outcomes	
Outcome	n (%)
<b>Neck hematoma</b>	
No	6662 (96.8)
Yes	135 (2.0)
Missing/Unknown	87 (1.3)
<b>Recurrent laryngeal nerve injury</b>	
No	6410 (93.1)
Yes	357 (5.2)
Missing/Unknown	117 (1.7)
<b>Hypocalcemia</b>	
No	6177 (89.7)
Yes	336 (4.9)
Missing/Unknown	371 (5.4)
<b>Surgical complications</b>	
No	6576 (98.1)
Yes	128 (1.9)



**Fig. 1.** Incidence rates (%) of negative outcomes after surgery for benign thyroid disease categorized by race including neck hematoma ( $p < 0.01$ ), recurrent laryngeal nerve injury or dysfunction ( $p < 0.01$ ), significant hypocalcemia ( $p < 0.01$ ), and other surgical complications ( $p < 0.01$ ). Asterisk (\*) represents a statistically significant difference in outcome rate ( $p$  value  $< 0.05$ ) for a particular race group when compared to the reference (white race).

advanced disease presentation or tumors with more aggressive features such as extrathyroidal extension or lymph node positivity.<sup>19–22</sup> The reason for this is likely multifactorial. Harari et al. showed that in a sample size of approximately 26 thousand patients, minority groups and those of lower socioeconomic status were found to have a higher percentage of metastatic and regional disease at presentation when compared with white patients.<sup>22</sup> Access to care and tumor biology were discussed as explanations for this disparity, however, notably the authors found no differences in aggressive well differentiated thyroid cancer (WDTC) tumor types among races.<sup>22</sup> Kuo et al. primarily focused on disparities in initial presentation of benign thyroid disease requiring surgical resection, and saw that black patients were much more likely to be referred to a surgeon after a longer disease duration when compared to white patients, and black patients commonly presented with compressive symptoms and/or dysphagia.<sup>25</sup> Delayed presentation may lead to advanced inflammation and fibrosis in Graves' disease or permit multinodular goiters that are larger in size with distorted anatomy, increasing the complexity of surgical resection.<sup>26–29</sup>

Theoretically, more advanced disease presentation is likely to contribute to worse postoperative outcomes, however it is unclear if this is the sole reason for such disparate results. It has been shown that patients who are referred to experienced surgeons at high-volume centers consistently have superior outcomes when compared to low-volume surgeons.<sup>2–6</sup> A few studies documented

results of inpatient versus outpatient surgery for thyroid disease, along with models to determine risk factors for negative outcomes.<sup>2–6</sup> Patients who had a planned same day discharge from the hospital postoperatively had improved clinical outcomes when compared to patients who were admitted to an inpatient service.<sup>2,3</sup> There were several factors identified to be a risk for poor negative outcome including advanced age  $>70$ , dependent functional status, as well as “non-Caucasian” race with a significant odds ratio of 1.48<sup>3</sup>. The persistent theme is that these ambulatory cases were performed by surgeons with high clinical volume. Interestingly, it was also seen that the majority demographic of patients receiving outpatient surgery were white, female, and possessed a higher median income.<sup>2</sup>

The lack of prompt surgical and/or specialist referral and unequal access to care for minority groups are pervasive in several aspects of healthcare. A strong patient-physician relationship is quintessential to allow for appropriate and timely treatment of patients; however, breakdown of this relationship can occur on both sides. Groups have looked at the mistrust that minority populations may have of healthcare and the fear that physicians would not act in their best interest. Various reasons for this include historical atrocities (i.e. Tuskegee Syphilis Study), anecdotal experiences by individual patients, or even negative myths regarding surgeons and surgery that is spread within communities. Implicit biases of healthcare professionals of any race (minority or otherwise) exist, and subconsciously drives clinical decision making.

**Table 3**  
Multivariate analysis of negative outcomes after surgery for benign thyroid disease categorized by race. Odds ratios with 95% confidence intervals were calculated after controlling for demographic variables and compared to white race as reference.

Table 3: Multivariate Logistic Regression Model of Postoperative Outcomes by Race				
Race	Neck hematoma OR (95% CI)	RLN injury OR (95% CI)	Hypocalcemia OR (95% CI)	Surgical complications OR (95% CI)
White	Reference	Reference	Reference	Reference
Black	2.46 (1.61–3.77)	1.93 (1.50–2.49)	0.92 (0.68–1.23)	1.82 (1.17–2.83)
Hispanic	0.78 (0.24–2.54)	1.05 (0.58–1.88)	1.38 (0.86–2.22)	0.47 (0.11–1.96)
Asian	1.40 (0.55–3.56)	1.83 (1.12–2.97)	0.97 (0.53–1.83)	1.10 (0.40–3.09)

Reprimanding poor punctuality in outpatient clinic, questioning if a patient will adhere to a treatment regimen, or difficulty in communication due to education level differences, unfortunately can drive physicians to circumvent usual care, and perpetuate the breakdown of the patient-physician relationship.<sup>30,31</sup> Efforts to improve the problem must be placed on both sides of the equation. First, by increasing outreach to minority and low-income communities, relationships with healthcare providers will be built and this will strengthen trust in the healthcare system. The health literacy in these communities will grow as education is spread on the importance of early diagnosis and prompt surgical treatment when appropriate. And second, healthcare providers should become more knowledgeable of both the obvious and subtle barriers to healthcare these communities face and grow empathetic to their challenges.

This study has some limitations. Although NSQIP is a large database that has been utilized in numerous studies on surgical outcomes, the data gathered is from participating hospitals only, which may not be nationally representative. As with many clinical databases, there is missing or incomplete information on patients, which can affect the validity of any observed phenomena. However, our study had a large sample size of over 6800 patients and an appropriately powered statistical analysis. It is important to note that NSQIP does not include “hospital type” or “surgeon level” as independent variables, which eliminates the ability to confirm disparities in patient referral patterns. The clinical outcomes including hypocalcemia and recurrent laryngeal nerve injury are only measured for 30 days postoperatively, which impedes the ability to determine whether the insult is permanent or temporary. Postoperative hypocalcemia requiring prolonged oral calcium supplementation may affect patient quality of life and is a morbid complication, but this is not specifically included in the definition of hypocalcemia. This omission could mask any significant differences in outcomes between race groups. Another limitation is the inability to determine causality with a retrospective study. There are unique social differences and both implicit and explicit biases between populations of people in different race groups that cannot be measured quantitatively in a retrospective analysis such as this. Even with these acknowledged limitations, this study appropriately adds to the growing body of literature illustrating the differences in clinical outcomes seen between racial and ethnic groups.

In conclusion, we found that rates of postoperative complications for benign thyroid disease are significantly different for certain minority groups when compared to white patients, concordant with results found in studies analyzing malignant thyroid disease. While these disparities could be explained by advanced disease at initial presentation and disproportionate referral and/or access to experienced high-volume surgeons, there is still work to be done in elucidating any and all causes of disparities and addressing them in order to improve standardization of healthcare.

## Declaration of competing interest

No disclosures or conflict of interest among all authors.

## References

- Vanderpump MP. The epidemiology of thyroid disease. *Br Med Bull.* 2011;99:39–51. <https://doi.org/10.1093/bmb/ldr030>.
- Al-Qurayshi Z, Srivastav S, Kandil E. Comparison of inpatient and outpatient thyroidectomy: demographic and economic disparities. *Eur J Surg Oncol.* 2016;42(7):1002–1008. <https://doi.org/10.1016/j.ejso.2016.03.010>.
- Tuggle CT, Roman S, Udelsman R, Sosa JA. Same-day thyroidectomy: a review of practice patterns and outcomes for 1,168 procedures in New York State. *Ann Surg Oncol.* 2011;18(4):1035–1040. <https://doi.org/10.1245/s10434-010-1398-0>.
- Hauch A, Al-Qurayshi Z, Randolph G, Kandil E. The importance of surgical volume on outcomes in thyroid surgery revisited: old is in again: editorial response to “what’s old is new again” by Julie Ann Sosa (doi: 10.1245/s10434-014-3850-z). *Ann Surg Oncol.* 2014;21(12):3721–3722. <https://doi.org/10.1245/s10434-014-3993-y>.
- Boudourakis LD, Wang TS, Roman SA, Desai R, Sosa JA. Evolution of the surgeon-volume, patient-outcome relationship. *Ann Surg.* 2009;250(1):159–165. <https://doi.org/10.1097/SLA.0b013e3181a77cb3>.
- Sosa JA, Bowman HM, Tielsch JM, Powe NR, Gordon TA, Udelsman R. The importance of surgeon experience for clinical and economic outcomes from thyroidectomy. *Ann Surg.* 1998;228(3):320–330. <https://doi.org/10.1097/0000658-199809000-00005>.
- Caulley L, Johnson-Obaseki S, Luo L, Javidnia H. Risk factors for postoperative complications in total thyroidectomy: a retrospective, risk-adjusted analysis from the National Surgical Quality Improvement Program. *Medicine (Baltim).* 2017;96(5), e5752. <https://doi.org/10.1097/MD.00000000000005752>.
- Kwon HJ, Morton RP. Ethnic disparities in thyroid surgery outcomes in New Zealand. *ANZ J Surg.* 2017;87(7-8):610–614. <https://doi.org/10.1111/ans.13142>.
- Hauch A, Al-Qurayshi Z, Friedlander P, Kandil E. Association of socioeconomic status, race, and ethnicity with outcomes of patients undergoing thyroid surgery. *JAMA Otolaryngol Head Neck Surg.* 2014;140(12):1173–1183. <https://doi.org/10.1001/jamaoto.2014.1745>.
- Nourelidine SI, Genther DJ, Lopez M, Agrawal N, Tufano RP. Early predictors of hypocalcemia after total thyroidectomy: an analysis of 304 patients using a short-stay monitoring protocol. *JAMA Otolaryngol Head Neck Surg.* 2014;140(11):1006–1013. <https://doi.org/10.1001/jamaoto.2014.2435>.
- Haider AH, Scott VK, Rehman KA, et al. Racial disparities in surgical care and outcomes in the United States: a comprehensive review of patient, provider, and systemic factors. *J Am Coll Surg.* 2013;216(3):482–492. <https://doi.org/10.1016/j.jamcollsurg.2012.11.014>. e412.
- Britton BV, Nagarajan N, Zogg CK, et al. Awareness of racial/ethnic disparities in surgical outcomes and care: factors affecting acknowledgment and action. *Am J Surg.* 2016;212(1):102–108. <https://doi.org/10.1016/j.amjsurg.2015.07.022>. e102.
- Elfenbein DM, Schneider DF, Havlena J, Chen H, Sippel RS. Clinical and socioeconomic factors influence treatment decisions in Graves’ disease. *Ann Surg.* 2015;224(4):1196–1199. <https://doi.org/10.1245/s10434-014-4095-6>.
- Jin J, Sandoval V, Lawless ME, Sehgal AR, McHenry CR. Disparity in the management of Graves’ disease observed at an urban county hospital: a decade-long experience. *Am J Surg.* 2012;204(2):199–202. <https://doi.org/10.1016/j.amjsurg.2011.10.010>.
- Al-Qurayshi Z, Randolph GW, Srivastav S, Kandil E. Outcomes in endocrine cancer surgery are affected by racial, economic, and healthcare system demographics. *Laryngoscope.* 2016;126(3):775–781. <https://doi.org/10.1002/lary.25606>.
- Asban A, Chung SK, Xie R, et al. Gender and racial disparities in survival after surgery among papillary and patients with follicular thyroid cancer: a 45-year experience. *Clin Med Insights Endocrinol Diabetes.* 2019;12. <https://doi.org/10.1177/1179551419866196>, 1179551419866196.
- Radowsky JS, Helou LB, Howard RS, Solomon NP, Stojadinovic A. Racial disparities in voice outcomes after thyroid and parathyroid surgery. *Surgery.* 2013;153(1):103–110. <https://doi.org/10.1016/j.surg.2012.06.001>.
- Dehal A, Abbas A, Hussain F, Johns S. Risk factors for neck hematoma after thyroid or parathyroid surgery: ten-year analysis of the nationwide inpatient sample database. *Perm J.* 2015;19(1):22–28. <https://doi.org/10.7812/TPP/14-085>.
- Tang J, Kong D, Cui Q, et al. Racial disparities of differentiated thyroid carcinoma: clinical behavior, treatments, and long-term outcomes. *World J Surg Oncol.* 2018;16(1):45. <https://doi.org/10.1186/s12957-018-1340-7>.
- Shah SA, Adam MA, Thomas SM, et al. Racial disparities in differentiated thyroid cancer: have we bridged the gap? *Thyroid.* 2017;27(6):762–772. <https://doi.org/10.1089/thy.2016.0626>.
- Garner EF, Maizlin II, Dellinger MB, et al. Effects of socioeconomic status on children with well-differentiated thyroid cancer. *Surgery.* 2017;162(3):662–669. <https://doi.org/10.1016/j.surg.2017.04.008>.
- Harari A, Li N, Yeh MW. Racial and socioeconomic disparities in presentation and outcomes of well-differentiated thyroid cancer. *J Clin Endocrinol Metab.* 2014;99(1):133–141. <https://doi.org/10.1210/jc.2013-2781>.
- Sosa JA, Mehta PJ, Wang TS, Yeo HL, Roman SA. Racial disparities in clinical and economic outcomes from thyroidectomy. *Ann Surg.* 2007;246(6):1083–1091. <https://doi.org/10.1097/SLA.0b013e31812eccc4>.
- Zevallos JP, Xu L, Yiu Y. The impact of socioeconomic status on the use of adjuvant radioactive iodine for papillary thyroid cancer. *Thyroid.* 2014;24(4):758–763. <https://doi.org/10.1089/thy.2013.0409>.
- Kuo LE, Simmons KD, Wachtel H, et al. Racial disparities in initial presentation of benign thyroid disease for resection. *Ann Surg Oncol.* 2016;23(8):2571–2576. <https://doi.org/10.1245/s10434-016-5199-y>.
- Sosa JA, Tuggle CT, Wang TS, et al. Clinical and economic outcomes of thyroid and parathyroid surgery in children. *J Clin Endocrinol Metab.* 2008;93(8):3058–3065. <https://doi.org/10.1210/jc.2008-0660>.
- FitzGerald RA, Sehgal AR, Nichols JA, McHenry CR. Factors predictive of emergency department visits and hospitalization following thyroidectomy and parathyroidectomy. *Ann Surg Oncol.* 2015;22(Suppl 3):S707–S713. <https://doi.org/10.1245/s10434-015-4797-4>.
- Wu TJ, Ha PK, El-Sayed IH, et al. Socioeconomic disparities in a population of

- patients undergoing total thyroidectomy for benign disease. *Head Neck*. 2019;41(3):715–721. <https://doi.org/10.1002/hed.25421>.
29. Moten AS, Thibault DP, Willis AW, Willis AI. Demographics, disparities, and outcomes in substernal goiters in the United States. *Am J Surg*. 2016;211(4):703–709. <https://doi.org/10.1016/j.amjsurg.2015.11.022>.
30. Schoenfeld AJ, Sturgeon DJ, Dimick JB, et al. Disparities in rates of surgical intervention among racial and ethnic minorities in medicare accountable care organizations. *Ann Surg*. 2019;269(3):459–464. <https://doi.org/10.1097/SLA.0000000000002695>.
31. Castellanos SA, Buentello G, Gutierrez-Meza D, et al. Use of Game Theory to model patient engagement after surgery: a qualitative analysis. *J Surg Res*. 2018;221:69–76. <https://doi.org/10.1016/j.jss.2017.07>.