Socioeconomic Determinants of Tertiary Rhinology Care Utilization

David M. Poetker, MD, MA[1,2], David R. Friedland, MD, PhD[1],
Jazzmyne A. Adams, MPH[1], Ling Tong, MA[3],
Kristen Osinski, MS[4], and Jake Luo, PhD[3]

Abstract

Objective. The objective of this study was to determine the impact of patient demographics and socioeconomic factors on the utilization of tertiary rhinology care services in an upper Midwestern academic medical center.

Study Design. Retrospective review of electronic health records.

Setting. Academic medical center.

Methods. The electronic health record of our academic center was interrogated for the demographics and diagnosis of chronic rhinosinusitis (CRS) among adult patients seen by fellowship-trained rhinologists from 2000 to 2019. Patient characteristics (age, sex, race, insurance status) and population-level data (median income and education level) were compared with utilization of tertiary rhinology services for CRS. Utilization rates were calculated for each regional zip code and correlated with census data for median income and education. The association between determinants of health and tertiary rhinology utilization was assessed by multivariate regression analyses.

Results. A total of 8325 patients diagnosed with CRS used tertiary rhinology services. Patients were older (median, 58.9 years) and more likely to be female (57.6%), White (85%), and privately insured (60%) when compared with patients seen across our hospital system ($P < .001$). Adjusted analyses showed median income, education level, and White race to be independently correlated with tertiary care utilization. Private insurance alone was not an independent contributing factor to access.

Conclusion. Utilization of tertiary rhinology services correlated with income, race, and education level. Private insurance was not an independent factor. These results highlight social differences in determinants of access to tertiary otolaryngologic care.

Keywords

health care disparities, socioeconomic factors, social determinants of health

*H*ealth care disparities are differences in health care utilization, access, and treatment, which may contribute to inequities in health outcomes. This is distinct from *health disparities*, which refer to patterns of disease burden associated with socioeconomic factors. Health determinants are predictors of health outcomes and include the subset of social determinants—namely, income, education, and family and social support.[1]

A recent report by the Center for Urban Population Health, an academic-affiliated community health organization in Milwaukee, Wisconsin, demonstrated regional health care disparities by socioeconomic status.[1] *Socioeconomic status* is a term used to supplement individual-level health information with measures of socioeconomic characteristics of the area of residence. Characteristics may include mean dwelling value, education level, employment, and income.[2]

Rhinosinusitis affects up to 15% of the US population annually, with a direct cost >\$11 billion.[3] Although there are no data correlating race with incidence of rhinosinusitis, there are data showing inequities between race and socioeconomic status with regard to work absenteeism, insurance coverage, specialty visits, and procedures.[4] Despite these secondary differences, chronic rhinosinusitis (CRS) appears to be equally susceptible across the population and can serve as a surrogate disorder to evaluate access to specialty care within otolaryngology.

[1]Department of Otolaryngology and Communication Sciences, Medical College of Wisconsin, Milwaukee, Wisconsin, USA
[2]Zablocki VA Medical Center, Milwaukee, Wisconsin, USA
[3]Department of Health Informatics and Administration, University of Wisconsin–Milwaukee, Milwaukee, Wisconsin, USA
[4]Clinical and Translational Science Institute, Medical College of Wisconsin, Milwaukee, Wisconsin, USA

Corresponding Author:
David R. Friedland, MD, PhD, Department of Otolaryngology and Communication Sciences, Medical College of Wisconsin, 8701 Watertown Plank Rd, Milwaukee, WI 53226, USA.
Email: dfriedland@mcw.edu

In 2020 our department initiated a comprehensive quality and outcomes assessment platform called OTO Clinomics to improve the provision of otolaryngologic care in southeast Wisconsin. Initial steps to improving and personalizing care are focusing on the demographics of those being served and the disparities in access. This study seeks to identify health care disparities by assessing racial and socioeconomic factors influencing utilization of tertiary rhinologic services provided at the only academic medical center in southeast Wisconsin.

Methods

The OTO Clinomics platform and processes for interrogating our electronic medical record were approved by the Medical College of Wisconsin/Froedtert Hospital Institutional Review Board (PRO00036649). The Clinical Research Data Warehouse, a component of the Clinical and Translational Science Institute of southeast Wisconsin (UL1TR001436), maintains a monthly updated mirror of the entire electronic health record system in a Jupyter Hub.

The Froedtert and Medical College health system predominantly serves southeast Wisconsin and contains >1.3 million individual patient records. In southeast Wisconsin, there is 1 academic medical center, which has had 2 or 3 fellowship-trained rhinologists at any one time between 2000 and 2019. We define *tertiary care* as care provided by fellowship-trained subspecialists at an academic medical center. There was 1 unaffiliated fellowship-trained rhinologist in the region from 2017 to 2019, whose patients were not accounted for in this study. Our comprehensive otolaryngology division sees relatively few patients with CRS as compared with the rhinology division, most of whom are seen in suburban satellite clinics. Thus, they were not accounted for in this study.

Patient Demographics and Study Design

All adult patients (≥18 years) diagnosed with CRS (*International Classification of Diseases, Ninth Revision* and *Tenth Revision* codes: J32.0-J32.4, J32.8-J32.9; 473.0-473.3, 473,8-473.9) by a fellowship-trained rhinologist at our institution from 2000 to 2019 were identified through query of the Jupyter Hub. Data extracted for each patient included diagnosis, provider, encounter date (shifted for privacy), age, race, zip code of primary residence, and insurance status at or nearest to the date of encounter.

We examined area of residence across the entire state with a focus on 8 counties comprising southeast Wisconsin. Identical demographic data were obtained for all unique patients in the entire health system to represent the baseline catchment area, as well as for those with a diagnosis of CRS. Rhinology utilization rate was defined as the number of unique patients seen in our clinic for CRS between 2000 and 2019 divided by the population of that zip code in the 2014 US Census Bureau American Community Survey statistics. Specific determinants of health were based on those commonly reported in the literature and those readily accessible from the US Census Bureau data.[2,5,6]

Determinants of health of those utilizing the tertiary care services at Froedtert Hospital were then compared directly with the demographics of all patients receiving care at Froedtert Hospital as well as with the general population to look for differences in relative rates of usage based on demographics.

Regional Demographic and Socioeconomic Data

US Census Bureau data (2010-2014) were accessed to determine the median age, racial distribution, median household income, educational level, and insurance status distribution for adults in each zip code from southeast Wisconsin. Zip codes in southeast Wisconsin were stratified by median income into the following bins: <$42,000, $42,000 to $53,100, >$53,100 to $59,300, >$59,300 to $67,500, >$67,500 to $77,800, >$77,800 to $87,000, and >$87,000. This stratification was used to be consistent with DATAUSA (datausa.io), a publicly accessible database compiling multiple government sources, including the Census Bureau, the Bureau of Labor Statistics, and the Bureau of Economic.

We assessed the Area Deprivation Index (ADI) for each zip code in Wisconsin. The ADI is a measure ranking neighborhoods by socioeconomic disadvantage with factors such as income, education, employment, and housing quality.[7,8] Regression analyses were performed comparing the ADI with the utilization rate for tertiary care rhinology services.

Statistical Analyses

Patient characteristics were obtained through query of the Jupyter Hub for those using rhinology services and those seen in the entire health system (Supplemental Material, "Methodology of Data Extraction for Chronic Rhinosinusitis Patients"; available online). Population-level data were computed from census records. These features were compared between groups (rhinology vs health system and rhinology vs region) by chi-square test. Age between groups was compared by an independent 2-group *t* test. Patients from the 126 zip codes composing the 8 counties of southeast Wisconsin, for which patient population data were available, accounted for 88.3% of all patients seen and were utilized for further analyses. Univariate analysis with the Kruskal-Wallis test assessed rhinology utilization rates, race, insurance status, and education within stratified income categories. Median values and interquartile ranges were reported and $P < .05$ used to represent statistically significant differences. Multivariate regression analyses were performed to independently assess the effect of race, income, education, and insurance status on utilization rate with P values calculated by analysis of variance. All statistical tests were performed within the Jupyter notebook with R language (version 3.6.1; R Foundation).

Results

Our rhinologists diagnosed CRS in 8325 unique patients (**Table 1**). Demographic and socioeconomic factors were compared between patients with CRS and (1) adult patients seen in our academic affiliated health system (n = 1,365,021) and (2) southeast Wisconsin residents (n = 2,083,474). Patients with CRS seen in our practice were significantly older than those seeking care in the health system and those residing in the region (58.9 years vs 50.8 vs 47.1, $P < .001$).

Table 1. Characteristics of Adult Patients: Rhinology Services, Froedtert Health System, and Southeastern Wisconsin (2010-2014).

	Patients, % (No.)[a]			Effect size (A vs B)	
	A: Rhinology (n = 8325)	B: Froedtert Health (n = 1,365,021)	SE Wisconsin (n = 2,083,474)	Odds ratio[b]	95% CI
Age, y, median (95% CI)	58.9 (24.6-88.9)	50.8 (4.2-95.6)	47.1	0.19[c]	0.174-0.217
Women	57.6 (4799)	50.2 (685,240)	50.7 (1,056,113)	1.35	1.293-1.410
Race					
White	85 (7079)	72 (982,471)	88 (1,622,691)	2.21	2.083-2.350
Black	9.3 (778)	15.6 (213,399)	6.0 (288,362)	0.56	0.517-0.600
Asian	1.3 (109)	2.2 (29,474)	1.6 (49,721)	0.60	0.497-0.726
Other	2.5 (205)	6.0 (82,403)	2.4 (89,264)	—	
Unknown	1.8 (154)	0.7 (9751)	2.0 (33,436)	—	
Insurance					
Private	60.0 (4994)	49.8 (680,346)	57.2 (1,169,000)	1.50	1.444-1.577
Public	38.1 (3168)	36.5 (497,872)	31.4 (643,000)	1.06	1.024-1.119
Other	0.9 (75)	1.2 (16,357)	3.6 (74,000)	—	
Self-pay	0.6 (54)	3.8 (52,065)	7.7 (157,000)	0.16	0.126-0.215
No insurance record	0.4 (34)	8.7 (118,381)		0.04	0.031-0.060

[a]Values are presented as % (No.) unless noted otherwise.
[b]For race, sex, and insurance variables, because they are categorical, we used odds ratios (ORs) as effect size statistics: OR >1, greater odds of association with the variable and utilization outcome; OR = 1, no association between variable and outcome; OR <1, lower odds of association between the variable and utilization.
[c]For the age variable, because it is continuous value, we used Cohen d as the effect size statistic: d = 0.2, small effect size; 0.5, medium effect size; 0.8, large effect size.

In addition, we saw a significantly greater proportion of women as compared with the proportion accessing the medical center or living in southeast Wisconsin (57.6% vs 50.2% vs 50.7%, $P < .001$).

The utilization rate ranged from 0% to 1.26% (**Figure 1**). Of the 8325 patients seen in our clinic, 7882 (94.7%) were from Wisconsin. The 8 counties of southeast Wisconsin accounted for 88.3% of all patients with CRS, with the highest utilization seen immediately proximal to the medical center. Residents of Milwaukee County represented 40.5% of all patients with CRS seen in our clinic and those of Waukesha County, 23.4% of all patients. The medical center is proximal to the border between these counties.

The rhinology service saw proportionally fewer Black patients than Black residents in southeast Wisconsin (9.3% vs 13.8%, $P < .001$) and fewer than were cared for in our health system (9.3% vs 15.6%, $P < .001$). We also assessed racial diversity in those diagnosed with CRS in primary care settings as opposed to our clinic, to identify potential differences in access to our service. There were significant differences between patients with sinusitis seen by the rhinology clinic and those in primary care settings: 85.0% vs 84.2%, White ($P < .05$); 9.3% vs 10.9%, Black ($P < .01$). However, these differences were of lesser magnitude when compared with the health system or southeast Wisconsin.

The rhinology clinic saw a significantly higher percentage of insured patients, private and public, when compared with our health system and the region. Sixty percent of patients seeing tertiary rhinology for CRS had private insurance, as opposed to 49.8% in the medical center and 56.1% in southeast Wisconsin ($P < .001$). Similarly, 38.1% of patients seeing rhinology for CRS had public insurance, as opposed to 36.5% and 30.9% in the hospital system and region, respectively ($P < .001$). Accordingly, the clinic saw a significantly lower percentage of patients who self-pay or have no insurance when compared with the health system and the region ($P < .001$).

A linear regression model based on categorized income levels as a sole predictor showed that rhinology clinic utilization correlated with the median income of the zip code of origin (**Table 2**). The social determinants race, private insurance rate, and college education rate were significant within each income category ($P < .001$), suggesting a positive linear correlation between each social determinant and income (Supplemental Figure S1, available online). Zip codes with median household incomes >$53,100 to $59,300 had the lowest utilization rate. Areas with higher median household income had significantly increased utilization rates. Utilization rate in zip codes in the median income category >$87,000 was significantly higher at a P value <.001 from each other income category.

Linear regression analyses showed a significant positive impact of income, education, and private insurance on utilization (**Figure 2**). White race did not reach statistical significance in this analysis. These analyses also demonstrated an inverse relationship between clinic utilization rate and ADI: the more disadvantaged an area, the lower the utilization rate (**Figure 3**).

Due to the codependency of these variables, multivariate regression was performed. This demonstrated college education, White race, and median income as significant independent factors in rhinology clinic utilization (**Table 3**). Private

Table 2. Rhinology Utilization, Race, Insurance Status, and Education Among Income Categories of 126 Zip Codes in Southeast Wisconsin.

	Income,[a] $								
	<42,000	42,000-53,100	>53,100-59300	>59,300-67,500	>67,500-77,800	>77,800-87,000	>87,000	Effect size[b]	95% CI
Utilization rate	0.22 (0.16-0.31)	0.25 (0.09-0.32)	0.18 (0.08-0.29)	0.25 (0.18-0.38)	0.29 (0.2-0.38)	0.3 (0.28-0.4)	0.49 (0.35-0.62)	0.499	0.355-0.620
White	36.8 (17.1-60.2)	82.5 (74.5-90.1)	92.6 (87.5-94.6)	94.9 (88.7-95.7)	94.7 (90.7-96.1)	96.1 (94.8-96.8)	95 (92.8-96.4)	0.648	0.534-0.739
Private insurance	30.5 (29.1-33.9)	47.3 (40.5-50.4)	53.2 (48.9-55.2)	52.8 (50.9-55.5)	58.9 (55.3-61)	62.4 (60-64.6)	63.8 (62.8-66.4)	0.849	0.792-0.892
College educated	18 (11.2-23.8)	21.5 (20.4-25.7)	21.2 (18.9-27.4)	30.3 (22.5-34.3)	30.7 (23.6-41)	33 (30.2-37.5)	50.5 (39-59.5)	0.644	0.529-0.736

[a]Values are presented as percentage (95% CI).
[b]Effect sizes were calculated via Pearson correlations (*r*). The effect size is low if *r* varies around 0.1, medium if around 0.3, and large if >0.5.
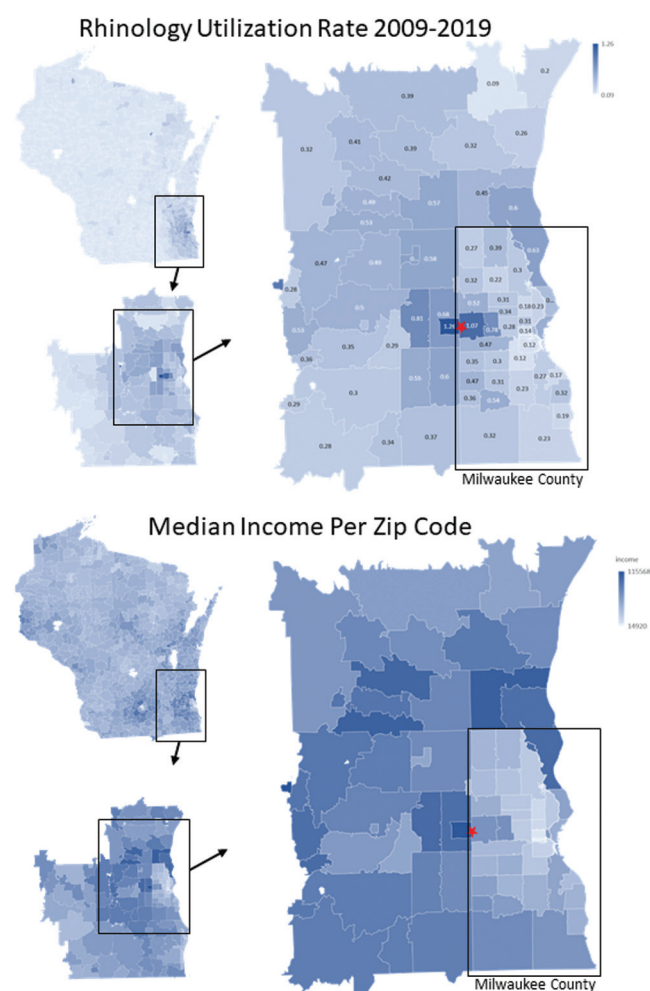

Figure 1. Geographic variation in tertiary rhinology utilization rate (top) and median income (bottom) for each zip code in Wisconsin, with a focus on southeast Wisconsin and the area immediately surrounding the tertiary rhinology clinic (red star).

insurance was not independently significantly correlated with utilization of rhinology services. For each 1% increase in college education rate, there was a 0.7% increase in rhinology utilization. White race and income had lesser-magnitude effects on utilization than education, with White race alone having a slightly negative relationship regarding utilization.

Discussion

Our results show that race and associated social determinants negatively affect access to rhinology care, a pattern seen across the United States.[9,10] The inequalities in access to care have been well established and shown to be greater in the United States than other wealthy countries.[11] As a first step to address these inequalities in access, we sought to define racial and socioeconomic factors influencing utilization of our rhinologic services, at the only academic medical center in southeast Wisconsin.

In 2017, Samuelson et al published an evaluation of the utilization rates of rhinology care in Davidson County, Tennessee.[5] The authors compared socioeconomic factors such as sex, race, and insurance status among utilization at the Vanderbilt Rhinology Clinic, utilization in general at the Vanderbilt University Medical Center, and the population data of Davidson County. They found disparities in rhinology utilization rates independently associated with college education but not uniquely associated with race, income, or insurance status.

We saw proportionally fewer Black patients versus the population in our region, although the magnitude of difference in the Vanderbilt study appears larger than in our clinic (clinic vs region: 12% vs 27%, Nashville, Tennessee; 9.3% vs 13.8%, southeast Wisconsin). This difference may be explained by the geographic range of our analyses. We studied the 8 counties of southeast Wisconsin, a defined state region for socioeconomic and business assessment. The Vanderbilt study assessed only Davidson County, principally Nashville. Milwaukee County has the highest Black population in Wisconsin, and comparison solely within this county identifies a similar utilization difference by Black patients, at 9.3% in our clinic versus 25.7% residing in Milwaukee County.

There was a lower proportion of Black patients seen in our clinic for CRS as compared with the proportion in the health system with a diagnosis of CRS (9.3% vs 10.9%). This raises a question of whether there is an internal bias, in addition to a regional factor, preventing patients with CRS from reaching our clinic. We were unable to analyze the 1.6% with CRS not seen in our clinic to identify unique barriers to referral. One explanation for the different proportions may be the accuracy of diagnosis. While we are working under the assumption that
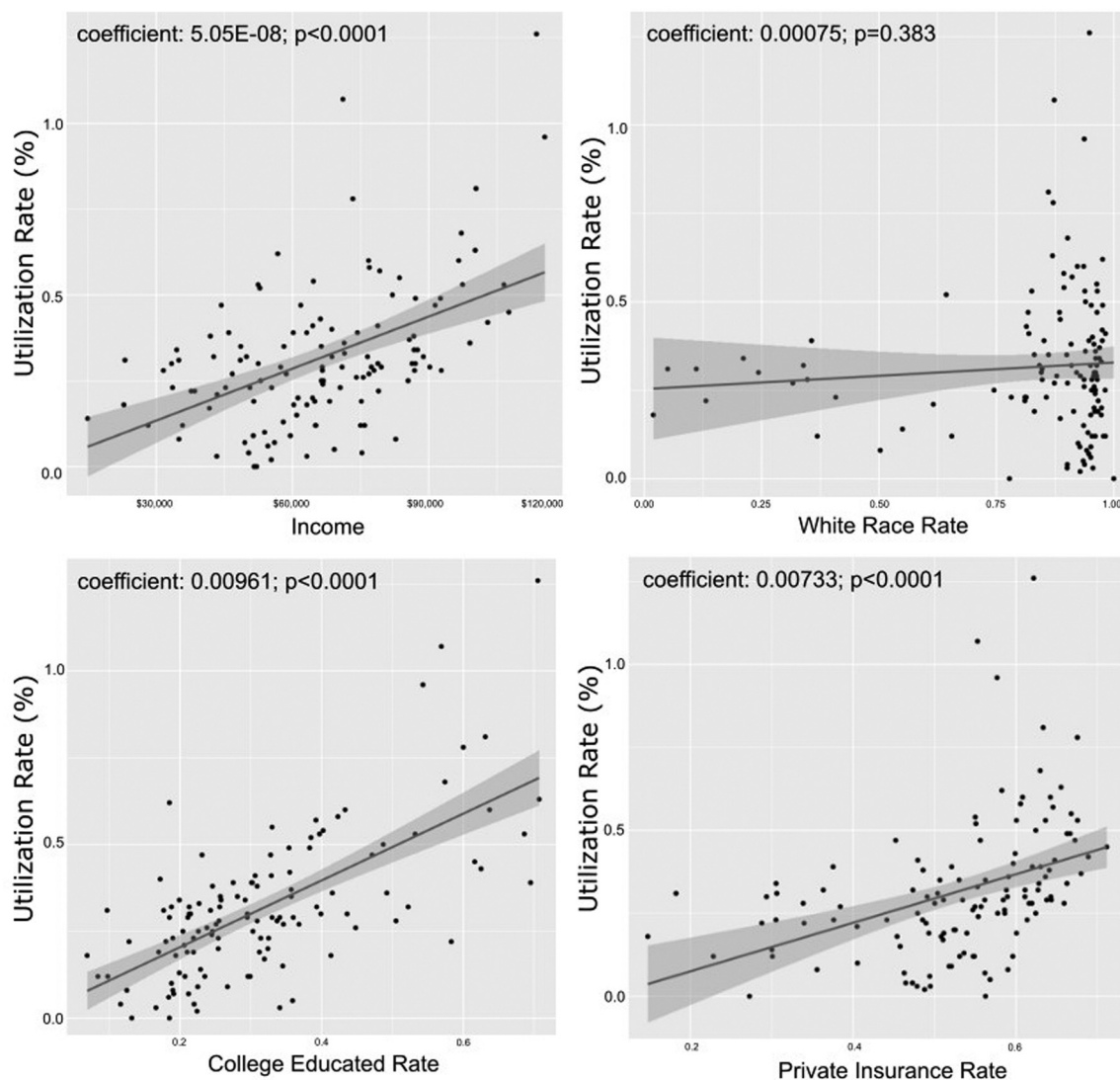
Figure 2. Median income, college education rate, and private insurance rate positively correlated with utilization ($P < .0001$). White race did not reach significance and was weakly negatively correlated with utilization rate in multiple regression analyses (see **Table 3**). Line indicates linear regression. Shaded area indicates 95% CI.

the diagnosis of CRS with our rhinology clinic is accurate, we cannot confirm the presence of CRS for those diagnosed in other departments.

Interestingly, no association has been found with socioeconomic status in patients with acute rhinosinusitis seeking care in the emergency department.[12,13] To our knowledge, this has not been studied in CRS, but perhaps there is a similar trend with patients with CRS in Milwaukee County, explaining the higher proportion of Black patients diagnosed with CRS outside our clinic.

The significant racial disproportion in utilization rate may represent geographic segregation. The segregation index is a dissimilarity index that represents the percentage of Blacks who would need to relocate to be fully integrated with Whites across metropolitan neighborhoods: 100 represents complete segregation and 0 complete integration.[14] Reproducing the Davidson County study in the Milwaukee area allows us to

compare a northern city to a southern city, as northern cities in general have higher segregation indices than those in the south. Milwaukee remains the most segregated city in America, largely due to the policy of redlining, which was a practice where banks limited home loans to people of color to certain parts of the city.[15] Milwaukee ranked highest in segregation of all major cities, with a segregation index of 79.8 between 2013 and 2017.[14] In contrast, Nashville ranked 35th in the nation with a score of 54.2.[14] Regional segregation and the location of our medical center in a more affluent area of Milwaukee County likely influence rhinology utilization rates. Interestingly, even with Milwaukee representing an extreme of segregation, we report similar findings of utilization with Nashville, which is a dramatically less segregated city.

A direct measure of a region's social and economic well-being is found in the ADI. A ranking of 1 indicates the lowest

Table 3. Multivariate Regression Analyses of Predictors of Rhinology Utilization in Southeast Wisconsin.[a]

Variable	Coefficient	SE	Upper bound	Lower bound	*P* value
College education rate	0.00727	1.25E-03	9.72E-03	4.82E-03	<.001
White, %	−0.0041	1.02E-03	−2.09E-03	−6.11E-03	<.001
Median income, $	2.66E-08	1.27E-08	5.16E-08	1.71E-09	.038
Privately insured, %	0.00398	2.77E-03	9.41E-03	−1.45E-03	.153

[a]Effect size was calculated with Cohen *f* statistics: *f* = 0.1, small effect; *f* = 0.25, medium effect; *f* = 0.4, large effect. Cohen *f* statistic is one appropriate effect size index to use for a 1-way analysis of variance. Cohen *f* is a measure of a standardized average effect in the population across all the levels of the independent variable. Cohen *f* static is calculated by $f^2 = R^2(1 - R^2) = 1.048$ and interpreted as follows: 0.02, small; 0.15, medium; 0.35, large. The confidence interval of R^2 is $(R^2\_upper, R^2\_lower) = R^2 \pm t_{(\frac{1-a}{2}, n-k-1)} SE_{R^2}$. The confidence interval of the *f* statistic is calculated by the upper and lower bound of the R.[19] Adjusted R^2 = 0.5119; the effect size of multivariate regression is 1.048(0.652-1.692).
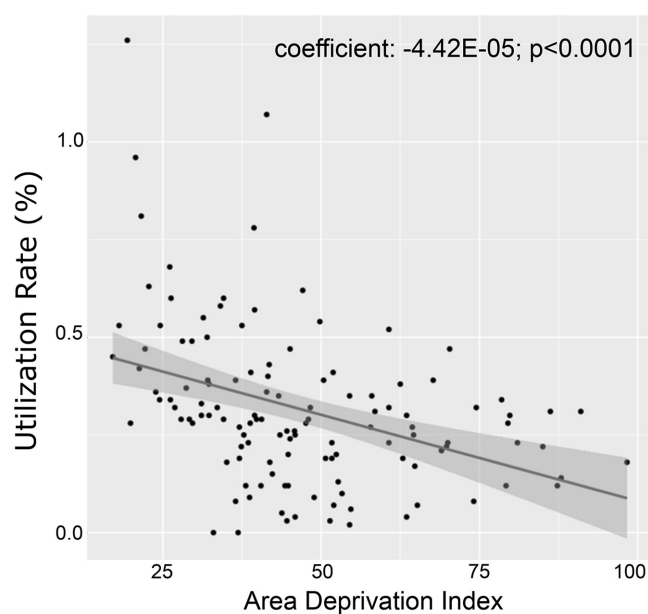

coefficient: -4.42E-05; p<0.0001

Figure 3. Linear regression analysis evaluating the effect of the Area Deprivation Index on rhinology utilization. Utilization from zip codes with higher indexes (ie, greater deprivation) showed significantly lower rates of tertiary care. Line indicates Pearson *r*. Shaded area indicates 95% CI.

level of "disadvantage" within the nation, and an ADI with a ranking of 100 indicates the highest level.[7,8] We found an inverse correlation between the ADI and clinic utilization, supporting the suggestion that socioeconomic factors within geographic locales influence access to tertiary care services.

Our rhinologists saw a significantly higher proportion of women than those in our health system or our community. Samuelson et al also noted a higher proportion of women seeking rhinology services versus that in the local community, although less than that in their health system overall.[5] A recent study indicates that, as compared with males, females have a greater perception of CRS symptoms despite having a higher tolerance for them.[16] Female-presenting symptoms of CRS are more often headache and facial pain, as opposed to nasal obstruction in males.[17] Perhaps migraine, which is more prevalent in females, is being misdiagnosed as CRS and thus contributing to this phenomenon.[18]

When controlling for other variables, Samuelson et al found that only college education correlated with utilization rate for CRS.[5] While college education rate was the strongest correlate for utilization among our determinants, the magnitude of the impact was seemingly less than that in the Nashville region. In that region, every 1% increase in rate of college education led to a 4% increase in rhinology utilization, while in the Milwaukee region this led to just a 0.727% increase. This may be related to the larger population of southeast Wisconsin as compared with Davidson County, leading to a larger denominator and smaller proportional change. For example, a 4% increase in utilization in the Nashville region would represent 19,612 patients, whereas a 0.727% increase in southeast Wisconsin would similarly represent 15,147 patients. Within this context, even such small effect sizes are of practical importance.

The rate of private insurance in our region did not independently show significant correlation with rhinology utilization rate. We feel that this lack of significance is related to the very low rate of uninsured patients in our area as compared with Nashville (7.7% vs 15%). We also did not find a significant negative impact of public insurance on rhinology utilization. In fact, the rhinology service saw proportionally greater volumes of publicly insured patients as compared with our health system and region (38.1% vs 36.5% vs 31.4%). Thus, having *any* insurance provides access to tertiary rhinology utilization, not specifically private insurance.

Potential limitations to this study, in addition to the aforementioned considerations, are that data extraction is dependent on the data fields populated in the electronic health record. We did, however, perform manual data extraction for a subpopulation of these patients, confirming the accuracy of the methodology. In this study, we are also working under the assumption that tertiary care rhinologists have a low misdiagnosis rate for CRS and that they are accurately coding the encounter diagnosis. We defined tertiary care as care provided by fellowship-trained subspecialists at an academic medical center. Comprehensive otolaryngologists in our department were not included, given that their practice is almost exclusively at satellite suburban clinics. This may have influenced the data, though it is unlikely given the small number of patients with CRS seen by these physicians. A community fellowship-trained rhinologist was in practice for 3 of the 20

years of data in this study, again potentially influencing our referral patterns, but this is unlikely to have significantly influenced the outcomes. Along these same lines, we make no assumption that other providers do not care for patients with CRS. Our interest is access to tertiary providers, which is why we compared our clinic data with our academic health system data and the region.

Although there are few data to suggest racial differences in the prevalence of CRS, genetic differences predisposing or protecting some populations from this condition could affect utilization rates and underlie our findings. Generalizability of our data is also uncertain; however, our data are consistent with those of a much less segregated city such as Nashville, raising concern for systemic barriers on a national level to accessing tertiary level care. This report should prompt others to examine their programs to identify inequities in care access.

In conclusion, disparities exist in utilization of tertiary rhinology services relative to race, income, and education level. Regions with the highest Black populations had lower median income and education levels and correspondingly lower tertiary care utilization rates. These results, as compared with reports from a Southern academic center, highlight the impact of social determinants on access to tertiary care for CRS.

Acknowledgment

Author Contributions

David M. Poetker, acquisition, analysis and interpretation of data; drafting of the manuscript; critical revision of the manuscript for important intellectual content; **David R. Friedland**, study concept and design; acquisition, analysis and interpretation of data; drafting of the manuscript; critical revision of the manuscript for important intellectual content; **Jazzmyne A. Adams**. acquisition, analysis and interpretation of data; drafting of the manuscript; critical revision of the manuscript for important intellectual content; **Ling Tong**, acquisition, analysis and interpretation of data; statistical analysis; **Kristen Osinski**, acquisition, analysis and interpretation of data; **Jake Luo**, acquisition, analysis and interpretation of data; drafting of the manuscript; critical revision of the manuscript for important intellectual content; statistical analysis.

Disclosures

Supplemental Material

Additional supporting information is available at http://journals.sagepub.com/doi/suppl/10.1177/2473974X211009830

References

1. Greer DM, Baumgardner DJ, Bridgewater FD, et al. *Milwaukee Heath Report 2013: Health Disparties in Milwaukee by Socioeconomic Status*. Center for Urban Population Health; 2013.

2. Mustard CA, Frohlich N. Socioeconomic status and the health of the population. *Med Care*. 1995;33:DS43-DS54.

3. Orlandi RR, Kingdom TT, Hwang PH, et al. International consensus statement on allergy and rhinology: rhinosinusitis. *Int Forum Allergy Rhinol*. 2016;6(suppl 1):S22-S209. doi:10.1002/alr.21695

4. Soler ZM, Mace JC, Litvack JR, Smith TL. Chronic rhinosinusitis, race, and ethnicity. *Am J Rhinol Allergy*. 2012;26(2):110-116. doi:10.2500/ajra.2012.26.3741

5. Samuelson MB, Chandra RK, Turner JH, Russell PT, Francis DO. The relationship between social determinants of health and utilization of tertiary rhinology care. *Am J Rhinol Allergy*. 2017;31(6):376-381. doi:10.2500/ajra.2017.31.4476

6. Vila PM, Swain GR, Baumgardner DJ, Halsmer SE, Remington PL, Cisler RA. Health disparities in Milwaukee by socioeconomic status. *WMJ*. 2007;106:366-372.

7. Kind AJH, Buckingham W. Making neighborhood disadvantage metrics accessible: the neighborhood atlas. *N Engl J Med*. 2018; 378:2456-2458. doi:10.1056/NEJMp1802313

8. University of Wisconsin School of Medicine and Public Health. 2015 Area Deprivation Index v2.0. Published 2019. Accessed February 25, 2021. https://www.neighborhoodatlas.medicine. wisc.edu/

9. Noonan AS, Velasco-Mondragon HE, Wagner FA. Improving the health of African Americans in the USA: an overdue opportunity for social justice. *Public Health Rev*. 2016;37:12. doi:10. 1186/s40985-016-0025-4

10. Singh GK, Daus GP, Allender M, et al. Social determinants of health in the United States: addressing major health inequality trends for the nation, 1935-2016. *Int J MCH AIDS*. 2017;6(2): 139-164. doi:10.21106/ijma.236

11. Dickman SL, Himmelstein DU, Woolhandler S. Inequality and the health-care system in the USA. *Lancet*. 2017;389:1431-1441.

12. Bergmark RW, Ishman SL, Scangas GA, Cunningham MJ, Sedaghat AR. Socioeconomic determinants of overnight and weekend emergency department use for acute rhinosinusitis. *Laryngoscope*. 2015;125(11):2441-2446. doi:10.1002/lary.25390

13. Scangas GA, Ishman SL, Bergmark RW, Cunningham MJ, Sedaghat AR. Emergency department presentation for uncomplicated acute rhinosinusitis is associated with poor access to healthcare. *Laryngoscope*. 2015;125(10):2253-2258. doi:10. 1002/lary.25230

14. Frey WH. Black-White segregation edges downward since 2000, census shows. The Brookings Institution. Published December 17, 2018. Accessed May 15, 2020. https://www. brookings.edu/blog/the-avenue/2018/12/17/black-white-segregation-edges-downward-since-2000-census-shows/

15. Mitchell B, Franco J. *Home Owner's Loan Corporation "Redlining" Maps: The Persistent Structure of Segregation and Economic Inequality*. National Community Reinvestment Coalition; 2018.

16. Phillips KM, Bergmark RW, Hoehle LP, et al. Differential perception and tolerance of chronic rhinosinusitis symptoms as a confounder of gender-disparate disease burden. *Int Forum Allergy Rhinol*. 2019;9(10):1119-1124. doi:10.1002/alr.22390

17. Busaba NY, Sin HJ, Salman SD. Impact of gender on clinical presentation of chronic rhinosinusitis with and without polyposis. *J Laryngol Otol*. 2008;122(11):1180-1184. doi:10.1017/S0022215107001302

18. Song TJ, Cho SJ, Kim WJ, Yang KI, Yun CH, Chu MK. Sex differences in prevalence, symptoms, impact, and psychiatric comorbidities in migraine and probable migraine: a population-based study. *Headache*. 2019;59(2):215-223. doi:10.1111/head.13470

19. Cohen J, Cohen P, West SG, Aiken LS. *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences*. 3rd ed. Lawrence Earlbaum Associates; 2003.