The relationship between social determinants of health and utilization of tertiary rhinology care

Madeleine B. Samuelson, M.D., M.P.H.,¹ Rakesh K. Chandra, M.D.,¹ Justin H. Turner, M.D., Ph.D.,¹ Paul T. Russell, M.D.,¹ and David O. Francis, M.D., M.S.²

ABSTRACT

Background: Chronic rhinosinusitis (CRS) has a high prevalence and significant cost and quality of life implications. Many types of practitioners care for patients with rhinosinusitis; however, patients with chronic or complicated conditions are often referred for tertiary rhinology services. It is unclear how social determinants of health affect access and utilization of these services. A better understanding of social barriers to tertiary rhinology care is needed to reduce health care disparities and improve health outcomes. The aim of the present study was to measure whether income, insurance status, race, and education affect utilization of tertiary rhinology care.

Methods: All adult patients diagnosed with CRS by rhinologists at a single tertiary care hospital were identified (2010–2014). Patient characteristics (age, gender, race, insurance status) were compared with population-level data from the hospital and from Davidson County, Tennessee, which includes Nashville. Rhinology utilization rates were calculated for each ZIP code within the county. The association between determinants of health (race, insurance status, education, median income) and tertiary rhinology utilization were measured by using multivariable regression analyses.

Results: A total of 1341 unique patients with CRS (median age, 50 years; 55% women, 80% white, 82% with private insurance) from Davidson County used tertiary rhinology services. These patients were significantly older and more likely to be female, white, and privately insured than patients seen hospital-wide or among the population of Davidson County ($p < 0.001$). Utilization rates were higher in ZIP codes with a lower proportion of minorities, a higher median income, and higher rates of private insurance and college education. However, in adjusted analysis, only attainment of a college education was independently associated with utilization of tertiary rhinology services. Utilization was 4% higher for every 1% increase in college-educated population (coefficient 0.04 [95% CI, 0.01–0.07]; $p = 0.01$).

Conclusion: Results of this study indicated that some social determinants of health (race, income, educational level, insurance status) do affect utilization of tertiary rhinology services. Higher utilization among those with higher income and educational attainment are contradictory to the data, which indicated that lower socioeconomic status was associated with a higher CRS rate. Further study is required to understand the disparities in rhinology utilization rates. (Am J Rhinol Allergy 31, 376–381, 2017; doi: 10.2500/ajra.2017.31.4476)

In North America, chronic rhinosinusitis (CRS) affects roughly 5–6% of the general population^{1,2} and accounts for approximately \$8.3 billion in overall direct health care costs annually.³ CRS is associated with significant morbidity and has quality-of-life consequences similar to patients with angina, congestive heart failure, chronic obstructive pulmonary disease, and chronic back pain.² Despite a high prevalence, cost, and substantial quality-of-life implications, CRS research has been limited and contradictory with regard to its association with social determinants of health. According to the World Health Organization, social determinants of health involve the fundamental aspects of one's living and working circumstances, including socioeconomic status (SES), employment, insurance status, education, and race, that can directly or indirectly affect one's health.⁴ In general, patients with a lower SES have poorer access to care and are less likely to seek medical assistance or be referred to subspecialists, despite having higher disease burdens and, subsequently, worse clinical outcomes.^{3,5–9} The same paradox of high disease burden among those with a lower SES and less utilization of care seem to exist for CRS.^{2,3,10,11}

Disparities in health care have major implications. Both the National Institutes of Health and the Institute of Medicine recognized

this and highlighted that certain groups are underrepresented in clinical trials and surgical outcomes research.^{12–14} Underrepresentation means that the effectiveness of interventions in these groups must be extrapolated from participants with disparate characteristics. A clearer understanding of how race and SES indicators, such as education, income, and insurance status, are associated with utilization of tertiary CRS care is needed as the medical community strives to reduce health care disparities and to improve health outcomes. As such, the aim of the present study was to investigate how income, insurance status, race, and education affect tertiary rhinology utilization in an urban or suburban population by using county-level U.S. Census data¹⁵, combined with regional tertiary care hospital statistics.

METHODS

This retrospective study was performed in accordance with the Declaration of Helsinki, Good Clinical Practice, and applicable regulatory requirements. The Vanderbilt University Medical Center Institutional Review Board approved this study (161080), and informed consent was waived due to the study's retrospective nature.

Patient Population

All adult patients (≥ 18 years) diagnosed with CRS (ICD9)¹⁶ by a fellowship-trained rhinologist from 2010–2014 and who resided within Davidson County, Tennessee (which includes Nashville), were identified through administrative records. The 2010–2014 time frame was selected because this is the period over which the U.S. Census reported community-level data. Data extracted for each patient included age, race, ZIP code of primary residence, and insurance status (commercial, Medicare, Medicaid, uninsured). Patients presented for evaluation by a rhinologist at Vanderbilt University Medical Center by referral from a primary care provider or another physician, such as an allergist, a pulmonologist, or an otolaryngologist. Some patients presented by self-referral; however, many insurance providers required specialist referral by a primary care provider or another physician.

From the ¹Division of Rhinology, Department of Otolaryngology, Vanderbilt University Medical Center, Nashville, Tennessee, and ² Division of Otolaryngology, Wisconsin Surgical Outcomes Research Program, Department of Surgery, University of Wisconsin, Madison, Wisconsin

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Address correspondence to Madeleine B. Samuelson, M.D., Division of Rhinology, Department of Otolaryngology, Vanderbilt University Medical Center, 1215 21st Ave South, 7209 MCE South Tower, Nashville, TN 37232-8605

E-mail address: Madeleine.B.Samuelson@vanderbilt.edu

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Table 1 Comparison of adult patient characteristics among those who used the rhinology services, all those cared for at Vanderbilt University Medical Center, and the population of Davidson County, Tennessee (2010–2014)

	Rhinology (<i>n</i> = 1341)	Vanderbilt (<i>n</i> = 227,129)	Davidson County (<i>n</i> = 490,290)	<i>p</i>
Age, median (interquartile range), y	50 (38–62)	43 (30.4–55.6)	40 (31–52)	<0.001
Women, % (no.)	55 (738)	60 (136,277)	52.3 (256,422)	<0.001
Race, % (no.)				
White	80 (1073)	63 (143,091)	60 (294,174)	<0.001
Black	12 (161)	16 (36,341)	27 (132,378)	
Asian	2 (27)	3 (6814)	3 (14,709)	
Other	1 (13)	0 (0)	1 (4903)	
Unknown	5 (67)	18 (40,883)	9 (44,126)	
Insurance, % (no.)				
Private	82 (1100)	65 (147,634)	58 (406,355)	<0.001
Public	15 (201)	22 (49,968)	26 (183,898)	
None	3 (40)	13 (29,527)	15 (104,849)	

Institution-Level Data

Vanderbilt University Medical Center–wide adult patient data (≥ 18 years) were provided through hospital operations and analytics for comparison (*e.g.*, age, race, insurance status). Excluded were patients who resided outside of Davidson County. Patient's race was self-reported in hospital intake records. In instances in which the patient elected not to report his or her race, he or she was classified as “unknown.”

County-Level Data

U.S. Census Bureau data (2010–2014) was accessed to determine the median age, race and/or ethnic distribution, median household income, educational level, and insurance status distribution for adults (≥ 18 years) in each ZIP code within Davidson County. In Davidson County, there were seven hospitals and four fellowship-trained rhinologists; all four were at Vanderbilt University Medical Center.

Outcome and Variables

Rhinology utilization rate was defined as the number of unique patients seen for CRS between 2010–2014 from a Davidson County ZIP code divided by the population from a specified ZIP code based on 2014 U.S. Census Bureau American Community Survey statistics. The 28 ZIP codes in Davidson County were stratified by median income into (1) $< \$34,999$, (2) $\$35,000$ – $49,999$, (3) $\$50,000$ – $74,999$, (4) $\$75,000$ – $\$99,999$, and (5) $> \$100,000$. This stratification method was used because it is the one used by the U.S. Census Bureau data report.

Statistical Analyses

Characteristics (median age, race, insurance status, median income) of patients who used rhinology services were first compared with population-level data from Vanderbilt University Medical Center and Davidson County by using χ^2 and Kruskal-Wallis tests when appropriate. In univariate analysis, we next compared the rhinology utilization rate, race (white versus nonwhite), insurance status (private versus other), and college educational attainment rates among ZIP code income strata by using the Kruskal-Wallis test. Multivariate regression analysis was used to determine independent predictors of rhinology utilization. Continuous variables are reported as medians and interquartile ranges (IQR). All statistical tests were performed by using Stata 12MP (StataCorp, L.L.C., College Station, TX), and $p < 0.05$ was used to represent statistical significance. Geographic representation of small area variation in rhinology utilization rates by Davidson County ZIP code was created by using Microsoft PowerPoint (Microsoft Corp., Redmond, WA).

RESULTS

Demographics

Vanderbilt rhinologists diagnosed CRS in 1341 unique patients (median age, 50 years, 55% women, 80% white, 82% with private insurance) from Davidson County between 2010 and 2014. Demographic and socioeconomic factors were compared among patients with CRS and (i) adult patients from this county seen at our tertiary care hospital ($n = 227,129$), and (ii) Davidson County residents ($n = 490,290$) (Table 1). Patients with CRS (median age, 50 years [IQR, 38–62 years]) were older than the median age of adults cared for at the hospital (median age, 43 years [IQR, 30.4–55.6 years]) or who lived in Davidson County (median age, 40 years [IQR 31–52 years]) ($p < 0.001$). The patients with CRS were also disproportionately white ($p < 0.001$) and privately insured ($p < 0.001$) in relation to comparators.

Small Area Variation

Tertiary rhinology utilization differed 5.4-fold across Davidson County's 28 ZIP codes (median, 2.1 [IQR, 1.8–3.2]; range, 1.2–6.6). Two county maps are shown in Fig. 1 that geographically demonstrate median income (A) and utilization rates (B). A strong positive relationship was observed between rhinology utilization and the ZIP code median income level. This association was confirmed in stratified analyses that showed that utilization was significantly higher in the top two income strata ($> \$75,000$) compared with the lower income strata ($< \$75,000$) (Table 2) ($p = 0.001$). A higher median ZIP code income was also significantly associated with a higher percentage of college-educated whites with private insurance.

Adjusted Analysis

Regression analysis when adjusting for race (white or nonwhite), private insurance (yes or no), and college education (yes or no) found that college education alone was an independent determinant of utilization (Table 3). Specifically, there was a 4% increased rhinology utilization for every 1% increased percentage in college educational level within a ZIP code in Davidson County, Tennessee (coefficient 0.04 [95% confidence interval, 0.01–0.07]) (Fig. 2). The relationship of regression analysis between rhinology utilization rate and education is shown in Fig. 2. An R^2 value of 54% indicated that the model explained 54% of the variability of data around its mean, which indicated that education was a relatively strong predictor of rhinology utilization.

DISCUSSION

Social factors that affect access to and utilization of rhinology care are poorly understood, despite the significant health care burden that

Figure 1. Geographic variation in (A) median income and (B) chronic rhinosinusitis diagnosis rates or each ZIP code in Davidson County, TN.

Table 2 Comparison of rhinology utilization, race, insurance status, and education among income categories of the ZIP codes in Davidson County, Tennessee

	Income Categories					<i>p</i>
	<\$35,000	\$35,000–\$49,999	\$50,000–\$74,999	\$75,000–\$99,999	>\$100,000	
Utilization rate (IQR)	1.8 (1.6–2.6)	2.0 (1.5–2.1)	2.2 (1.8–3.2)	5.13 (3.0–6.6)	4.7 (4.0–5.4)	0.02
White, % (IQR)	31 (17–45)	54 (45–61)	78 (72–85)	91 (80–93)	91 (86–95)	0.002
Private insurance, % (IQR)	66 (56–76)	58 (53–62)	79 (70–86)	89 (85–91)	90 (89–90)	0.001
College educated, % (IQR)	22 (18–34)	27 (20–34)	35 (24–53)	70 (55–77)	67 (66–68)	0.01

IQR = Interquartile range.

Table 3 Results of multivariate regression that evaluated predictors of rhinology utilization

Variable	Coefficient (95% confidence interval)	<i>p</i>
College education	0.04 (0.01–0.07)	0.01
Non-Hispanic white	0.02 (–0.004 to 0.04)	0.11
Median income	0.00001 (–0.00002 to 0.00004)	0.41
Private insurance	–0.02 (–0.05 to 0.02)	0.32

CRS presents.^{1–3} It is critical to understand how these social determinants of health affect access to care and disparities in the diagnosis and treatment of CRS. Perceived effectiveness of interventions may differ based on race, educational level, and other social factors. Therefore, enrollment in CRS trials should strive to include a diverse population so that results are generalizable to the entire population. Failure to include diverse patients in trials can bias research findings and thereby limit their applicability to underrepresented portions of the population.¹⁴

In the present study, social determinants of health, including income, educational level, insurance status, and race, were each strongly associated with the likelihood of using a tertiary rhinology service. Those patients from ZIP codes with higher median incomes (>\$75,000) were twice as likely to be seen by rhinology specialists than those with lower income levels (Fig. 1). Interestingly, after adjusting for these factors, the only independent predictor of utilization was the educational level. Specifically, there was a 4% increased rate of rhinology utilization for every 1% increase in the college-educated population in a ZIP code within Davidson County, Tennessee. Of note, the sample size of ZIP codes (*n* = 28) was small. We would expect that, with greater power, other social determinants would also be significantly associated with utilization.

Analysis of the demographic data of this study indicated that patients seen by a Vanderbilt rhinologist were more likely to be older and white than the Vanderbilt patient population or the Davidson County population, but there was no statistically significant difference between gender distribution. The median age of the Vanderbilt rhinology group was higher (median age, 50 years [IQR, 38–62 years]) than the hospital or county populations (hospital median age, 43 years [IQR, 30.4–55.6 years]; county median age, 40 years [IQR, 31–52, years]) (*p* < 0.001). Patients from the Vanderbilt Rhinology group were also more likely to be white than any other racial group (*p* < 0.001). This is in concert with data from a 2009 National Health Interview Survey that demonstrates that, although whites and African Americans report similar rates of sinusitis, more whites are seen by a specialist or receive surgical treatment.¹⁰ Although the majority of the patient population were women, this was not significantly different from the gender distribution of the hospital or surrounding county. This contrasts with analysis of recent data that indicates that CRS is more prevalent in female than male patients.¹⁷

Several explanations for the apparent relationship between social determinants of health and rhinology utilization are possible. First,

more economically advantaged patients (higher income, insurance coverage) likely have greater access to medical care, particularly specialists. In the present series, a higher income bracket was associated with a lower proportion of minorities and a greater percentage of privately insured and college educated citizens, which indicated that combinations of social determinants may affect rates of rhinology utilization. Disparate utilization of rhinology care was previously observed by Soler *et al.*,¹⁰ who found that minorities and those of lower SES tend to delay medical care due to cost-related concerns and, thus, are less apt to see expensive medical specialists or to have surgical procedures. Furthermore, patients who are insured and have more education tend to have better health literacy and more routinely see their primary care physician, when chronic issues such as CRS are likely to be addressed.¹⁸

Inequity in rhinology care could represent either over- or underutilization. Many factors may affect unevenness of care, including variations in access to care, patient proclivity to seek care, use of diagnostic testing, and physician threshold to refer to specialists.¹⁹ The finding that rhinology utilization is greatest in higher income and highly educated ZIP codes could represent a case of overutilization. The patients with higher incomes or educational attainment may have more regular primary care visits and also a lower threshold to be referred to a specialist for nasal symptoms where they would be diagnosed with CRS. It is equally possible that persons from ZIP codes with lower median income and educational levels who may have symptoms consistent with CRS may not seek or cannot afford specialty care and, therefore, underuse the specialty care. There are many possible factors that contribute to why those from disadvantaged social situations are unable to use tertiary rhinology services, which could include less job security, worse coping mechanisms, poor transportation services, or less control over one's work or home life, all factors associated with lower SES and worse health.^{4,6,20} Small area variation data such as that presented here are hypothesis generating and cannot uncover which phenomenon, over- or underutilization, is occurring. However, analysis of these data effectively exhibited an inequality in rhinology utilization, which seemed to be closely linked to the social determinants of health discussed.

A second possible explanation for the disparity is that those with higher income or educational level actually had higher rates of CRS and required escalated rhinologic care. Some investigators might argue that greater economic means translates into cleaner homes and less exposure to “friendly” microbes early in life, which are needed to train the immune system to react appropriately to stimuli.^{21,22} Ostensibly, this “hygiene hypothesis” seems plausible because CRS has been closely related to immune dysfunction. However, the opposite effect has been consistently shown for asthma, which shares an etiologic immune connection. Specifically, results of some studies indicate that persons from lower SES are more likely to develop asthma.^{3,5} Thus, we did not believe that the hygiene hypothesis was a likely explanation for the observed variation and disparities in tertiary rhinology utilization.

There are inherent limitations to our study. As is convention in other similar variation studies, median ZIP code incomes were used

Figure 2. Relationship between rhinology utilization rates and the percentage of college educated residents by Davidson County ZIP code.

n = 28
RMSE = 0.946

$$y = 0.652 + 0.052x$$

$$R^2 = 54.0\%$$

as a surrogate for individual patient incomes. Although this study design risked the introduction of ecologic fallacy, in which conclusions about individuals were based on analysis of group data, the results of this study were intended to be hypothesis generating and to encourage further research to determine if, in fact, there is a true association. Another consideration is the generalizability of the findings. It is possible that patients seen by rhinologists and the population of Davidson County are not representative of other academic medical centers or the U.S. population. In addition, there may be unknown environmental factors at play. Local toxins, inhalants, or pollutants that we are unaware of may play a larger role in CRS development than SES. Another consideration is the large Vanderbilt patient population of “unknown” race. At Vanderbilt, race is self-reported, and, for any patient who declines to designate his or her race or who is not asked, race is listed as “unknown.” Although only 5% of the Vanderbilt rhinology group’s patient race was listed thus, 18% of the Vanderbilt general patient population was listed as “unknown.” Thus, the race of the two populations may not vary significantly.

Furthermore, community physician referral practice patterns and patient insurance requirements may affect which patients present for tertiary rhinology care. Although the only fellowship-trained rhinologists in Davidson County are at Vanderbilt University Medical Center, most local general otolaryngologists treat patients with chronic sinus disease and only refer them to a tertiary care physician for more complicated disease. Patients may also be referred by a primary care provider or another physician to a rhinologist for evaluation of CRS. Most insurance providers require referral by another physician for evaluation by a specialist; however, some providers allow for self-referral. All of these factors may affect which patients present for tertiary rhinology care. However, U.S. insurance referral practices may not be entirely culpable. A 2011 study by Kilty *et al.*² that involves Canadian patients demonstrates that lower family income and lower educational level are associated with higher self-reported sinus disease symptom severity ($p < 0.05$). It was hypothesized that,

even in the setting of the Canadian universal health care system, SES may have affected specialist referrals from a primary care provider, with only the more severe cases in the lower SES group being referred.

Nonetheless, our observations strongly indicated that social determinants of health influence the utilization of tertiary rhinology care. The findings described herein are not unique and have corollaries across medicine and major health policy implications. As observed previously, income, educational level, and insurance status influence health outcomes.^{23–25} Higher income, higher educational attainment, and better health insurance correlate with improved health.²⁰ These factors need to be carefully weighed when considering the generalizability of findings from studies that underrepresent minorities and those of lesser economic means.

CONCLUSION

Social determinants of health (race, income, education level, insurance status) impact the utilization of rhinology subspecialists. Although income, race, insurance status, and education were all strongly associated with utilization, the only independent predictor was attainment of a college education, which may underlie the other observed social disparities. It was unclear whether the findings herein represented overutilization in the economically advantaged or underutilization in the economically disadvantaged. Further study is needed to investigate these relationships.

REFERENCES

1. Lu-Myers Y, Deal AM, Miller JD, et al. Comparison of Socioeconomic and Demographic Factors in Patients with Chronic Rhinosinusitis and Allergic Fungal Rhinosinusitis. *Otolaryngol Head Neck Surg* 153(1):137–143, 2015.
2. Kilty SJ, McDonald JT, Johnson S, and Al-Mutairi D. Socioeconomic status: a disease modifier of chronic rhinosinusitis? *Rhinology* 49: 533–537, 2011.

3. Smith DF, Ishman SL, Tunkel DE, and Boss EF. Chronic rhinosinusitis in children: Race and socioeconomic status. *Otolaryngol Head Neck Surg* 149:639–644, 2013.
4. Marmot, M. Social determinants of health inequalities. *Lancet* 365: 1099–1104, 2005.
5. Smith DF, and Boss EF. Racial/ethnic and socioeconomic disparities in the prevalence and treatment of otitis media in children in the United States. *Laryngoscope* 120:2306–2312, 2010.
6. Marmot MG, and Wilkinson RG. (2003). *Social determinants of health the solid facts*. Copenhagen: WHO Regional Office for Europe.
7. Steenland K, Henley J, Calle E, and Thun M. Individual- and Area-Level Socioeconomic Status Variables as Predictors of Mortality in a Cohort of 179,383 Persons. *Am J Epidemiol* 159:1047–1056, 2004.
8. National Institutes of Health. NIH launches research program to reduce health disparities in surgical outcomes. April 18, 2016. <https://www.nih.gov/news-events/news-releases/nih-launches-research-program-reduce-health-disparities-surgical-outcomes>. Accessed: August 18, 2017.
9. Bennett KM, Scarborough JE, Pappas TN, and Kepler TB. Patient socioeconomic status is an independent predictor of operative mortality. *Annals of Surgery* 252:552–557, 2010.
10. Soler ZM, Mace JC, Litvack JR, and Smith TL. Chronic rhinosinusitis, race, and ethnicity. *Am J Rhinol Allergy* 26:110–116, 2012.
11. Miller JD, Deal AM, McKinney KA, et al. Markers of disease severity and socioeconomic factors in allergic fungal rhinosinusitis. *Int Forum Allergy Rhinol* 4:272–279, 2014.
12. Fisher JA, and Kalbaugh CA. Challenging assumptions about minority participation in US clinical research. *American journal of public health* 101:2217–2222, 2011.
13. Murthy VH, Krumholz HM, and Gross CP. Participation in cancer clinical trials: race-, sex-, and age-based disparities. *JAMA* 291:2720–2726, 2004.
14. Froom P, Melamed S, Kristal-Boneh E, et al. Healthy volunteer effect in industrial workers. *J Clin Epidemiol* 52:731–735, 1999.
15. United States Census Bureau. (2010–2014). *American Fact Finder*. Retrieved from https://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml, August 18, 2017.
16. ICD-9-CM: International Classification of Diseases, 9th Revision, Clinical Modification. Salt Lake City, Utah: Medicode, 1996.
17. Ference EH, Tan BK, Hulse KE, et al. Commentary on gender differences in prevalence, treatment, and quality of life of patients with chronic rhinosinusitis. *Allergy Rhinol (Providence)* 6:82–88, 2015.
18. Cutler DM, and Lleras-Muney A. Education and Health: Evaluating Theories and Evidence. *Making Americans Healthier: Social and Economic Policy as Health Policy*, edited by J House, R Schoeni, G Kaplan, and H Pollack. New York: Russell Sage Foundation. 2008.
19. Birkmeyer JD, Reames BN, McCulloch P, et al. Understanding of regional variation in the use of surgery. *Lancet* 382:1121–1129, 2013.
20. Benach J, Vives A, Amable M, et al. Precarious Employment: Understanding an Emerging Social Determinant of Health. *Annual Review of Public Health* 35:229–253, 2014.
21. Strachan DP. Hay fever, hygiene, and household size. *BMJ* 299:1259–1260, 1989.
22. Scudellari M. News feature: Cleaning up the hygiene hypothesis. *Proc Natl Acad Sci U S A* 114:1433–1436, 2017.
23. Kennedy BP, Kawachi I, Glass R, and Prothrow-Stith D. Income distribution, socioeconomic status, and self rated health in the United States: multilevel analysis. *BMJ* 317:917–921, 1998.
24. Kaufman JS, Cooper RS, and McGee DL. Socioeconomic Status and Health in Blacks and Whites: The Problem of Residual Confounding and the Resiliency of Race. *Epidemiology* 8:621–628, 1997.
25. Bosma H, van de Mheen HD, Borsboom GJ, and Mackenback JP. Neighborhood Socioeconomic Status and All-Cause Mortality. *Am J Epidemiol* 153:363–371, 2001. □