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Access disparities to Magnet hospitals for ischemic stroke patients

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Abstract

Access disparities to centers of excellence can have detrimental consequences for population health. We investigated the presence of racial disparities in the access of stroke patients to hospitals recognized by the Magnet Recognition Program of the American Nurses Credentialing Center (ANCC). We performed a cohort study of all ischemic stroke patients who were registered in the New York Statewide Planning and Research Cooperative System (SPARCS) database from 2009–2013. We examined the association of African-American race with Magnet status hospitalization after ischemic stroke. A mixed effects propensity adjusted multivariable regression analysis was used to control for confounding. During the study period, 176,557 patients presented with ischemic stroke, and met the inclusion criteria. Overall, 4,624 (13.7%) African-Americans, and 27,468 (19.2%) non African-Americans with ischemic stroke were admitted to Magnet Hospitals. Using a multivariable logistic regression, we demonstrate that African-Americans were associated with lower admission rates to Magnet institutions (OR 0.70; 95% CI, 0.68–0.73) (Table 2). This persisted in a mixed effects logistic regression model (OR 0.75; 95% CI, 0.71–0.78) to adjust for clustering at the county level, and a propensity score adjusted logistic regression model (OR 0.87; 95% CI, 0.83–0.90). Using a comprehensive all-payer cohort of ischemic stroke patients in New York State we identified an association of African-American race with lower rates of admission to Magnet hospitals.

Keywords

ischemic stroke; Magnet recognition; center of excellence; racial disparities; SPARCS

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INTRODUCTION

Stroke is one of the leading causes of death and disability in the United States.²⁸ In this setting, racial disparities in stroke-related mortality constitute a major public health problem.^{17,20,25} Stroke incidence among young African-Americans is approximately two to four times higher than among whites, whereas related mortality is three times higher.^{13,20,25,30} The etiologies underlying these disparities are only partially understood.⁹ Hypothesized factors include differences in vascular risk factors, socioeconomic status, variability in quality of care, and differential access to care.^{9,12} Stroke-specific, as well as general, centers of excellence have been associated with improved outcomes in this population.^{4,18,19} They offer higher rates of timely and efficient goal-directed interventions, including neuro-critical care, use of thrombolytics and mechanical thrombectomy, which have all individually been associated with superior stroke outcomes.^{4,19}

Prior studies have investigated the access disparities to centers of excellence for stroke. Mullen et al²³ demonstrated that non-whites were more likely to have access to primary stroke centers within an hour, in a geographic study of the United States. Lyster et al²¹ did not find a differential effect of telemedicine on the access of different races to stroke care. The Magnet Recognition Program of the American Nurses Credentialing Center (ANCC)² is another regionalization initiative designed to identify health care facilities with a commitment to quality improvement, and excellent nursing care delivery, and has been associated with improved stroke outcomes. There has been no previous investigation attempting to answer this access question for Magnet hospitals in a comprehensive all-payer cohort, using advanced observational techniques.

We used the New York Statewide Planning and Research Cooperative System (SPARCS)⁶ to study the association of African-American race with being hospitalized in a Magnet hospital for ischemic stroke patients. We utilized a battery of approaches to control for confounding, including regression adjustment, and propensity score adjustment, whereas mixed effects methods were employed to control for clustering at the hospital level.

METHODS

New York Statewide Planning and Research Cooperative System (SPARCS)

This study was approved by the Dartmouth Committee for Protection of Human Subjects. All patients who were hospitalized for acute ischemic stroke, and were registered in the SPARCS (New York State Department of Health, Albany, NY)⁶ database between 2009 and 2013 were included in the analysis. For these years, SPARCS contains patient-level details for every hospital discharge, ambulatory surgery, and emergency department admission in New York State as coded from admission and billing records. More information about SPARCS is available at <https://www.health.ny.gov/statistics/sparcs/>.

Magnet Recognition Program

The Magnet Recognition program of the ANCC was established in 1994 by a subsidiary of the American Nurses Association.² Magnet recognition lasts for four years. As of 2015, 402 facilities in the United States were recognized by the program. This program involves

rigorous documentation and site visits to evaluate institutions across five core principles: transformational leadership, a structure that empowers staff, an established professional nursing practice model, support for knowledge generation and application, and robust quality improvement mechanisms.² More information on this process can be found at <http://www.nursecredentialing.org/Magnet>.

Cohort Definition

In order to establish the cohort of patients, we used *International Classification of Disease-9-Clinical Modification* (ICD-9-CM) codes to identify patients in the database who were hospitalized for acute ischemic stroke (ICD-9-CM code 433.x1, 434.x1) between 2009 and 2013.

Outcome variables

The primary outcome variable was hospitalization in a Magnet institution for acute ischemic stroke. The program's website was used to identify hospitals in New York State that obtained Magnet recognition and the year this was achieved. Hospitals were classified as having Magnet recognition in the corresponding year of the analysis. Classifications were updated each year of the study period in case of mergers or closures.

Exposure variables

The primary exposure variable was African-American race.

Covariates (Table S1) used for risk-adjustment were age, gender, insurance (private, Medicare, Medicaid, uninsured, other), patient location during the stroke (inpatient versus outpatient setting) and stroke intervention either via administration of IV-tPA (intravenous tissue plasminogen activator) (ICD-9-CM 99.10, V45.88) or mechanical thrombectomy (ICD-9-CM 39.74).

The comorbidities used for risk adjustment were diabetes mellitus (DM), smoking, chronic lung disease, hypertension, hypercholesterolemia, peripheral vascular disease (PVD), congestive heart failure (CHF), coronary artery disease (CAD), history of transient ischemic attack (TIA), alcohol abuse, obesity, chronic renal failure (CRF), and coagulopathy. Only variables that were defined as "present on admission" were considered part of the patient's preadmission comorbidity profile.

We additionally controlled for hospital characteristics including primary stroke center or comprehensive stroke center status, hospital size, and Get with the Guidelines program participation.

Statistical analysis

The association of race with Magnet hospitalization was examined in a multivariable setting.

A logistic regression was used for our categorical outcome (admission to a Magnet hospital). The covariates used for risk adjustment in these models were: age, gender, insurance, and all the comorbidities and hospital characteristics mentioned previously. In order to control for regional clustering, we used mixed effects methods with patient county as a random effect

variable. In an alternative way to control for confounding, we used a propensity adjusted (with deciles of propensity score) logistic regression model. We calculated the propensity score with a separate logistic regression model, using all the covariates mentioned previously. Mixed effects methods were also used for the propensity-adjusted model.

In order to demonstrate the robustness of our data in a sensitivity analysis, we used several categories of race (African-American, Hispanic, Asian, Caucasian, and other). The magnitude and direction of the observed associations did not change and therefore these results are not reported further.

Regression diagnostics were used for all models. All results are based on two sided tests, and the level of statistical significance was set at 0.05. This study, based on 176,557 patients, has sufficient power (80%) at a 5% type I error rate to detect differences in Magnet hospital admission, as small as 0.7%. Statistical analyses were performed using Stata version 13 (StataCorp, College Station, TX).

RESULTS

Patient characteristics

In the selected study period there were 176,557 patients hospitalized for acute ischemic stroke (mean age was 71.3 years, with 53.0% females) who were registered in SPARCS. 33,794 (19.1%) were African-Americans, and 142,763 (80.9%) non-African-Americans. The characteristics of the two cohorts at baseline can be seen in Table 1.

Inpatient case-fatality

Overall, 4,624 (13.7%) African-Americans, and 27,468 (19.2%) non African-Americans with ischemic stroke were admitted to Magnet hospitals. African-Americans were associated with lower rates of admission to a Magnet hospital for acute ischemic stroke in comparison to non African-Americans (OR 0.66; 95% CI, 0.64–0.69) in unadjusted analysis. Likewise, using a multivariable logistic regression, we identified that African-Americans were associated with lower admission rates to Magnet institutions (OR 0.70; 95% CI, 0.68–0.73) (Table 2). This persisted in a mixed effects logistic regression model (OR 0.75; 95% CI, 0.71–0.78) to adjust for clustering at the county level, and a propensity score adjusted logistic regression model (OR 0.87; 95% CI, 0.83–0.90).

DISCUSSION

Using a comprehensive all-payer cohort of patients in New York State with acute ischemic stroke we identified an association of African-American race with lower rates of Magnet institution hospitalization. These results were consistent across techniques to control for confounders. Through recent inclusion in US News and World Report rating,²⁹ endorsement by the Leapfrog Group,¹ and media attention these initiatives are increasingly recognized by the public. Magnet recognition is heavily advertised by hospitals.² These facilities have been found to have lower rates of nursing burnout and improved overall financial performance, as well as superior stroke outcomes.^{2,5,7,8,10,11}

Prior investigations have demonstrated conflicting results regarding the access of racial minorities with acute ischemic stroke to centers of excellence. Mullens et al²² using the Reasons for Geographic And Racial Differences in Stroke (REGARDS) prospective population-based cohort did not identify racial disparities in access to primary stroke centers. They identified mainly geographic factors associated with the observed access disparities. However, this study was not particularly designed or powered to answer the question about racial disparities. The same group, in a national study demonstrated that non-whites were more likely to have access within 1 hour to a primary stroke center than whites (77% versus 62%).²³ The latter study was a probabilistic analysis based on the entire US population, and did not account for the true stroke burden in the country. Using a similar methodology, a study by Lyster et al²¹ identified no significant impact of telemedicine on racial access disparities to primary stroke centers in Texas, albeit it suffers from the same bias. Lastly, Aparicio et al³ identified limited access of African-Americans to evidence based treatments, such as thrombolytics, among patients admitted in primary stroke centers.

Our study purposefully addresses many of these methodologic limitations. First, we created a cohort of all patients in a major state, giving a true picture of practice in the community. Second, we used advanced observational techniques to control for confounding. Propensity score stratification was used to adjust our analyses for known confounders. Regional factors have been identified consistently as major contributors to access disparities to centers of excellence. The possibility of clustering at the regional level, which can bias the results of multi-center national studies, was accounted for by using mixed effects methods. Results were consistent across techniques, supporting the validity of the observed associations.

Further research into the racial disparities associated with access to Magnet hospitals in stroke care is warranted. It is likely that minorities tend to live in communities with lower quality hospitals minimizing their access to Magnet recognized institutions. This data should provide information to policy makers, regulators, payers, and administrators when designing the structure of hospital systems and optimizing healthcare delivery. Hospitals serving these populations should be incentivized to improve their nursing standards, and achieve Magnet recognition.^{2,5,7,8,10,11,15,16,26} Such institutional commitment to quality improvement empowers nurses and physicians to deliver evidence-based care, establish effective communication, and identify patient problems quicker,^{15,16,26} which is particularly critical in the largely protocol driven stroke care.

Our study has several limitations. Residual confounding could account for some of the observed associations, despite the use of advanced observational techniques. In addition, coding inaccuracies will undoubtedly occur and can affect our estimates. However, several reports have demonstrated that coding for stroke has shown nearly perfect association with medical record review.^{14,27} Although SPARCS includes all hospitals from the entire New York State, the generalization of this analysis to the entire US population is uncertain. SPARCS does not provide any clinical information on the functional status of the patients (National Institutes of Health Stroke Scale). However, this would be expected to bias our results towards the null, underscoring the importance of the observed associations.

Additionally, we were lacking post-hospitalization, and long-term data on our patients. Quality metrics (i.e. modified Rankin score) are also not available through SPARCS. Although stroke outcomes were not the target of our analysis, functional outcomes can only be provided by prospective registries. In this direction, the NeuroPoint Alliance has created the first module for a cerebrovascular registry, with results expected in the near future.²⁴ Finally, causality cannot be definitively established based on observational data, despite the use of advanced techniques.

Conclusions

Access disparities in centers of excellence can have detrimental consequences for population health. We investigated the presence of racial disparities in the access of stroke patients to hospitals recognized by Magnet Recognition Program of the American Nurses Credentialing Center (ANCC). Using a comprehensive all-payer cohort of ischemic stroke patients in New York State we identified an association of African-American race with lower rates of admission to Magnet hospitals.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

1. The Leapfrog group, in, 2016, Vol 2016
2. American Nurses Credentialing Center. ANCC Magnet Recognition Program. 2016; 2016
3. Aparicio HJ, Carr BG, Kasner SE, Kallan MJ, Albright KC, Kleindorfer DO, et al. Racial Disparities in Intravenous Recombinant Tissue Plasminogen Activator Use Persist at Primary Stroke Centers. *J Am Heart Assoc*. 2015; 4:e001877. [PubMed: 26467999]
4. Bekelis K, Marth NJ, Wong K, Zhou W, Birkmeyer JD, Skinner J. Primary Stroke Center Hospitalization for Elderly Patients With Stroke: Implications for Case Fatality and Travel Times. *JAMA Intern Med*. 2016; 176:1361–1368. [PubMed: 27455403]
5. Brady-Schwartz DC. Further evidence on the Magnet Recognition program: implications for nursing leaders. *J Nurs Adm*. 2005; 35:397–403. [PubMed: 16200007]
6. Health NYSDo. Statewide Planning and Research Cooperative System (SPARCS). 2015; 2015
7. Hess R, Desroches C, Donelan K, Norman L, Buerhaus PI. Perceptions of nurses in magnet® hospitals, non-magnet hospitals, and hospitals pursuing magnet status. *J Nurs Adm*. 2011; 41:315–323. [PubMed: 21799363]
8. Houston S, Leveille M, Luquire R, Fike A, Ogola GO, Chando S. Decisional involvement in Magnet®, magnet-aspiring, and non-magnet hospitals. *J Nurs Adm*. 2012; 42:586–591. [PubMed: 23151932]
9. Howard VJ, McClure LA, Meschia JF, Pulley L, Orr SC, Friday GH. High prevalence of stroke symptoms among persons without a diagnosis of stroke or transient ischemic attack in a general population: the REasons for Geographic And Racial Differences in Stroke (REGARDS) study. *Arch Intern Med*. 2006; 166:1952–1958. [PubMed: 17030827]

10. Jayawardhana J, Welton JM, Lindrooth RC. Is there a business case for magnet hospitals? Estimates of the cost and revenue implications of becoming a magnet. *Med Care*. 2014; 52:400–406. [PubMed: 24535022]
11. Kelly LA, McHugh MD, Aiken LH. Nurse outcomes in Magnet® and non-Magnet hospitals. *J Nurs Adm*. 2012; 42:S44–S49. [PubMed: 22976894]
12. Kimball MM, Neal D, Waters MF, Hoh BL. Race and income disparity in ischemic stroke care: nationwide inpatient sample database, 2002 to 2008. *J Stroke Cerebrovasc Dis*. 2014; 23:17–24. [PubMed: 22818388]
13. Kleindorfer DO, Khoury J, Moomaw CJ, Alwell K, Woo D, Flaherty ML, et al. Stroke incidence is decreasing in whites but not in blacks: a population-based estimate of temporal trends in stroke incidence from the Greater Cincinnati/Northern Kentucky Stroke Study. *Stroke*. 2010; 41:1326–1331. [PubMed: 20489177]
14. Kokotailo RA, Hill MD. Coding of stroke and stroke risk factors using international classification of diseases, revisions 9 and 10. *Stroke*. 2005; 36:1776–1778. [PubMed: 16020772]
15. Kramer M, Schmalenberg C. Development and evaluation of essentials of magnetism tool. *J Nurs Adm*. 2004; 34:365–378. [PubMed: 15303055]
16. Kramer M, Schmalenberg CE. Best quality patient care: a historical perspective on Magnet hospitals. *Nurs Adm Q*. 2005; 29:275–287. [PubMed: 16056163]
17. Kumar N, Khera R, Pandey A, Garg N. Racial Differences in Outcomes after Acute Ischemic Stroke Hospitalization in the United States. *J Stroke Cerebrovasc Dis*. 2016; 25:1970–1977. [PubMed: 27212273]
18. Lichtman JH, Jones SB, Leifheit-Limson EC, Wang Y, Goldstein LB. 30-day mortality and readmission after hemorrhagic stroke among Medicare beneficiaries in Joint Commission primary stroke center-certified and noncertified hospitals. *Stroke*. 2011; 42:3387–3391. [PubMed: 22033986]
19. Lichtman JH, Jones SB, Wang Y, Watanabe E, Leifheit-Limson E, Goldstein LB. Outcomes after ischemic stroke for hospitals with and without Joint Commission-certified primary stroke centers. *Neurology*. 2011; 76:1976–1982. [PubMed: 21543736]
20. Lloyd-Jones D, Adams R, Carnethon M, De Simone G, Ferguson TB, Flegal K, et al. Heart disease and stroke statistics--2009 update: a report from the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. *Circulation*. 2009; 119:e21–e181. [PubMed: 19075105]
21. Lyerly MJ, Wu TC, Mullen MT, Albright KC, Wolff C, Boehme AK, et al. The effects of telemedicine on racial and ethnic disparities in access to acute stroke care. *J Telemed Telecare*. 2016; 22:114–120. [PubMed: 26116854]
22. Mullen MT, Judd S, Howard VJ, Kasner SE, Branas CC, Albright KC, et al. Disparities in evaluation at certified primary stroke centers: reasons for geographic and racial differences in stroke. *Stroke*. 2013; 44:1930–1935. [PubMed: 23640827]
23. Mullen MT, Wiebe DJ, Bowman A, Wolff CS, Albright KC, Roy J, et al. Disparities in accessibility of certified primary stroke centers. *Stroke*. 2014; 45:3381–3388. [PubMed: 25300972]
24. NeuroPoint Alliance. The National Neurosurgery Quality and Outcomes Database (N²QOD). 2015; 2015
25. Stansbury JP, Jia H, Williams LS, Vogel WB, Duncan PW. Ethnic disparities in stroke: epidemiology, acute care, and postacute outcomes. *Stroke*. 2005; 36:374–378. [PubMed: 15637317]
26. Stimpfel AW, Rosen JE, McHugh MD. Understanding the role of the professional practice environment on quality of care in Magnet® and non-Magnet hospitals. *J Nurs Adm*. 2014; 44:10–16. [PubMed: 24316613]
27. Tirschwell DL, Longstreth WTJ. Validating administrative data in stroke research. *Stroke*. 2002; 33:2465–2470. [PubMed: 12364739]
28. Towfighi A, Saver JL. Stroke declines from third to fourth leading cause of death in the United States: historical perspective and challenges ahead. *Stroke*. 2011; 42:2351–2355. [PubMed: 21778445]

29. US News and World Report. Best Hospitals. 2016; 2016
30. White H, Boden-Albala B, Wang C, Elkind MS, Rundek T, Wright CB, et al. Ischemic stroke subtype incidence among whites, blacks, and Hispanics: the Northern Manhattan Study. *Circulation*. 2005; 111:1327–1331. [PubMed: 15769776]

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Table 1

Patient characteristics

		All Patients		African American Patients		Non-African American Patients		P-Value			
		N= 176557	SD	N=33794	SD	N=142763	SD				
Age		Mean	71.32	14.88	Mean	66.10	14.63	Mean	72.56	14.66	<0.0001
		N		%	N		%	N		%	P-Value
Magnet hospital			32092	18.18		4624	13.68		27468	19.24	
Female gender			93497	52.96		18833	55.73		74664	52.30	
Race	African-American		106981	60.77		0	0.00		106981	75.21	<0.0001
	Caucasian		33794	19.20		33794	100.00		0	0.00	<0.0001
	Hispanic		15518	8.82		0	0.00		15518	10.91	<0.0001
	Asian		4973	2.83		0	0.00		4973	3.50	<0.0001
	Other		14762	8.39		0	0.00		14762	10.38	<0.0001
Insurance	Medicare		105305	59.75		16387	48.61		88918	62.39	<0.0001
	Medicaid		12131	6.88		4273	12.68		7858	5.51	<0.0001
	Private		50506	28.66		11283	33.47		39223	27.52	<0.0001
	Uninsured		6764	3.84		1463	4.34		5301	3.72	<0.0001
	Other		1536	0.87		306	0.91		1230	0.86	0.434
Transient Ischemic Attack			12725	7.21		2204	6.52		10521	7.37	<0.0001
Coronary Artery Disease			54593	30.92		8185	24.22		46408	32.51	<0.0001
Chronic Obstructive Pulmonary Disease			25169	14.26		4069	12.04		21100	14.78	<0.0001
Congestive Heart Failure			31906	18.07		6227	18.43		25679	17.99	0.059
Diabetes Mellitus			59964	33.96		14921	44.15		45043	31.55	<0.0001
Coagulopathy			5504	3.12		899	2.66		4605	3.23	<0.0001
Chronic Renal Failure			24413	13.83		6282	18.59		18131	12.70	<0.0001
Hypertension			135560	76.78		28306	83.76		107254	75.13	<0.0001
Smoking			19565	11.08		4348	12.87		15217	10.66	<0.0001
Hypercholesterolemia			79926	45.27		13906	41.15		66020	46.24	<0.0001
Obesity			10809	6.12		2568	7.60		8241	5.77	<0.0001

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	All Patients N= 176557		African American Patients N=33794		Non-African American Patients N=142763		P-Value
	Mean	SD	Mean	SD	Mean	SD	
Alcohol	6460	3.66	1627	4.81	4833	3.39	<0.0001
Peripheral Vascular Disease	13112	7.43	1985	5.87	11127	7.79	<0.0001
Charlson Comorbidity Index	1.42	1.74	1.60	1.82	1.37	1.71	<0.0001

SD: Standard Deviation

Table 2

Models demonstrating the association African-American race with Magnet hospitalization for ischemic stroke patients

Models	OR (95% CI)	P-value
Unadjusted	0.66 (0.64–0.69)	<0.0001
Logistic regression		
Standard	0.70 (0.68–0.73)	<0.0001
Mixed effects model	0.75 (0.71–0.78)	<0.0001
Propensity score adjusted model	0.87 (0.83–0.90)	<0.0001

OR: Odds Ratio; CI: Confidence Interval