ORIGINAL RESEARCH

Relationship Between Language Preference and Intravenous Thrombolysis Among Acute Ischemic Stroke Patients

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***Background*—**Approximately 20% of the US population primarily speaks a language other than English at home. Yet the effect of language preference on treatment of acute ischemic stroke (AIS) patients remains unknown. We aimed to evaluate the influence of language preference on AIS patients' receipt of intravenous (IV) thrombolysis.

***Methods and Results*—**We analyzed data from 3894 AIS patients who participated in the American Heart Association "Get With The Guidelines®—Stroke" program at our hospital from January 1, 2003 to April 30, 2014. Information included patients' language in which they preferred to receive medical care. We used descriptive statistics and stepwise logistic regression models to examine associations between patients' language preference and receipt of IV thrombolysis, adjusting for relevant covariates. A total of 306/3295 (9.3%) AIS patients preferred to speak a non-English language and represented 25 different languages. Multivariable analyses adjusting for other socioeconomic factors showed that non-English-preferring patients were more likely than English-preferring patients to receive IV thrombolysis (OR=1.64; CI=1.09-2.48; *P*=0.02). However, in models that also included age, sex, and initial NIH Stroke Scale, patients' language preference was no longer significant (OR 1.38; CI=0.88-2.15; *P*=0.16), but NIH Stroke Scale was strongly associated with receiving IV thrombolysis (OR=1.15 per point; CI=1.13-1.16; *P*<0.0001).

***Conclusions*—**Contrary to our hypothesis, non-English-preferring was not associated with lower rates of IV thrombolysis among AIS patients once initial stroke severity was accounted for. **(*J Am Heart Assoc*. 2016;5:e003782 doi: 10.1161/JAHA.116.003782)**

Key Words: disparities • language • plasminogen activators • registry • statistics • stroke • thrombolysis

Linguistic barriers can negatively impact clinical communications and challenge the effective, safe, and equitable delivery of clinical care.[1] Being unable to communicate in a common language is particularly problematic for patients and clinicians who face time-sensitive treatment decisions. For example, the early management of acute ischemic stroke (AIS) patients requires clinicians to rapidly and accurately ascertain their symptoms, time of symptom onset, and medical history to appropriately consider potentially life-saving thrombolytic therapy.[2] With this in mind, patients' linguistic needs must be addressed to appropriately care for the over 61.6 million Americans who identify speaking a language other than English at home, including a subgroup of 25.1 million Americans who self-identify as speaking English "less than very well" and are therefore considered to have limited English proficiency.[3] This study aimed to expand existing stroke quality of care and disparities research by focusing on patients' language preferences. We evaluated if language preference would be associated with reduced rates of intravenous (IV) thrombolysis in a consecutive cohort of patients in our institutional stroke registry, as prior data suggest that language barriers may contribute to stroke disparities.[4] We hypothesized that AIS patients who preferred to receive care in a non-English language would be less likely to receive IV thrombolysis after adjustment for age, sex, and stroke severity.

Methods

Study Population

Patients included in this retrospective study were enrolled in the "Get With the Guidelines®—Stroke" (GWTG-Stroke) Registry at Massachusetts General Hospital (MGH) between January 1, 2003 and April 30, 2014. GWTG-Stroke is a national data collection system and performance measurement tool developed by the American Heart Association to improve the quality of care and outcomes for stroke and transient ischemic

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attack patients; since 2003, over 1800 hospitals across the United States have entered more than 2 million patient records.[5] MGH is a 999-bed hospital in Boston, MA that provides 24-7 acute stroke team coverage for thrombolytic therapy.[6] Hospital personnel were trained in using GWTG-Stroke to collect data on consecutive patients admitted for AIS; patients were included by prospective clinical identification or retrospectively by using International Classification of Diseases-Ninth Revision discharge codes.[7] The details of case ascertainment and data collection were previously described.[7]

For this study, patients were included if they (1) had been discharged from MGH between January 1, 2003 and April 30, 2014 with AIS as their primary hospitalization reason; (2) were entered into GWTG-Stroke; and (3) had a language preference captured in the hospital's administrative database. Patients were excluded if their AIS occurred while admitted at a healthcare facility (n=1600), they were transferred from another hospital (n=1271), or their primary residence was out of country (n=222) because our analyses included neighborhood socioeconomic variables that require a US zip code. Patients with multiple admissions were included only for their first stroke-related hospitalization.

Variables of Interest

GWTG-Stroke collects information on stroke patients' demographics and medical history and hospitals' adherence to evidence-based treatments, in-hospital outcomes, and provision of standardized discharge instructions. For this study, we did deterministic linkage to incorporate participants' language preference, neighborhood zip code, and marital status by using the Partners Healthcare System Research Patient Data Registry (RPDR), a repository for demographic and clinical data from various hospital databases.[8] Missing race/ethnicity (n=312) and insurance entries (n=9) in GWTG-Stroke were supplemented with data from RPDR.

Demographic and socioeconomic measures included patients' self-reported age (years); sex (female, male); race (Asian, American Indian/Alaskan Native, Black, Multiracial, Native Hawaiian/Pacific Islander, White); Hispanic ethnicity (yes/no); marital status (single, married/partnered, divorced/separated, widowed); and insurance status (private/other, Medicare, Medicaid, uninsured/self-pay). Patients' neighborhood income (percentage of families in zip code whose income was below poverty level in the past 12 months) was obtained using the US Census Bureau geocoding program American FactFinder,[9] which is based on the 2008–2012 American Community Survey 5-year Estimates.[10]

Patients' language preferences were self-identified in response to the standardized question "In what language do you prefer to receive medical information?" on registering at MGH or when updating their information. In our study, patients were categorized as English-preferring (EP) or non-English-preferring (NEP). If patients arrived at MGH without having previously registered, staff obtained language preference information from patients directly or, if unconscious, from their families, friends, or the referring hospital.

Clinical information included patients' medical history ascertained from self-report or electronic records. This included conditions known to be associated with stroke: atrial fibrillation, coronary artery disease or prior myocardial infarction, carotid stenosis, diabetes mellitus, dyslipidemia, heart failure, hypertension, peripheral vascular disease, previous stroke/transient ischemic attack (TIA), prosthetic heart valve, or smoking (yes/no answers).

Emergency AIS care measures included time to hospital arrival from when the patient was last known to be well (minutes) and from discovery of stroke symptom (minutes); hospital-arrival mode (emergency medical services from home/scene, private/transport/taxi/other from home/scene); NIH Stroke Scale (NIHSS) score at initial evaluation (0-42, from the least to most severe stroke); door-to-needle time (minutes); receipt of IV thrombolysis within 3 hours of time last known well for patients arriving at the hospital within 2 hours of time last known well (yes/no); and receipt of intra-arterial catheter-based treatment at MGH (yes/no).

Statistical Analyses

Descriptive statistics was performed to examine associations between patients' language preference and their demographic, socioeconomic, and clinical characteristics as well as their AIS care. Means, standard deviations, and percentages or median and interquartile ranges were generated for each variable. Two-way t-tests and chi-squared tests were performed to determine associations. Variables with more than 5% of the data missing were excluded. Statistical significance was set at the P=0.05 level.

We performed stepwise logistic regression models to examine associations between patients' language preference and the use of IV thrombolysis, adjusting for covariates known to predict stroke care and outcomes. Models were defined a priori to examine the separate effects of socioeconomic and clinical factors. Odds ratios and 95% confidence intervals were calculated for each covariate.

To determine if language preference had an effect on AIS patients' receipt of IV thrombolysis beyond other socioeconomic factors, the first regression model included patients' race, ethnicity, marital status, and insurance status.[11-15] The second model introduced age, sex, and NIHSS score, 3 factors known to influence receipt of IV thrombolysis.[16,17] For the fully adjusted model, ordinal variables for race, insurance status, and marital status were converted to binary variables.

All analyses were completed using IBM SPSS Statistics for Windows, version 20 (IBM Corp, Armonk, NY). Informed consent requirements were waived. The institutional review board granted approval for this study.

Results

A total of 3295 AIS patients met the study inclusion/exclusion criteria. NEP patients constituted 9.3% (n=306) of all AIS patients. In univariate analyses, NEP patients were more likely to self-identify as racial/ethnic minorities; be uninsured or have Medicaid; and live in neighborhoods with greater poverty levels (all $P<0.05$) (Table 1). Altogether, NEP patients spoke a total of 25 languages, including Spanish (n=130; 42.4%), Portuguese (n=59; 19.2%), Haitian/French Creole (n=41; 13.4%), Mandarin/Cantonese Chinese (n=35; 11.4%), Italian (n=35; 11.4%), Cambodian (n=19; 6.2%), Arabic (n=13; 4.2%), Vietnamese (n=10; 3.3%), and Russian (n=9; 2.9%).

Clinically, NEP patients had significantly higher rates of preexisting diabetes, hypertension, and stroke/TIA (all $P<0.05$) when compared to EP patients (Table 1). On hospital arrival, NEP patients had greater stroke severity than EP patients (NIHSS 4 vs 3; $P=0.01$). This difference was not due to language-dependent NIHSS items (level of consciousness; language; dysarthria) (Table 1). NEP patients were more likely to utilize EMS transport to the hospital (66.1% versus 62.4%; $P<0.01$), have higher rates of IV thrombolysis (13.31% vs 9.4%; $P=0.04$), and have intra-arterial catheter-based treatments (6.5% vs 4.3%; $P=0.008$) (Table 2). Importantly, door-to-needle time for NEP and EP patients did not differ (59 vs 52 minutes; $P=0.625$) (Table 2).

In the initial multivariable analysis adjusting for socioeconomic factors, NEP patients were more likely than EP patients to receive IV thrombolysis (OR=1.64; 95% CI=1.09-2.48) (Table 3). However, in a second model accounting for socioeconomic factors plus age, sex, and initial NIHSS, language preference was no longer significant (OR=1.38; CI=0.88-2.15; $P=0.16$), but NIHSS, as many previous studies have found, was strongly associated with receiving thrombolysis (OR=1.15 per point; CI=1.13-1.16; $P<0.0001$) (Table 3).

Discussion

This is the first US study focusing on the relationship of AIS patients' language preferences to their care. The linguistic diversity captured in this group of AIS patients cared for at a Massachusetts tertiary referral center reflects what is and will continue to be the reality across America. In 2013, 61.6 million individuals or 20% of the US population spoke a language other than English at home.[18] Although most also spoke English "very well," 25.1 million or 41% of them spoke English less than "very well," representing those whom the US Census Bureau considers limited-English proficient (LEP).[18] Similar to this study's NEP cohort, most US LEP individuals speak Spanish (16.2 million), Chinese (1.6 million), Vietnamese (847 000), Korean (599 000), or Tagalog (509 000).[19] In Massachusetts, 8.8% of the state's population is LEP, and Spanish is the most commonly spoken language after English, followed by Portuguese, Chinese, Vietnamese, and French Creole.[20]

We can expect to see more NEP patients who need language assistance in US health-care settings. The US LEP population has expanded by 80% from 14 to 25.1 million between 1990 and 2013.[18] Although most LEP individuals live in California, Texas, New York, Florida, Illinois, and New Jersey, nontraditional immigrant destinations such as Nevada, North Carolina, and Georgia saw a 379% growth in their LEP residents from 1990 to 2013.[18] The US LEP population will exponentially increase by 2050, as projections suggest that foreign-born populations will more than double to 81 million and that the Hispanic population will triple to 128 million people.[21]

The linguistically and culturally diverse NEP population is especially vulnerable to disparities because of a double bind. Mirroring the US LEP population, this study's NEP cohort faced a combination of challenges beyond linguistic barriers: they were also more likely to be racial/ethnic minorities, uninsured, and reside in poorer neighborhoods.[22,23] Prior studies have shown that racial minority, lower-income, and less-educated stroke patients are less likely to receive thrombolysis.[24-26] Furthermore, low-income stroke patients have less access to mechanical thrombectomy, experience longer wait times for carotid endarterectomy, and are less likely to receive in-hospital speech therapy, physiotherapy, or occupational therapy.[27,28] Adding an extra layer of disadvantage, NEP patients often do not have access to clinicians fluent in their language or to professional medical interpreters.[29] This limits patients' ability to disclose vital information, which can negatively impact their clinical care and outcomes.[30,31]

Contrary to our hypothesis, NEP stroke patients received higher rates of IV thrombolysis when compared to EP patients, and this difference seemed to be associated with NEP patients' stroke severity rather than language preference or socioeconomic disadvantage. We suspect there was no difference in IV thrombolysis rates between NEP and EP patients due in part to our institution's participation in GWTG-Stroke and our rigorous systemic quality improvement efforts, which standardize AIS care and IV thrombolysis decisions based on clinical criteria.[32] Clinical standardization can be an important mitigating factor to prevent health care disparities; evidence-based protocols help reduce implicit biases among decision makers.[33] For example, hospitals participating in GWTG-Heart Failure eliminated racial and sex disparities in the use of implantable cardiac defibrillators.[34] In stroke, a prior

Table 1. Characteristics of Acute Ischemic Stroke Patients Discharged From Our Tertiary Stroke Center With Information Available on Language Preference (N=3295)

	Non-English-Preferring Patients (n=306)	English-Preferring Patients (n=2989)	*P* Value
Sociodemographic measures			
Age, years, mean (SD)	69.69 (13.73)	69.39 (15.2)	0.73
Female, n (%)	166 (54.2)	1357 (45.4)	0.03
Race, n (%)			<0.0001
Asian	54 (20.2)	46 (1.6)	
American Indian/Alaskan Native	1 (0.4)	3 (0.1)	
Black	43 (16.1)	152 (5.2)	
Multiracial	1 (0.4)	2 (0.1)	
Native Hawaiian/Pacific Islander	3 (1.1)	2 (0.1)	
White	165 (61.8)	2745 (93.1)	
Unknown	39 (12.7)	39 (1.3)	
Hispanic ethnicity, n (%)	107 (35)	78 (2.6)	<0.0001
Marital status, n (%)			0.23
Single	43 (14.1)	567 (19.0)	
Married/partnered	141 (46.1)	1381 (46.2)	
Divorced/separated	31 (10.1)	261 (8.7)	
Widowed	74 (24.2)	633 (21.2)	
Unknown*	17 (5.6)	147 (4.9)	
Socioeconomic measures			
% of families in zip code with incomes below poverty level in the past 12 months, median (IQR)	11.30 (7.1, 16.7)	7.30 (3.8, 12.0)	<0.0001
Insurance status, n (%)			<0.0001
Private/other†	124 (40.5)	1063 (35.6)	
Medicare	154 (50.3)	1848 (61.8)	
Medicaid	9 (2.9)	25 (0.8)	
Uninsured/self-pay	19 (6.2)	52 (1.7)	
Clinical characteristics, n (%)			
No past medical history	32 (10.5)	311 (10.4)	0.98
Atrial fibrillation	46 (15)	605 (20.2)	0.03
Carotid artery disease/prior myocardial infarction	56 (18.3)	665 (22.2)	0.11
Carotid stenosis	7 (2.3)	169 (5.7)	0.01
Diabetes mellitus	93 (30.4)	702 (23.5)	0.007
Dyslipidemia	130 (42.5)	1244 (41.6)	0.77
Heart failure	12 (3.9)	105 (3.5)	0.71
Hypertension	232 (75.8)	2041 (68.3)	0.007
Peripheral vascular disease	5 (1.6)	157 (5.3)	0.005
Previous stroke/TIA	33 (10.8)	193 (6.5)	0.004
Prosthetic heart valve	4 (1.3)	24 (0.8)	0.36
Smoker	28 (9.2)	483 (16.2)	0.001

*"Other" and "unknown" categories merged.
†Other insurance: veterans, Champus, PPO, HMO, and non-Medicaid assistance programs.

Table 2. Emergency Care of Acute Ischemic Stroke Patients According to Language Preference (n=3295)

	Non-English-Preferring Patients (n=306)	English-Preferring Patients (n=2989)	*P* Value
Prehospital management			
Time from when patient was last known to be well to hospital arrival, minutes, median (IQR)	8.52 (1.95, 33.25)	8.5 (2.33, 29.98)	0.79
Time from discovery of stroke symptoms to hospital arrival, minutes, median (IQR)	5.37 (1.1, 28.5)	4.68 (1.4, 20.77)	0.96
Arrival mode, n (%)			0.004
EMS from home/scene	201 (66.1)	1851 (62.4)	
Private transport/taxi/other from home/scene	93 (30.6)	852 (28.7)	
Unknown	10 (3.3)	261 (8.8)	
Thrombolytic/reperfusion therapy			
NIHSS Score at onset, median (IQR)	4 (2, 12)	3 (1, 9)	0.01
Language-dependent components	0 (0, 2)	0 (0, 2)	0.45
Language-independent components	3 (1, 9)	2 (0, 5)	<0.001
Door-to-needle time, minutes, median (IQR)	59 (40, 86)	52 (36, 73.2)	0.625
Received intravenous TPA within 3 hours of stroke onset, n (%)	40 (13.1)	281 (9.4)	0.04
Received intra-arterial catheter-based treatment, n (%)	20 (6.5)	130 (4.3)	0.008

EMS indicates emergency medical services; NIHSS, NIH Stroke Scale; TPA, tissue plasminogen activator.

analysis showed that hospitals that implemented GWTG-Stroke guidelines experienced a reduction of racial and ethnic differences in receiving defect-free stroke care.[35]

Additionally, we suspect that there was no difference in IV thrombolysis rates between NEP and EP patients because Massachusetts is 1 of 20 states with legislation requiring cultural competency training and state-sponsored activities to implement the National Standards for Culturally and Linguistically Appropriate Services in Health and Health Care (the National CLAS Standards) devised by the Office of Minority Health to help eliminate health disparities.[36] National CLAS standards include, for example, promoting a culturally and linguistically diverse governance, leadership, and workforce; educating and training governance, leadership, and workforce in culturally and linguistically appropriate policies and practices on an ongoing basis; offering language assistance to individuals who have LEP at no cost to them to facilitate timely access to all health care and services; and providing easy-to-understand print and multimedia materials and signage in the languages commonly used by the populations in the service area. The fact that Massachusetts had the seventh highest proportion of foreign-born residents in 2010

Table 3. The Association Among Language Preference, Patient Characteristics, and IV Thrombolysis in Acute Ischemic Stroke Patients

	Unadjusted			Model Adjusted for SES			Fully Adjusted Model		
	OR	95% CI	*P* Value	OR	95% CI	*P* Value	OR	95% CI	*P* Value
NEP	1.45	1.02 to 2.07	0.04	1.64	1.09 to 2.48	0.02	1.38	0.88 to 2.15	0.16
Nonwhite race	1.02	0.71 to 1.46	0.93	1.15	0.78 to 1.71	0.47	1.22	0.8 to 1.87	0.36
Hispanic	0.99	0.61 to 1.65	0.99	0.79	0.46 to 1.39	0.42	0.68	0.37 to 1.23	0.2
Not married/partnered	1.13	0.9 to 1.42	0.3	1.13	0.9 to 1.43	0.3	1.19	0.92 to 1.54	0.2
Not privately insured	0.96	0.76 to 1.22	0.75	0.96	0.75 to 1.22	0.72	1.14	0.85 to 1.54	0.39
Age	1.01	0.99 to 1.01	0.21				0.99	0.98 to 1.00	0.07
Female	0.89	0.71 to 1.12	0.21				1.03	0.8 to 1.34	0.8
NIHSS	1.14	1.12 to 1.16	<0.0001				1.15	1.13 to 1.16	<0.0001

NEP indicates non-English-preferring; NIHSS, NIH Stroke Scale; SES, socioeconomic status; nonwhite race: Asian, American Indian, Alaskan Native, Black, Native Hawaiian, Pacific Islander, and Multiracial participants; not married/partnered: divorced, separated, widowed participants; not privately insured: Medicare, Medicaid, uninsured, and self-pay participants.

has likely fostered a heightened awareness among legislators of the importance of interventions aimed at eliminating cultural and linguistic barriers to health care.[37]

This single-site study demonstrates that NEP and EP ischemic stroke patients can receive the same care under circumstances where a health institution rigorously enforces GWTG-Stroke guidelines while in an environment that also actively promotes the use of language assistance and translated materials.[36] Currently, there are still 17 states that do not have legislation on cultural competency or state-sponsored National CLAS implementation.[36] Further studies in these types of jurisdictions are needed to determine the care NEP stroke patients receive even when they receive care in hospitals that participate in programs such as GWTG-Stroke.

The reduction in stroke mortality rates in recent years is largely attributable to preventative interventions such as smoking cessation and the appropriate control of hypertension, diabetes, and dyslipidemia.[38] However, a large sector of the population may be left behind despite these preventative efforts, as studies have shown persistently greater prevalence of diabetes mellitus and hypertension among Hispanic and black patients compared to white patients.[39] Similarly, our data showed greater prevalence of preexisting vascular risk factors of diabetes, hypertension, and stroke/TIA among NEP patients, of whom 35% identified as Hispanic, 20.2% as Asian, and 16.1% as Black. Language barriers may be placing NEP populations at risk of not understanding well why preventative medications were prescribed or their possible side effects and therefore remain at risk of new or recurrent AIS.[40] Additionally, NEP populations may not be able to participate in lifestyle intervention programs for smoking cessation, dietary modifications, and increased physical activity if these interventions are not offered in languages other than English.[4,41] Because NEP patients are more likely to live in neighborhoods with higher poverty rates, they additionally face poor access to healthy food options and limited availability of green spaces for physical activity.[42,43]

This single-center retrospective study has several limitations. We may have underestimated the number of NEP AIS patients. Our institution routinely asks patients in what language they prefer to receive medical information, but patients may have declined to answer due to lack of awareness of the availability of free-of-cost interpreters, fear that requesting an interpreter may delay care, or preference for having a family member interpret. Additionally, available retrospective data did not allow us to analyze the effect of professional medical interpreters (PMI) or members of the care team who were proficient in patients' preferred language; future research must evaluate the utilization of PMI in the care of NEP stroke patients as their involvement may improve care.[44]

Moving forward, we must facilitate stroke patients' access to linguistically and culturally appropriate care.[45] This may be achieved in part by increasing the number of stroke clinicians who have fluency in non-English languages and by enhancing the utilization of PMIs during stroke encounters.[44,46] We propose consistently incorporating linguistic information into GWTG-Stroke to facilitate assuring quality care for all patients regardless of their ability to speak English. In addition, multilingual versions of the NIHSS should be available to allow for accurate assessment of stroke severity in the increasingly diverse populations we serve. Furthermore, we recommend that future efforts focus on targeting stroke prevention for NEP populations—providing quality stroke care at hospitals is critical, but it is equally important to prevent strokes among NEP and minority communities.

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