HHS Public Access

Author manuscript

J Stroke Cerebrovasc Dis. Author manuscript; available in PMC 2018 August 01.

Published in final edited form as:

J Stroke Cerebrovasc Dis. 2017 August ; 26(8): 1781–1786. doi:10.1016/j.jstrokecerebrovasdis.2017.04.006.

Sex Disparity in Stroke Quality of Care in a Community-Based Study

Mollie McDermott, MD,
University of Michigan Stroke Program

Lynda D. Lisabeth, PHD,
University of Michigan Stroke Program and Department of Epidemiology

Jonggyu Baek, PHD,
University of Michigan Department of Epidemiology

Eric E. Adelman, MD,
University of Michigan Stroke Program

Nelda M. Garcia,
University of Michigan Stroke Program

Erin Case,
University of Michigan Department of Epidemiology

Morgan S. Campbell, MD,
Corpus Christi physician

Lewis B. Morgenstern, MD, and
University of Michigan Stroke Program and Department of Epidemiology

Darin B. Zahuranec, MD, MS
University of Michigan Stroke Program

Abstract

Background—Studies have suggested that women may receive lower stroke quality of care (QOC) than men, although population-based studies at non-academic centers are limited. We investigated sex disparities in stroke QOC in the Brain Attack Surveillance in Corpus Christi Project.

Methods—All ischemic stroke patients admitted to one of six Nueces County non-academic hospitals between Feb 2009 and Jun 2012 were prospectively identified. Data regarding

Corresponding Author: Mollie McDermott, MD, Cardiovascular Center, 3rd Floor, Reception C, 1500 East Medical Center Drive, SPC 5855, Ann Arbor, MI 48109-5855, mcdermom@med.umich.edu, Tel: (734)936-4420, Fax: (734)232-4447.

Disclosures
None

compliance with seven performance measures (PMs) were extracted from the medical records. Two overall quality metrics were calculated: a composite score of QOC representing the number of achieved PMs over all patient-appropriate PMs, and a binary measure of defect-free care. Multivariable models with generalized estimating equations assessed the association between sex and individual PMs and between sex and overall quality metrics.

Results—A total of 757 patients (51.6% female) were included in our analysis. After adjustment, women were less likely to receive DVT prophylaxis at 48 hours (relative risk [RR]=0.945; 95% CI, 0.896–0.996), an antithrombotic by 48 hours (RR=0.952; 95% CI, 0.939–0.965), and to be discharged on an antithrombotic (RR=0.953; 95% CI, 0.925–0.982). Women had a lower composite score (mean difference −0.030, 95% CI −0.057 to −0.003) and were less likely to receive defect-free care than men (RR=0.914; 95% CI, 0.843–0.991).

Conclusions—Women had lower overall stroke QOC than men, although absolute differences in most individual PMs were small. Further investigation into the factors contributing to the sex disparity in guideline-concordant stroke care should be pursued.

Keywords

ischemic stroke; women; gender; quality

Introduction

Women have worse outcomes after stroke than men [1,2]. Even after adjustment for women's older age at stroke onset, women are more likely than men to have transitioned to institutional living at three months [3] and are less likely than men to be independent in their instrumental activities of daily living at six months [4] after stroke.

Studies investigating the reasons for sex-specific differences in stroke outcome have suggested that women may receive fewer standard diagnostic tests [5,6] and less frequent appropriate therapy [7,8] after stroke when compared to their male counterparts. In addition, women may receive lower guideline-concordant quality of care (QOC) after stroke than men. In an analysis of almost 400,000 ischemic stroke patients in the Get With the Guidelines Stroke (GWTG-Stroke) Program, women were less likely than men to receive defect-free stroke care (66.3 versus 71.1%, $p<0.0001$) [9].

Population-based studies regarding sex differences in stroke QOC are limited, with most being registry-based. Population-based studies at non-academic centers may better represent typical stroke care in the United States than studies involving treatment at academic centers. Thus, the paucity of data from non-academic sites limits our understanding of the important real-world factors contributing to women's worse outcomes after stroke. We investigated sex disparities in QOC in the population-based Brain Attack Surveillance in Corpus Christi (BASIC) Project in Nueces County, Texas, a community without an academic medical center.

Methods

The methods of the BASIC project have been described in detail elsewhere [10]. In brief, BASIC is an observational study that uses active and passive surveillance to identify Nueces County residents > 44 years of age with potential stroke who are admitted to any of the six hospitals in the community. These hospitals serve a bi-ethnic, predominantly urban population. The two major hospital systems in this community have been involved in the American Heart Association Get With The Guidelines Stroke (GWTG-Stroke) program since 2007, although the current project was separate from any activities for GWTG-Stroke. Two of the hospitals were certified as Primary Stroke Centers by the Joint Commission, one in January 2009 and the other in December 2010. Each potential stroke patient is validated as an acute ischemic stroke through systematic medical record review by a neurologist or stroke fellowship-trained emergency medicine physician. Validated stroke cases are invited to participate in an interview, and those who are interviewed undergo detailed medical record abstraction. Our study cohort consisted of all acute ischemic stroke patients who participated in BASIC between February 2009 and June 2012.

Baseline demographic data for all validated stroke patients were recorded. Data were abstracted from the medical record regarding compliance with seven Joint Commission performance measures (yes versus no): patient provided deep vein thrombosis (DVT) prophylaxis at 48 hours; patient discharged on an antithrombotic; patients with atrial fibrillation discharged on anticoagulation; patient given tissue plasminogen activator (tPA); patient prescribed an antithrombotic at 48 hours; patient prescribed a cholesterol medication at discharge; and patient evaluated for rehabilitation. Of note, medication contraindications are included in the definition of each quality measure, so it was not considered a failure if a patient did not receive a medication that was not appropriate for him or her. A composite score of QOC representing the number of achieved performance measures over all patient-appropriate measures was calculated for each patient. We also included a binary measure of defect-free care (yes versus no): patient received all appropriate performance measures. Our assessments of these quality metrics were performed independent of each hospital's internal quality assessment. Furthermore, we did not report our metrics back to the relevant hospitals until after data collection was complete.

We used generalized estimating equations (GEE) to examine the association between sex and each individual performance measure and between sex and the overall quality metrics (composite score and defect-free care). To examine sex differences in individual performance measures, we fit a Poisson model (unadjusted) with robust standard errors to report relative risk for the binary outcomes and a linear model (unadjusted) with robust standard errors for the continuous composite score. To account for hospital clustering, we then used generalized estimating equations (GEE) with a log link function for the binary outcomes and GEE with the identity link function for the continuous outcome, and robust standard errors were additionally corrected for the small number of clusters used (n=6 hospitals) [11]. Adjustment for hospital clustering was not performed for the tPA and anticoagulant for atrial fibrillation performance measures due to small numbers of eligible participants for these measures at some of the hospitals. In order to assess the effect of potential confounders of any observed sex differences in the quality measures, we

sequentially added covariates to the regression models for each of the individual and overall quality metrics, beginning with an unadjusted model including sex alone, next adding in hospital clustering (except for tPA and atrial fibrillation indicators as above), and then demographics including age and ethnicity. To avoid overfitting the model, no additional adjustment was performed for the individual performance measures due to the low number of outcome events per variable [12]. However, for the two overall quality metrics where there were a larger number of outcome events per variable, a final fully adjusted model was developed to additionally adjust for education, insurance, pre-stroke disability (modified Rankin scale score 0–2 versus 3–5), NIHSS, and comorbidity index. Appropriate functional forms of continuous variables were adjusted in models; a quadratic term of age was included for the continuous composite score; NIHSS was transformed in log scale and included with its quadratic term for the two overall quality measures. Finally, to investigate changes in compliance over time, we calculated the mean composite QOC score and the percent of defect-free care across men and women for each year of the study (2009 through 2012).

This study was approved by the institutional review board at each participating institution and the University of Michigan.

Results

There were 1127 Mexican American (MA) and non-Hispanic Whites (NHW) ischemic stroke patients during the study period with 765 (67.8%) agreeing to be interviewed. A total of 760 patients were eligible for QOC assessment. Three patients were excluded for incomplete data. Of the 757 patients included in the analysis, 536 (70.8%) were cared for at a primary stroke center. Women represented 391 (51.6%) of this cohort. MAs represented 480 (63.4%) of this cohort.

Compared to men, women were older (median age 72 versus 65, $p<0.0001$) and less likely to identify as married/living together (37.9% versus 61.2%, $p<0.0001$) than men (See Table 1). Women were less likely to self-pay (11.0% versus 19.7%, $p=0.002$). Women were more likely than men to have a diagnosis of Alzheimer's disease or dementia (14.6% versus 8.7%, $p=0.013$) and atrial fibrillation (17.4% versus 12.3%, $p=0.049$). Compared with men, women were less likely to have coronary artery disease (27.4% versus 39.1%, $p=0.001$), be a former or current smoker (24.3% versus 46.7%, $p<0.0001$), and have excessive alcohol intake (1.3% versus 10.4%, $p<0.001$). No difference was found in women versus men for ethnicity or highest level of education reached. There was a trend toward a higher median NIHSS score in women versus men (5 versus 4, $p=0.053$).

Performance Measures

When looking at individual performance measures, women were less likely than men to receive DVT prophylaxis at 48 hours after adjustment (76.9% versus 81.6%; RR=0.945; 95% CI, 0.896–0.996) (See Table 2). Women were less likely to be discharged on an antithrombotic after adjustment (83.6% versus 88.5%; RR=0.953; 95% CI, 0.925–0.982). In the unadjusted model, women were less likely to be discharged on a cholesterol medication (75.2% versus 86.6%; RR=0.868; 95% CI, 0.799–0.944). However, after adjustment for hospital clustering and demographics, no statistically significant difference was found

between sexes in discharge on a cholesterol medication (RR=0.880; 95% CI, 0.758–1.020). Women were less likely than men to receive an antithrombotic at 48 hours in both the unadjusted (RR=0.945; 95% CI, 0.909–0.982) and adjusted (RR=0.952; 95% CI, 0.939–0.965) models. No difference was found between sexes in anticoagulation at discharge, receipt of tPA, or evaluation for rehabilitation in either the unadjusted or adjusted models.

Overall Quality Metrics

On unadjusted analysis, women had a composite QOC score of 0.84 and men had a composite QOC score of 0.88 (mean difference −0.044; 95% confidence interval [CI], −0.073 to −0.015) (See Table 3). Women also had a significantly lower composite QOC score (mean difference −0.030; 95% CI, −0.057 to −0.003) in the fully adjusted model. Defect-free care was delivered to 55.8% of women compared to 62.0% of men. In unadjusted analysis, there was no sex difference in receipt of defect-free care (relative risk [RR]=0.899; 95% CI, 0.798–1.013). After adjustment for hospital clustering, demographics, socioeconomic status, pre-stroke disability, NIHSS score, and comorbidity index, women were significantly less likely than men to receive defect-free care (RR=0.914; 95% CI, 0.843–0.991). Across men and women, the mean (SD) of the composite QOC score was 0.82 (0.22) in 2009, 0.88 (0.20) in 2010, 0.87 (0.19) in 2011, and 0.88 (0.20) in 2012. Defect-free care was 50% in 2009, 63% in 2010, 59% in 2011, and 65% in 2012.

Discussion

We found significant QOC differences between women and men. While these differences were modest, given that there should be no difference in quality of care for men versus women, even small differences are notable. While most of the patients in this sample were treated at hospitals already focusing on stroke quality improvement (GWTG-Stroke), our findings suggest that additional attention to eliminating disparities in QOC is needed beyond just participation in national quality improvement programs.

Women with acute ischemic stroke had a lower composite QOC score (number of achieved performance measures over all patient-appropriate measures) and were less likely to receive defect-free stroke care than men. Absolute differences in most individual performance measures were small. However, women were significantly less likely to receive DVT prophylaxis by 48 hours; receive an antithrombotic by 48 hours; and to be discharged on an antithrombotic in the adjusted analysis.

Our results in these non-academic centers are consistent with the findings of Reeves et al in their analysis of sex-based differences in stroke QOC in the GWTG-Stroke program [9]. Women in their analysis were also less likely than their male counterparts to receive DVT prophylaxis by 48 hours (87.9% versus 89.4%), have an antithrombotic prescribed within 48 hours (93.6% versus 94.7%), and to have an antithrombotic prescribed at discharge (94.3% versus 95.2%). In their analysis, women were significantly less likely to receive defect-care than men (66.3% versus 71.1%), a magnitude of difference similar to that observed in our study (55.8% versus 62.0%). There was no overlap between patients in our study that may have been included in GWTG-Stroke and patients in the Reeves study, as the Reeves study reported on data through 2008, and our data collection started in 2009. Our work extends on

this GWTG analysis by focusing specifically on a non-academic community-based setting and by demonstrating that sex differences in quality persist.

Other studies have also reported that female ischemic stroke patients are less likely to receive an antiplatelet than their male counterparts. A 2012 meta-analysis of 45 studies evaluating stroke gender disparities across > 670,000 patients found that women were less likely to receive an antiplatelet than men (odds ratio [OR]=0.89; 95% CI, 0.84–0.94) [7]. Women in this analysis were also less likely to receive a statin medication (OR=0.71; 95% CI, 0.60–0.84). We found a similar association between sex and cholesterol medication, although the association did not reach statistical significance (RR=0.880; 95% CI, 0.758–1.020). Most studies have found that women receive tPA less frequently than men [7,13–15], although some studies have found no sex difference [16–18]. In this study, we found no significant difference between men and women in the proportion of patients treated with IV tPA (RR=1.077; 95% CI, 0.792–1.466).

The strengths of our study include its large cohort size and prospective design. In addition, our study includes a high proportion of MAs, a population that has historically been underrepresented in the stroke literature. Our cohort is limited to a specific geographic location and may not be generalizable to other communities. Another limitation of our study is that we were unable to control for PSC certification. At the time of our study, one hospital was already certified and one became certified in the study years. The number of stroke patients treated prior to certification was too small to detect a change in hospital practice based on certification status. Furthermore, the two major hospital systems in this community have been involved in GWTG-Stroke since 2007, which may make them less representative of community hospitals across the country. Additionally, it is possible that unmeasured confounders contributed to our observed differences.

Our sample size was not large enough to investigate potential drivers of the sex disparity in stroke QOC, such as income or stroke severity. Subsequent analyses of QOC measures in larger studies should include sequential modeling to determine the degree to which specific factors, such as socioeconomic status and stroke severity, affect the sex disparity in stroke QOC.

In conclusion, women in our study had a lower overall stroke QOC and less defect-free stroke care than men. Further investigation into the factors contributing to the sex disparity in stroke outcomes should be pursued.

Acknowledgments

This study was performed in the Corpus Christi Medical Center and CHRISTUS Spohn Hospitals, CHRISTUS Health system, in Corpus Christi, Texas.

Sources of Funding

This study was funded by the NIH/NINDS R01 NS038916. Dr. Darin Zahuranec has received support from NIH/NIA K23 AG038731. Dr. Jonggyu Baek was supported in part by U10NS086526.

References

1. Persky RW, Turtzo LC, McCullough LD. Stroke in women: Disparities and outcomes. Curr Cardiol Rep. 2010; 12:6–13. [PubMed: 20425178]
2. Kapral MK, Fang J, Hill MD, et al. Sex differences in stroke care and outcomes: Results from the Registry of the Canadian Stroke Network. Stroke. 2005; 36:809–814. [PubMed: 15731476]
3. Glader EL, Stegmayr B, Norrving B, et al. Sex differences in management and outcome after stroke: A Swedish national perspective. Stroke. 2003; 34:1970–1975. [PubMed: 12855818]
4. Lai SM, Duncan PW, Dew P, et al. Sex differences in stroke recovery. Prev Chronic Dis. 2005; 2:A13.
5. Smith MA, Lisabeth LD, Brown DL, et al. Gender comparisons of diagnostic evaluation for ischemic stroke patients. Neurology. 2005; 65:855–858. [PubMed: 16186523]
6. Smith EE, Pan W, Olson D, et al. Frequency and determinants of lipid testing in ischemic stroke and transient ischemic attack: Findings from get with the guidelines-stroke. Stroke. 2010; 41:232–238. [PubMed: 20035071]
7. Giralt D, Domingues-Montanari S, Mendioroz M, et al. The gender gap in stroke: A meta-analysis. Acta Neurol Scand. 2012; 125:83–90. [PubMed: 21649609]
8. Smith DB, Murphy P, Santos P, et al. Gender differences in the Colorado Stroke Registry. Stroke. 2009; 40:1078–1081. [PubMed: 19211487]
9. Reeves MJ, Fonarow GC, Zhao X, et al. Quality of care in women with ischemic stroke in the GWTG program. Stroke. 2009; 40:1127–1133. [PubMed: 19211482]
10. Morgenstern LB, Smith MA, Sanchez BN, et al. Persistent ischemic stroke disparities despite declining incidence in Mexican Americans. Ann Neurol. 2013; 74:778–785. [PubMed: 23868398]
11. Mancl LA, DeRouen TA. A covariance estimator for GEE with improved small-sample properties. Biometrics. 2001; 57:126–134. [PubMed: 11252587]
12. Peduzzi P, Concato J, Kemper E, et al. A simulation study of the number of events per variable in logistic regression analysis. J Clin Epidemiol. 1996; 49:1373–1379. [PubMed: 8970487]
13. Reeves M, Bhatt A, Jajou P, et al. Sex differences in the use of intravenous rt-PA thrombolysis treatment for acute ischemic stroke: A meta-analysis. Stroke. 2009; 40:1743–1749. [PubMed: 19228855]
14. Reeves MJ, Bushnell CD, Howard G, et al. Sex differences in stroke: Epidemiology, clinical presentation, medical care, and outcomes. Lancet Neurol. 2008; 7:915–926. [PubMed: 18722812]
15. Gargano JW, Wehner S, Reeves M. Sex differences in acute stroke care in a statewide stroke registry. Stroke. 2008; 39:24–29. [PubMed: 18048851]
16. Allen NB, Myers D, Watanabe E, et al. Utilization of intravenous tissue plasminogen activator for ischemic stroke: Are there sex differences? Cerebrovasc Dis. 2009; 27:254–258. [PubMed: 19176959]
17. Gattringer T, Ferrari J, Knoflach M, et al. Sex-related differences of acute stroke unit care: Results from the Austrian stroke unit registry. Stroke. 2014; 45:1632–1638. [PubMed: 24736235]
18. Kapral MK, Degani N, Hall R, et al. Gender differences in stroke care and outcomes in Ontario. Women Health Iss. 2011; 21:171–176.

J Stroke Cerebrovasc Dis. Author manuscript; available in PMC 2018 August 01.

Table 1

Baseline characteristics of the study cohort.

		Overall (N=757)		Male (N=366)		Female (N=391)		
		N or Median	% or (Q1, Q3)	N or Median	% or (Q1, Q3)	N or Median	% or (Q1, Q3)	P-value*
Ethnicity	Mexican American	480	63.4	234	63.9	246	62.9	0.771
Age		68	(58.0–80.0)	65	(57.0–77.0)	72	(60.0–81.0)	<.0001
Female		391	51.7					
Marital Status	Married/living together	372	49.1	224	61.2	148	37.9	<.0001
	Single	48	6.3	22	6.0	26	6.6	
	Widow	198	26.2	47	12.8	151	38.6	
	Divorced/separated	139	18.4	73	19.9	66	16.9	
Education	< High school	291	38.4	138	37.7	153	39.1	0.132
	High school	212	28.0	96	26.2	116	29.7	
	Vocational/some college	141	18.6	66	18.0	75	19.2	
	College or more	113	14.9	66	18.0	47	12.0	
Health Insurance	Self-pay	115	15.2	72	19.7	43	11.0	0.002
	Medicare, Medicaid and Medicare, VA	161	21.3	64	17.5	97	24.8	
	Medicaid	20	2.6	8	2.2	12	3.1	
	Private, Private and Medicare	461	60.9	222	60.7	239	61.1	
Baseline mRS	0–2	573	75.7	305	83.3	268	68.5	<.0001
Risk factors								
	Alzheimer’s/Dementia	89	11.8	32	8.7	57	14.6	0.013
	Atrial Fibrillation	113	14.9	45	12.3	68	17.4	0.0493
	Cancer	96	12.7	41	11.2	55	14.1	0.237
	COPD	90	11.9	42	11.5	48	12.3	0.7337
	CHF	86	11.4	38	10.4	48	12.3	0.412
	CAD/MI	250	33.0	143	39.1	107	27.4	0.001
	Excessive ETOH	43	5.7	38	10.4	5	1.3	<.0001
	Diabetes Mellitus	365	48.2	185	50.5	180	46.0	0.2145

		Overall (N=757)		Male (N=366)		Female (N=391)		
		N or Median	**% or (Q1, Q3)**	**N or Median**	**% or (Q1, Q3)**	**N or Median**	**% or (Q1, Q3)**	**P-value***
	ESRD	44	5.8	19	5.2	25	6.4	0.4798
	Epilepsy	26	3.4	16	4.4	10	2.6	0.171
	High Cholesterol	356	47.0	162	44.3	194	49.6	0.140
	Hypertension	620	81.9	301	82.2	319	81.6	0.8151
	Parkinson's	13	1.7	6	1.6	7	1.8	0.873
	Stroke/TIA history	246	32.5	109	29.8	137	35.0	0.123
	Smoker	266	35.1	171	46.7	95	24.3	<.0001
				254	69.4	282	72.1	0.410
Comorbidity index		4		3.5		3		0.098
NIHSS		4		4		5		0.053

*Chi-square test for categorical variable, and Kruskal-Wallis non-parametric test for continuous variables.

VA = Veteran Affairs, mRS = modified Rankin scale, COPD = chronic obstructive pulmonary disease, CHF = congestive heart failure, CAD = coronary artery disease, MI = myocardial infarction, ETOH = alcohol, ESRD = end-stage renal disease, TIA = transient ischemic attack, NIHSS = National Institute for Health Stroke Scale

J Stroke Cerebrovasc Dis. Author manuscript; available in PMC 2018 August 01.

Table 2

The association of sex with seven individual stroke performance measures.

Performance Measure	% Received in Females	% Received in Males	Unadjusted Analysis		Adjustment for Hospital Clustering, Age, and Ethnicity	
			RR	95% CI	RR	95% CI
tPA administered * (n=90)	63.6	60.0	1.061	0.758, 1.485	1.164	0.826, 1.640
DVT prophylaxis at 48 hours (n=525)	76.9	81.6	0.943	0.863, 1.029	0.945†	0.896, 0.996
Antithrombotic at 48 hours (n=675)	91.2	96.6	0.945†	0.909, 0.982	0.952†	0.939, 0.965
Discharged on anticoagulati on for atrial fibrillation * (n=127)	74.0	64.8	1.141	0.899, 1.449	1.104	0.878, 1.388
Discharged on cholesterol medication (n=524)	75.2	86.6	0.868†	0.799, 0.944	0.880	0.758, 1.020
Discharged on antithrombotic (n=684)	83.6	88.5	0.944	0.889, 1.003	0.953†	0.925, 0.982
Evaluated for rehabilitation (n=636)	96.7	95.8	1.009	0.979, 1.041	1.005	0.950, 1.065

*Adjustment for hospital clustering for the tPA and anticoagulation PMs was not possible due to small number of eligible participants at some hospitals.

†Denotes significance at $p<0.05$.

Table 3

Overall quality metrics with male as the referent.

	Unadjusted analysis		**Adjusted analysis***	
Composite QOC†	Mean difference = −0.044	p=0.003	Mean difference = −0.030	p=0.027
Defect-free care	RR= 0.899	p=0.080	RR†= 0.914	p=0.030

QOC = quality of care, RR= relative risk

*Adjustment for random effects of hospitals, socioeconomic status, pre-stroke disability, initial stroke severity (NIHSS), and comorbidity index. NIHSS was transformed in log scale and included with its quadratic term for both composite QOC and defect-free care.

†A quadratic term of age was included for the composite QOC score.