ORIGINAL RESEARCH

Trends in Transient Ischemic Attack Hospitalizations in the United States

Lucas Ramirez, MD; May A. Kim-Tenser, MD; Nerses Sanossian, MD; Steven Cen, PhD; Ge Wen, MS; Shuhan He, MD; William J. Mack, MD; Amytis Towfighi, MD

***Background*—**Transient ischemic attack (TIA) is a major predictor of subsequent stroke. No study has assessed nation-wide trends in hospitalization for TIA in the United States.

***Methods and Results*—**Temporal trends in hospitalization for TIA (International Classification of Diseases, Ninth Revision code 435.0–435.9) from 2000 to 2010 were assessed among adults aged ≥25 years using the Nationwide Inpatient Sample. Age-, sex-, and race/ethnic-specific TIA hospitalization rates were calculated using the weighted number of hospitalizations as the numerator and the US population as the denominator. Age-adjusted rates were standardized to the 2000 US Census population. From 2000 to 2010, age-adjusted TIA hospitalization rates decreased from 118 to 83 per 100 000 (overall rate reduction, −29.7%). Age-specific TIA hospitalization rates increased for individuals aged 24 to 44 years (10–11 per 100 000), but decreased for individuals aged 45 to 64 (74 to 65 per 100 000), 65 to 84 (398 to 245 per 100 000), and ≥85 years (900 to 619 per 100 000). Blacks had the highest age-adjusted yearly hospitalization rates, followed by Hispanics and whites (124, 82, and 67 per 100 000 in 2010). Rates slightly increased for blacks, but decreased for Hispanics and whites. Compared to women, age-adjusted TIA hospitalization rates were lower and declined more steeply in men (132 to 89 per 100 000 versus 134 to 97 per 100 000).

***Conclusions*—**Although overall TIA hospitalizations have decreased in the United States, the reduction has been more pronounced among older individuals, men, whites, and Hispanics. These findings highlight the need to target risk-factor control among women, blacks, and individuals aged <45 years. **(*J Am Heart Assoc*. 2016;5:e004026 doi: 10.1161/JAHA.116.004026)**

Key Words: hospitalization • Nationwide Inpatient Sample • transient ischemic attack • trends

Cerebrovascular diseases are among the leading causes of morbidity and mortality in the United States[1]; however, recent studies have shown promising declines in prevalence and mortality.[2–5] Although several studies have assessed recent temporal trends in hospitalizations for ischemic stroke, no study has assessed trends for transient ischemic attack (TIA). Several factors may influence temporal trends in TIA hospitalizations, including true changes in incidence, changes in the definition for TIA, alterations in management (inpatient vs outpatient), and improvements in stroke detection (where events previously classified as TIA are classified as strokes). The aims of this study were to assess trends in race/ethnic-, age-, and sex-specific rates of hospitalization for TIA between 2000 and 2010.

Methods

We analyzed data from the Nationwide Inpatient Sample (NIS), the largest publicly available all-payer inpatient care database in the United States. The NIS contains data from ≈8 million de-identified hospital stays a year and approximates a 20% stratified sample of nonfederal US hospitals.[6] Most hospitals in the United States are nonfederal (97% in 2000 and 97.5% in 2010)[7] and include government hospitals operated by the city, county, and state, as well as hospitals operated by for-profit and nonprofit organizations. The database sampling strategy allows for extrapolation from the sample to represent and be generalizable to all US hospitalizations nationwide, using sampling weights. The database is maintained by the

From the Keck School of Medicine (L.R., M.A.K.-T., N.S., S.C., G.W., S.H., W.J.M., A.T.), Departments of Neurology (L.R., S.C., A.T.) and Neurosurgery (M.A.K.-T., N.S., S.C., W.J.M.), and Roxanna Todd Hodges Comprehensive Stroke Clinic (M.A.K.-T., N.S., S.C., W.J.M.), University of Southern California, Los Angeles, CA; Department of Neurology, Rancho Los Amigos National Rehabilitation Center, Downey, CA (N.S., A.T.).

An accompanying Table S1 is available at http://jaha.ahajournals.org/content/5/9/e004026/DC1/embed/inline-supplementary-material-1.pdf

Correspondence to: Lucas Ramirez, MD, 1100 N State St, CT A4E #117, Los Angeles, CA 90033. E-mail: lucasram@usc.edu

Received June 5, 2016; accepted August 23, 2016.

National Healthcare Cost Utilization Project (HCUP) of the Agency for Healthcare Research and Quality (AHRQ). Detailed information on the design of the NIS is available at www.hcup-us.ahrq.gov.

We followed the HCUP guideline for the data analysis (https://www.hcup-us.ahrq.gov/tech_assist/tutorials.jsp). The study qualified for institutional review board waiver. Discharge data were obtained from January 1, 2000 through December 31, 2010. TIA was defined by the International Classification of Diseases, Ninth revision primary discharge diagnosis codes for transient cerebral ischemia (435.0–435.9).[8] The total number of TIA admissions for adults aged ≥25 years was estimated using SAS 9.4 PROC SURVEYMEANS (SAS Institute Inc., Cary, NC) by accounting for sampling weight to reflect the overall US population. Age-, sex-, and race/ethnic-specific TIA hospitalization rates were calculated using the weighted number of hospitalizations as the numerator and the US civilian population as the denominator. Yearly rate comparisons across years were standardized with the age distribution of the US population in 2000. For comparison across year and sex, all rates were standardized with the age distribution of the US female population in 2000, whereas for comparison across year and race, all rates are were standardized with the age distribution of the US white population in 2000. The average rate of change is the average of the percent change from the preceding year across all years after 2000.

Results

Overall, age-adjusted TIA hospitalization rates in the United States decreased from 118 to 83 per 100 000 population from 2000 through 2010 (absolute rate change, −29.7%; Table 1). The decline was greater from 2000 to 2005 (average rate change, −4.82%/year) versus 2006 to 2010 (−1.96%/year). The decline in TIA hospitalizations was driven by individuals aged ≥65 years. Age-specific TIA rates increased in individuals 25 to 44 years (10–11 per 100 000; +10%), but decreased for all other age groups: 45 to 64 (74–65 per 100 000; −12.2%); 65 to 84 (398–245 per 100 000; −38.4%) and ≥85 years (900–619 per 100 000; −31.2%; Figure 1).

Blacks had the highest age-adjusted yearly hospitalization rates, followed by Hispanics and whites (124, 82, and 67 per 100 000 in 2010; Figure 2). From 2000 to 2010, TIA hospitalization rates decreased for Hispanics (−31.1%) and whites (−24.7%), but slightly increased for blacks (+3.3%). Hospitalization rates slightly increased for whites from 2006 to 2010 (+3.1%). The difference in TIA rates between Hispanics and whites decreased 9% from 2000 to 2010, but increased 37% between blacks and whites.

Age-adjusted TIA hospitalization rates were lower in men and had a steeper decline compared to women (132 to 89 per 100 000 [−32.6%] in men vs 134 to 97 per 100 000 [−27.6%] in women; Figure 3).

The Charlson Comorbidity Index scores for individuals with TIA increased from 2000 to 2010 (≥3: 6.02–9.83%). In-hospital mortality decreased from 0.25% to 0.15% (Table 2 and Table S1[9]).

Discussion

In this nationally representative sample, age-adjusted TIA hospitalization rates decreased 29.7% from 2000 to 2010 in

Table 1. Age-Adjusted Transient Ischemic Attack Hospitalization Rates Per 100 000

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Overall	118	117	112	105	96	92	95	90	92	87	83
Age categories, y											
25–44	10	10	10	11	10	11	12	11	12	12	11
45–64	74	71	72	71	66	63	68	66	69	65	65
65–84	398	393	372	345	311	291	299	277	282	263	245
85 and over	900	933	864	785	729	716	710	664	672	617	619
Race											
Hispanic	119	108	110	136	94	85	102	79	78	93	82
White	89	84	76	70	64	64	65	59	70	67	67
Black	120	117	123	118	117	90	110	110	109	112	124
Sex											
Male	132	131	121	115	104	99	103	97	99	92	89
Female	134	134	130	120	111	106	110	104	107	100	97

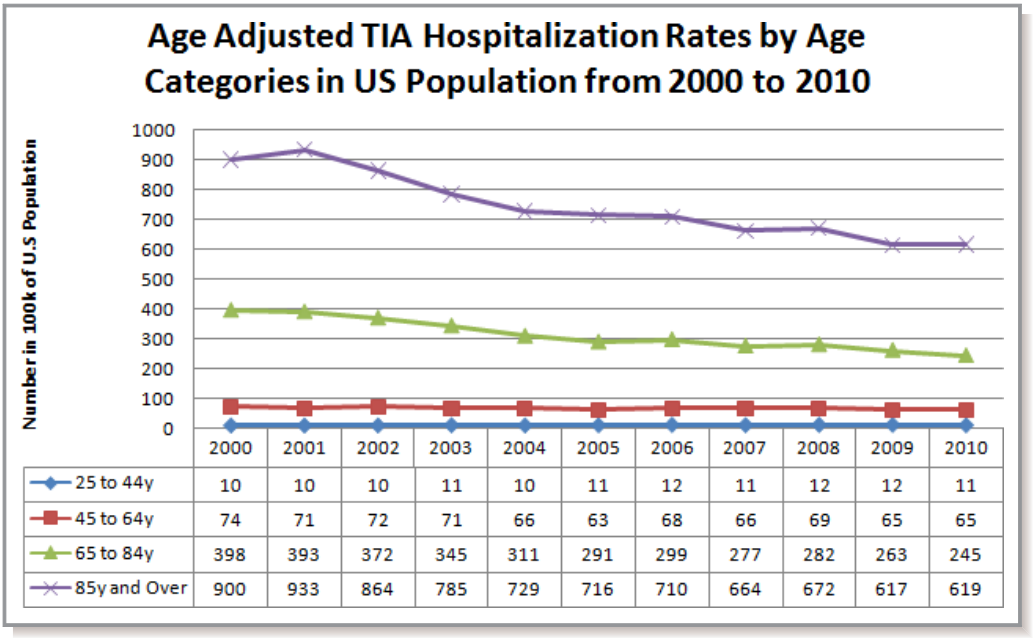

Figure 1. Age-category–specific TIA hospitalization rates per 100 000 in the United States from 2000 to 2010. TIA indicates transient ischemic attack.

the United States, with a greater decline occurring in the first 5 years. Overall, blacks had the highest age-adjusted TIA hospitalization rates, followed by Hispanics and whites. Individuals aged >45 years, Hispanics, whites, and men saw the greatest declines, but rates increased for individuals aged <45 years and blacks. Comorbidity scores increased from 2000 to 2010, but in-hospital deaths decreased.

This study is the first to assess recent trends in TIA rates among a national sample of the US population. TIA incidence in the United States is estimated at 200 000 to 500 000 per year,[10] and 14% to 78.7% are typically hospitalized.[11–15] Data from the National Hospital Ambulatory Medical Care Survey (NHAMCS) demonstrated a stable 54% annual admission from 1992 to 2001.[15] The HCUP showed a decline in TIA hospitalizations from 1997 to 2005.[8] Recent data from the NHAMCS showed that the percentage of hospital admissions from emergency departments (EDs) for acute ischemic stroke (AIS) or TIA increased from 71% to 78%, whereas ED visits decreased 35% between 2001 and 2011.[16]

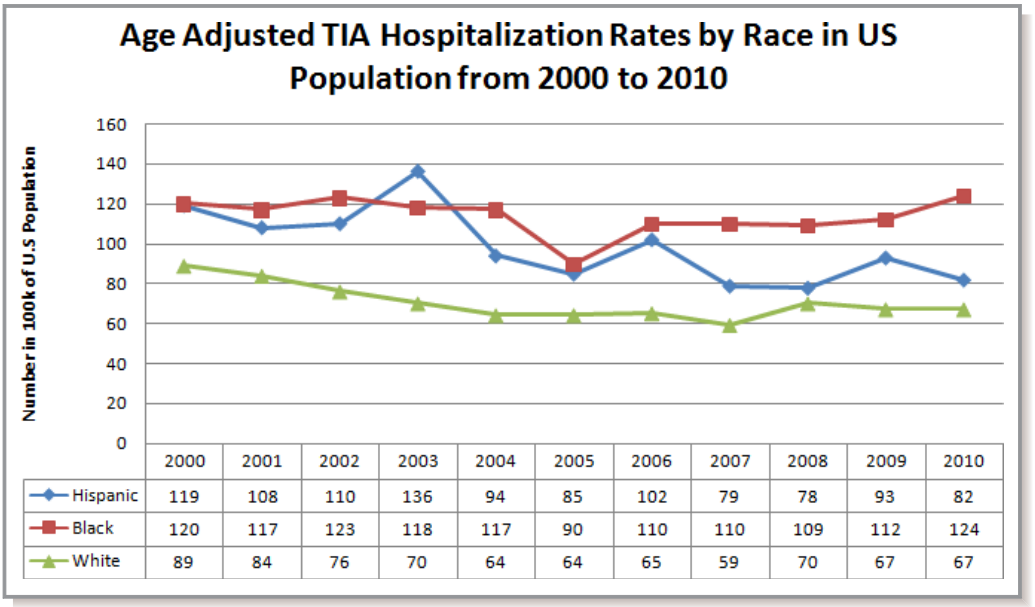

Figure 2. Race/ethnic differences in age-adjusted TIA hospitalization rates per 100 000 in the United States from 2000 to 2010. TIA indicates transient ischemic attack.

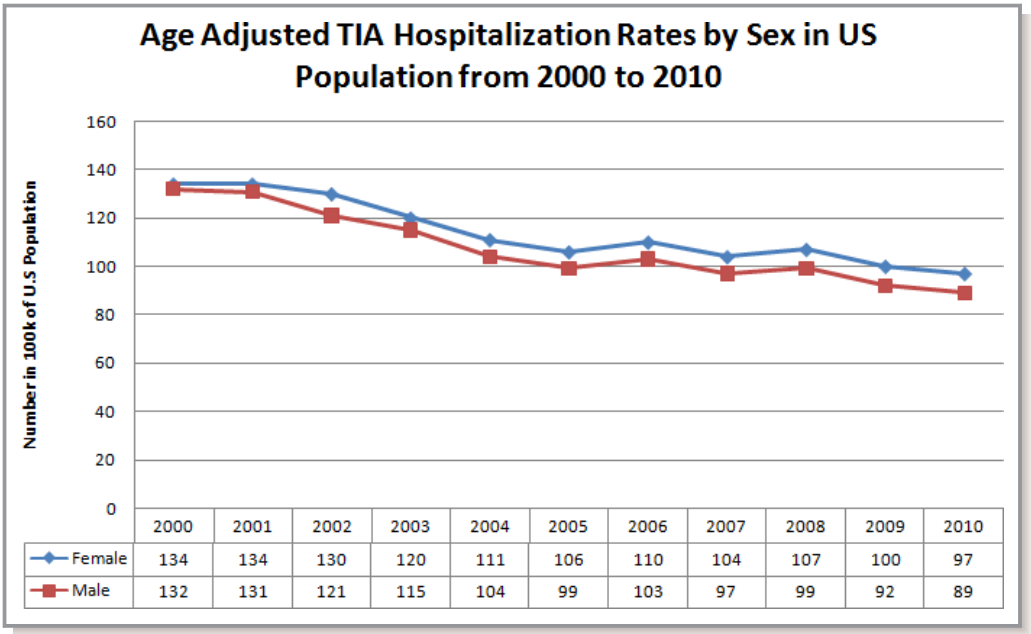

Figure 3. Sex differences in age-adjusted TIA hospitalization rates per 100 000 in the United States from 2000 to 2010. TIA indicates transient ischemic attack.

Cohort studies, such as Greater Cincinnati/Northern Kentucky Stroke Study (GCNKSS), Brain Attack Surveillance in Corpus Christi Project (BASIC), and Rochester, Minnesota, have shown that TIA incidence increases with age,[13,17,18] is higher in men,[13,17] and is higher in blacks[13] and Hispanics[18] compared to whites. Administrative data from NHAMCS showed that incidence rates increased with age, is higher in women, whites and non-Hispanics.[15] Similarly, data regarding AIS epidemiology show increased incidence with age,[19,20] male sex,[19,21–23] and higher rates in blacks and Hispanics compared to whites.[18,19,24,25] Trend analysis have shown an overall decline in age-adjusted AIS rates,[19,20,22] with increasing rates for the young.[19,20,25]

Our finding of higher TIA hospitalization rates in older individuals corroborated previous studies[13,15,17,18]; however, we uniquely showed an increase in TIA hospitalization rates from 2000 to 2010 in young adults and a decrease for individuals aged >45 years. We showed that TIA hospitalizations rates were lower in men, consistent with a past ED diagnosis-based national database,[15] though differing from 2 previous cohort studies.[13,17] Our finding of steeper declines in men compared to women has not been previously described. TIA hospitalization rates were greatest in blacks throughout the decade, consistent with a previous cohort study,[13] though differing from an ED diagnosis-based national database.[15] This is the first study to show increasing TIA hospitalizations in blacks and decreasing rates in whites and Hispanics.

There have been numerous changes that may impact TIA hospitalization rates. Classically, TIA was defined as a sudden, focal neurological deficit lasting <24 hours.[26] Given that studies have demonstrated infarcts on diffusion-weighted magnetic resonance imaging (MRI) in 30% to 50% of patients using that definition,[27] TIA is now considered a brief episode of neurological dysfunction caused by focal brain or retinal ischemia without evidence of acute infarction.[27] In addition, with recognition of the risk of subsequent stroke and worse long-term survival in individuals with TIA,[11,28–30] attention has focused on early, more-aggressive treatment and evaluation of TIA.

Contributors to declining TIA hospitalization rates may include lower incidence, possibly attributed to primary cardiovascular prevention efforts[31–34] and improved post-stroke care.[35] This is supported by decreasing ED visit rates for AIS and TIA[16] and declining AIS hospitalization rates.[19] The decline in in-hospital deaths despite higher comorbidity scores may reflect improved hospital care. The new imaging-based definition of TIA[27] and more-widespread use of MRI[15,16,36,37] may affect the proportion coded as TIA at discharge.

Our study has limitations. First, TIA hospitalization rates underestimate the true incidence of TIA given that patients are often not admitted.[11–16] Changes in practice, such as observing patients in 24-hour observational units or seeing them in TIA clinics, likely influence admission rates to a small degree.[38] These services, however, are only offered at specialized centers, and even when they are offered, only a small proportion of individuals are not admitted. In the TIAregistry.org project, where sites were chosen based on having a dedicated system of care for patients with TIA, only

Table 2. Sociodemographic and Clinical Characteristics of Hospitalized Patients for TIA in the United States From 2000 to 2010

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Age, y											
25–44, %	3.88	3.8	4.15	4.53	4.63	4.85	5	5.1	5.27	5.17	4.91
45–64, %	21.49	21.29	22.79	24.23	25.05	25.43	26.72	27.55	27.91	28.05	29.29
65–84, %	56.85	56.32	55.08	53.8	52.59	51.22	50.28	49.23	48.81	48.85	46.97
Over 85, %	17.77	18.6	17.97	17.44	17.72	18.5	17.99	18.12	18.01	17.93	18.83
Charlson index											
<1, %	80.62	80.47	80.11	79.51	79.23	78.65	78.13	78.03	77.77	77.43	76.96
1–2, %	13.36	13.4	13.21	13.42	13.6	13.59	13.33	13.12	13.23	13.1	13.21
≥3, %	6.02	6.13	6.69	7.08	7.17	7.75	8.54	8.86	9	9.47	9.83
Discharge status											
Against medical advice, %	0.73	0.64	0.84	0.92	0.91	1.08	1.38	1.18	1.32	1.4	1.37
Died in hospital, %	0.25	0.22	0.22	0.2	0.21	0.16	0.18	0.14	0.16	0.15	0.15
Discharged alive, destination unknown, %		0.02	0.01	0.02	0.01	0.01	0.01	0.01	0.03	0.02	0.01
Home health care, %	7.97	7.77	8.17	8.17	9.93	9.99	10.41	10.39	10.4	10.72	11.87
Other, including: SNF, intermediate care, another type of facility, %	12.65	13.27	13.04	12.56	13.08	13.23	12.52	12.73	11.61	11.93	12.04
Routine, %	76.89	76.73	76.5	77.03	74.72	74.4	74.32	74.47	75.44	74.72	73.65
Short-term hospital, %	1.52	1.35	1.23	1.1	1.14	1.14	1.17	1.08	1.05	1.05	0.91
Sex											
Female, %	59.22	59.5	60.19	59.14	59.42	59.52	59.01	58.86	58.69	58.72	58.62
Male, %	40.78	40.5	39.81	40.86	40.58	40.48	40.99	41.14	41.31	41.28	41.38
Hospital bed size*											
Large, %	58.93	60.49	61.57	60.56	60.68	62.98	59.49	61.08	62.6	63.85	64.38
Medium, %	28.24	27.22	26.14	27.08	26.27	24.43	25.86	26.5	24.64	24.68	23.92
Small, %	12.83	12.29	12.3	12.36	13.06	12.58	14.65	12.42	12.76	11.47	11.7

Continued

DOI: 10.1161/JAHA.116.004026

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Table 2. Continued

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Hospital region											
Midwest, %	21.38	23.5	22.75	22.15	24.19	22.12	22.75	22.35	22.57	20.46	21.3
Northeast, %	23.11	20.79	21.6	22.27	20.53	21.97	22.02	20.6	21.13	22.14	23.42
South, %	41.16	42.04	42.32	40.85	41.85	41.65	41.28	41.75	41.97	42.68	40.25
West, %	14.35	13.67	13.33	14.73	13.43	14.26	13.94	15.3	14.33	14.72	15.02
Length of stay											
Mean days±SE	3.32±0.04	3.14±0.03	3.15±0.03	3.07±0.04	2.99±0.03	2.95±0.03	2.89±0.03	2.81±0.03	2.68±0.03	2.6±0.03	2.56±0.03
Payment types											
Medicaid, %	4.06	4	4.26	5	4.63	4.74	5.13	5.03	5.29	6	6.43
Medicare, %	71.06	71.33	71.02	69.95	68.88	68.96	68	66.18	64.99	65.16	65.39
No charge, %	0.21	0.19	0.19	0.17	0.23	0.45	0.36	0.3	0.47	0.49	0.36
Other pay, %	1.49	1.55	1.38	1.63	1.64	1.59	1.78	2.16	2.16	1.89	2.2
Private including HMO, %	21.09	20.7	20.74	21	21.89	21.13	21.66	22.75	23.65	22.41	21.25
Self pay, %	2.09	2.23	2.41	2.26	2.73	3.14	3.06	3.58	3.44	4.06	4.37
Race											
Asian/Pacific, %	1.28	1.46	1.62	1.93	1.86	1.55	1.53	1.96	1.69	1.69	1.81
Black, %	11.01	11.24	12.88	12.95	14.46	11.75	13.62	14.93	13.32	13.88	15.55
Hispanic, %	6.59	6.46	7.27	9.5	7.96	7.74	9.04	8.18	7.29	8.87	8.52
Native American, %	0.26	0.38	0.17	0.16	0.39	0.3	0.67	0.68	0.49	0.44	0.6
Other Race, %	1.8	1.38	1.77	2.05	1.76	2.21	1.97	2.15	2.89	2.84	2.18
White, %	79.06	79.08	76.28	73.41	73.57	76.46	73.17	72.09	74.33	72.28	71.34
Rural/urban											
Rural, %	20	20.06	19.01	18.53	17.86	17.28	16.34	15.27	14	13.44	13.62
Urban, %	80	79.94	80.99	81.47	82.14	82.72	83.66	84.73	86	86.56	86.38
Teaching/nonteaching											
Nonteaching, %	66.51	66.41	67.19	67.15	67.38	69.46	60.44	62.24	60.68	62.74	59.74
Teaching, %	33.49	33.59	32.81	32.85	32.62	30.54	39.56	37.76	39.32	37.26	40.26

AMA indicates against medical advice; HMO, Health Maintenance Organization; SNF, skilled nursing facility; TIA, transient ischemic attack.
*Hospital bed-size categories defined in Table S1.[9]

23% of patients were evaluated in a day or outpatient clinic setting.[39] In addition, not all individuals with TIA symptoms seek medical attention when symptoms resolve.[40] Public knowledge of stroke warning signs did not improve from 2000 to 2005 in a large US population survey.[41] The likelihood that an individual will seek medical attention after TIA depends on factors such as health literacy, cultural beliefs, insurance status, and access to care, whereas the likelihood of diagnosing TIA depends upon hospital and provider factors. Therefore, although NIS is a national sample of US hospitals, individuals with poor access to care and the underinsured or uninsured were probably less likely to seek care if the symptoms resolved. Second, implementation of the new imaging-based definition of TIA[27] may have been variable during the study period, and more-widespread use of MRI may have affected the proportion of individuals coded as TIA versus AIS. Third, given that this is an observational study, one cannot assume causality. Fourth, as with any administrative data set, there is the possibility of coding errors, including the miscoding of TIA as AIS or vice versa.[42] Fifth, because of differences in race/ethnic categories in NIS versus the census data, TIA rates are underestimated in Hispanics. In the census, Hispanic ethnicity and race are separate measurements; therefore, populations reported under Hispanics include Hispanic white, Hispanic black, and Hispanic Asian. In NIS, race and ethnicity are combined; individuals are coded as Latino or other race. Despite these limitations, the study's strengths include large sample size, nation-wide representation, and clinician-based TIA diagnosis. Further research is warranted to determine causes of disparate hospitalization rates, to better ascertain nationwide trends in incidence, and identify strategies to target subgroups who are most vulnerable.

Sources of Funding

This research was supported by the Roxanna Todd Hodges Foundation and Joachim Splichal (Sanossian).

Disclosures

Towfighi, MD, is supported by 1U54NS081764-01 from the National Institute of Neurological Disorders and Stroke and 11SDG7590160 from the American Heart Association. The remaining authors have no disclosures to report.

References

1. Go AS, Mozaffarian D, Roger VL, Benjamin EJ, Berry JD, Blaha MJ, Dai S, Ford ES, Fox CS, Franco S, Fullerton HJ, Gillespie C, Hailpern SM, Heit JA, Howard VJ, Huffman MD, Judd SE, Kissela BM, Kittner SJ, Lackland DT, Lichtman JH, Lisabeth LD, Mackey RH, Magid DJ, Marcus GM, Marelli A, Matchar DB, McGuire DK, Mohler ER III, Moy CS, Mussolino ME, Neumar RW, Nichol G, Pandey DK, Paynter NP, Reeves MJ, Sorlie PD, Stein J, Towfighi A, Turan TN, Virani SS, Wong ND, Woo D, Turner MB; American Heart Association Statistics C, Stroke Statistics S. Heart disease and stroke statistics—2014 update: a report from the American Heart Association. *Circulation*. 2014;129:e28–e292.
2. Ovbiagele B. Nationwide trends in in-hospital mortality among patients with stroke. *Stroke*. 2010;41:1748–1754.
3. Towfighi A, Ovbiagele B, Saver JL. Therapeutic milestone: stroke declines from the second to the third leading organ- and disease-specific cause of death in the United States. *Stroke*. 2010;41:499–503.
4. 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.
5. Ovbiagele B, Markovic D, Towfighi A. Recent age- and gender-specific trends in mortality during stroke hospitalization in the United States. *Int J Stroke*. 2011;6:379–387.
6. *Healthcare Cost and Utilization Project (HCUP): Nationwide Inpatient Sample (NIS)*. Rockville, MD: Agency for Healthcare Research and Quality; 2000–2010.
7. National Center for Health Statistics. *Health, United States, 2012: With Special Feature on Emergency Care*. Hyattsville, MD: U.S. Government Printing office; 2013.
8. Russo CA, Andrews RM. *Hospital Stays for Stroke and Other Cerebrovascular Diseases, 2005: Statistical Brief #51. Healthcare Cost and Utilization Project (HCUP) Statistical Briefs*. Rockville, MD: Agency for Healthcare Research and Quality; 2006.
9. *HCUP NIS Description of Data Elements. Healthcare Cost and Utilization Project (HCUP)*. Rockville, MD: Agency for Healthcare Research and Quality; 2008. Available at: www.hcup-us.ahrq.gov/db/vars/hosp_bedsize/nisnote.jsp. Accessed March 05, 2016.
10. Johnston SC. Clinical practice. Transient ischemic attack. *N Engl J Med*. 2002;347:1687–1692.
11. Johnston SC, Gress DR, Browner WS, Sidney S. Short-term prognosis after emergency department diagnosis of TIA. *JAMA*. 2000;284:2901–2906.
12. Lisabeth LD, Ireland JK, Risser JM, Brown DL, Smith MA, Garcia NM, Morgenstern LB. Stroke risk after transient ischemic attack in a population-based setting. *Stroke*. 2004;35:1842–1846.
13. Kleindorfer D, Panagos P, Pancioli A, Khoury J, Kissela B, Woo D, Schneider A, Alwell K, Jauch E, Miller R, Moomaw C, Shukla R, Broderick JP. Incidence and short-term prognosis of transient ischemic attack in a population-based study. *Stroke*. 2005;36:720–723.
14. Chaudhry SA, Tariq N, Majidi S, Afzal MR, Hassan AE, Watanabe M, Rodriguez GJ, Suri MF, Hussain S, Qureshi AI. Rates and factors associated with admission in patients presenting to the ED with TIA in the United States-2006 to 2008. *Am J Emerg Med*. 2013;31:516–519.
15. Edlow JA, Kim S, Pelletier AJ, Camargo CA Jr. National study on emergency department visits for transient ischemic attack, 1992–2001. *Acad Emerg Med*. 2006;13:666–672.
16. Talwalkar A, Uddin S. Trends in emergency department visits for ischemic stroke and transient ischemic attack: United States, 2001–2011. *NCHS Data Brief*. 2015;194:1–8.
17. Brown RD Jr, Petty GW, O'Fallon WM, Wiebers DO, Whisnant JP. Incidence of transient ischemic attack in Rochester, Minnesota, 1985–1989. *Stroke*. 1998;29:2109–2113.
18. Morgenstern LB, Smith MA, Lisabeth LD, Risser JM, Uchino K, Garcia N, Longwell PJ, McFarling DA, Akuwumi O, Al-Wabil A, Al-Senani F, Brown DL, Moye LA. Excess stroke in Mexican Americans compared with non-Hispanic whites: the Brain Attack Surveillance in Corpus Christi Project. *Am J Epidemiol*. 2004;160:376–383.
19. Ramirez L, Kim-Tenser MA, Sanossian N, Cen S, Wen G, He S, Mack WJ, Towfighi A. Trends in acute ischemic stroke hospitalizations in the United States. *J Am Heart Assoc*. 2016;5:e003233 doi: 10.1161/JAHA.116.003233.
20. Lee LK, Bateman BT, Wang S, Schumacher HC, Pile-Spellman J, Saposnik G. Trends in the hospitalization of ischemic stroke in the United States, 1998–2007. *Int J Stroke*. 2012;7:195–201.
21. Appelros P, Stegmayr B, Terent A. Sex differences in stroke epidemiology: a systematic review. *Stroke*. 2009;40:1082–1090.
22. Fang J, Alderman MH, Keenan NL, Croft JB. Declining US stroke hospitalization since 1997: National Hospital Discharge Survey, 1988–2004. *Neuroepidemiology*. 2007;29:243–249.
23. Pathak EB, Sloan MA. Recent racial/ethnic disparities in stroke hospitalizations and outcomes for young adults in Florida, 2001–2006. *Neuroepidemiology*. 2009;32:302–311.
24. White H, Boden-Albala B, Wang C, Elkind MS, Rundek T, Wright CB, Sacco RL. Ischemic stroke subtype incidence among whites, blacks, and Hispanics: the Northern Manhattan Study. *Circulation*. 2005;111:1327–1331.

25. Kissela BM, Khoury JC, Alwell K, Moomaw CJ, Woo D, Adeoye O, Flaherty ML, Khatri P, Ferioli S, De Los Rios La Rosa F, Broderick JP, Kleindorfer DO. Age at stroke: temporal trends in stroke incidence in a large, biracial population. *Neurology*. 2012;79:1781–1787.
26. Albers GW, Caplan LR, Easton JD, Fayad PB, Mohr JP, Saver JL, Sherman DG; Group TIAW. Transient ischemic attack–proposal for a new definition. *N Engl J Med*. 2002;347:1713–1716.
27. Easton JD, Saver JL, Albers GW, Alberts MJ, Chaturvedi S, Feldmann E, Hatsukami TS, Higashida RT, Johnston SC, Kidwell CS, Lutsep HL, Miller E, Sacco RL; American Heart A, American Stroke Association Stroke C, Council on Cardiovascular S, Anesthesia, Council on Cardiovascular R, Intervention, Council on Cardiovascular N, Interdisciplinary Council on Peripheral Vascular D. Definition and evaluation of transient ischemic attack: a scientific statement for healthcare professionals from the American Heart Association/American Stroke Association Stroke Council; Council on Cardiovascular Surgery and Anesthesia; Council on Cardiovascular Radiology and Intervention; Council on Cardiovascular Nursing; and the Interdisciplinary Council on Peripheral Vascular Disease. The American Academy of Neurology affirms the value of this statement as an educational tool for neurologists. *Stroke*. 2009;40:2276–2293.
28. Giles MF, Rothwell PM. Risk of stroke early after transient ischaemic attack: a systematic review and meta-analysis. *Lancet Neurol*. 2007;6:1063–1072.
29. Gattellari M, Goumas C, Garden F, Worthington JM. Relative survival after transient ischaemic attack: results from the program of research informing stroke management (PRISM) study. *Stroke*. 2012;43:79–85.
30. Wu CM, McLaughlin K, Lorenzetti DL, Hill MD, Manns BJ, Ghali WA. Early risk of stroke after transient ischemic attack: a systematic review and meta-analysis. *Arch Intern Med*. 2007;167:2417–2422.
31. Yoon SS, Ostchega Y, Louis T. Recent trends in the prevalence of high blood pressure and its treatment and control, 1999–2008. *NCHS Data Brief*. 2010;48:1–8.
32. Hyre AD, Muntner P, Menke A, Raggi P, He J. Trends in ATP-III-defined high blood cholesterol prevalence, awareness, treatment and control among U.S. Adults. *Ann Epidemiol*. 2007;17:548–555.
33. Centers for Disease C, Prevention. Vital signs: prevalence, treatment, and control of hypertension–United States, 1999–2002 and 2005–2008. *MMWR Morb Mortal Wkly Rep*. 2011;60:103–108.
34. Centers for Disease C, Prevention. Vital signs: prevalence, treatment, and control of high levels of low-density lipoprotein cholesterol–United States, 1999–2002 and 2005–2008. *MMWR Morb Mortal Wkly Rep*. 2011;60:109–114.
35. Parker C, Schwamm LH, Fonarow GC, Smith EE, Reeves MJ. Stroke quality metrics: systematic reviews of the relationships to patient-centered outcomes and impact of public reporting. *Stroke*. 2012;43:155–162.
36. Burke JF, Kerber KA, Iwashyna TJ, Morgenstern LB. Wide variation and rising utilization of stroke magnetic resonance imaging: data from 11 states. *Ann Neurol*. 2012;71:179–185.
37. Rao VM, Parker L, Levin DC, Sunshine J, Bushee G. Use trends and geographic variation in neuroimaging: nationwide Medicare data for 1993 and 1998. *AJNR Am J Neuroradiol*. 2001;22:1643–1649.
38. Olivot JM, Wolford C, Castle J, Mlynash M, Schwartz NE, Lansberg MG, Kemp S, Albers GW. Two aces: transient ischemic attack work-up as outpatient assessment of clinical evaluation and safety. *Stroke*. 2011;42:1839–1843.
39. Amarenco P, Lavallee PC, Labreuche J, Albers GW, Bornstein NM, Canhao P, Caplan LR, Donnan GA, Ferro JM, Hennerici MG, Molina C, Rothwell PM, Sissani L, Skoloudik D, Steg PG, Touboul PJ, Uchiyama S, Vicaut E, Wong LK; Investigators TIo. One-year risk of stroke after transient ischemic attack or minor stroke. *N Engl J Med*. 2016;374:1533–1542.
40. Johnston SC, Fayad PB, Gorelick PB, Hanley DF, Shwayder P, van Husen D, Weiskopf T. Prevalence and knowledge of transient ischemic attack among US adults. *Neurology*. 2003;60:1429–1434.
41. Kleindorfer D, Khoury J, Broderick JP, Rademacher E, Woo D, Flaherty ML, Alwell K, Moomaw CJ, Schneider A, Pancioli A, Miller R, Kissela BM. Temporal trends in public awareness of stroke: warning signs, risk factors, and treatment. *Stroke*. 2009;40:2502–2506.
42. Kokotailo RA, Hill MD. Coding of stroke and stroke risk factors using international classification of diseases, revisions 9 and 10. *Stroke*. 2005;36:1776–1781.

SUPPLEMENTAL MATERIAL

Table S1. Hospital Bed Size Categories[1]

BEDSIZE CATEGORIES (Beginning in 1998)			
Location and Teaching Status	Hospital Bedsize		
	Small	Medium	Large
NORTHEAST REGION			
Rural	1-49	50-99	100+
Urban, nonteaching	1-124	125-199	200+
Urban, teaching	1-249	250-424	425+
MIDWEST REGION			
Rural	1-29	30-49	50+
Urban, nonteaching	1-74	75-174	175+
Urban, teaching	1-249	250-374	375+
SOUTHERN REGION			
Rural	1-39	40-74	75+
Urban, nonteaching	1-99	100-199	200+
Urban, teaching	1-249	250-449	450+
WESTERN REGION			
Rural	1-24	25-44	45+
Urban, nonteaching	1-99	100-174	175+
Urban, teaching	1-199	200-324	325+

Note: Table S1. Hospital Bed Size and Categories. Reprinted from HCUP NIS Description of Data Elements, in Healthcare Cost and Utilization Project (HCUP), Retrieved August 26, 2016, from https://www.hcup-us.ahrq.gov/db/vars/hosp_bedsize/nisnote.jsp. Copyright 2008 by the Agency for Healthcare Research and Quality. Reprinted with permission.

Supplemental Reference:

1. HCUP NIS Description of Data Elements. Healthcare Cost and Utilization Project (HCUP). September 2008. Agency for Healthcare Research and Quality, Rockville, MD. www.hcup-us.ahrq.gov/db/vars/hosp_bedsize/nisnote.jsp.