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The impact of ethnic/racial status on access to care and outcomes after stroke: A narrative systematic review

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Improving poststroke outcomes is contingent on early symptom recognition and timely access to life-saving interventions. Several studies have reported differences in access to care among stroke patients from different ethnic/racial backgrounds, although some of the findings present contrasting results. A 2011 AHA/ASA Scientific Statement noted ethnic/racial disparities in access and receipt of stroke care. The aim of this systematic review was to comprehensively identify and describe the impact of ethnic/racial status on access to care after onset of stroke symptoms. We undertook a systematic search of the following databases: Cochrane, JBI, Trove, ProQuest, Ethos, CINAHL, MEDLINE, Embase, PsycINFO, Academic Search Elite, and Scopus to find relevant qualitative, quantitative, or mixed-method studies focused on ethnicity/race, stroke, and access to health care services in adult (≥18 years) stroke patients. A narrative synthesis approach was used to generate key themes describing the impact of ethnic/racial differences in stroke-related care. Twenty-five studies were included in this systematic review. Narrative synthesis yielded 4 key themes related to differences in 1) transportation to hospital, emergency wait time, hospital admission, and length of stay; 2) receipt of intravenous thrombolysis; 3) receipt of mechanical-reperfusion therapies and imaging procedures; and 4) risk of death, based on ethnicity/race. Generally, but not universally, ethnic/racial minorities (particularly black patients) had lower access to poststroke care, but no greater mortality risk. Reducing health-related disparities will improve treatment outcomes among ethnic stroke patients. (J Vasc Nurs 2019;37:199-212)

Obtaining life-saving therapies for stroke depends on early recognition of stroke symptoms, rapid access to and treatment in emergency departments, and receipt of evidence-based interventions thereafter. Ethnic minorities are known to experience less access to care[1–3] in addition to receiving lower level of medical care.[4,5] A lack of knowledge on the part of the patient and family regarding illness symptoms, language barriers, and insurance/payment challenges in some health care systems, and a lack of cultural sensitivity on the part of a health care provider, can lead to differential treatment and referral patterns in patients of ethnic/racial minorities regardless of their presenting illness.[1,3,6]

There are 2 main types of stroke: ischemic and hemorrhagic. The vast majority of strokes are ischemic (approximately 87%) and the rest are hemorrhagic.[7] Intravenous thrombolysis with tissue-type plasminogen activator (tPA) is the only approved treatment for patients with acute ischemic stroke. It is known to significantly improve outcomes in patients when administered within a 3-hour period from symptom onset[8–10] and in some cases may be given up to 4.5 hours from symptom onset.[11] A delay in hospital presentation and provider-level factors are the most important critical reasons of low incidence of tPA treatment in many minority stroke patients.[12,13] Utilization of t-PA in ischemic stroke is also known to vary by age, socioeconomic status, hospital size and case volume, geography, and use of emergency medical services (EMSs).[14–18] These same variables also influence the quality of care for patients with hemorrhagic stroke.[19–22]

Stroke incidence is higher among blacks, Hispanics, and American Indians compared to whites.[3] Chinese and south Asians are also at a higher risk of stroke compared to other ethnic groups.[23,24] An American Heart Association/American Stroke Association (AHA/AHS) Scientific Statement, published in 2011, noted ethnic/racial disparities in access and receipt of stroke care.[3] Thus, it is imperative to examine contemporary disparities in stroke-related care in ethnic/racial minority populations. The aim of this systematic review was to comprehensively identify and describe the impact of ethnic/racial status on access to care after onset of stroke symptoms.

METHOD

Study design

A narrative synthesis approach based on the guidelines by Popay et al,[25] which is a textual approach, was used to conduct this systematic review. Narrative synthesis appraises the research

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TABLE 1

SAMPLE OF MESH SEARCH

Medline (OVID) 2000–2019, English only

No.	*Search term*	*Results*
1	(Cerebrovascular Disorders or stroke).sh	76,450
2	(Immigrant* OR ethnic* OR "ethnic minorit*" OR race OR racial).af	190,178
3	(access* OR barrier* OR facilitator*).af	561,295
4	Health services.sh OR (health service* OR health care).af	707,996
5	1 AND 2 AND 3 AND 4	77

studies by interpretative analysis to explain the findings, rather than a meta-synthesis or statistical analysis approach.[24] The review protocol was registered in PROSPERO-International Prospective Register of Systematic Reviews (identification number: CRD42018106286).

Search methods

The main search concepts used as both keywords and subject headings were stroke and ethnicity. The search was undertaken with the assistance of a health sciences librarian at Queensland University of Technology. The search included articles published between 2010 and May 2019 and was identified from the following databases: Cochrane, JBI, Trove, ProQuest, Ethos, CINAHL, MEDLINE, Embase, PsycINFO, Academic Search Elite, and Scopus. The search strategy and terms can be seen in the exemplar search strategy from MEDLINE (see Table 1).

Two reviewers (T.L.G. and K.K.-S.) conducted the initial screening by independently reviewing titles and abstracts of the records retrieved from the search strategy using inclusion and exclusion criteria. Inclusion criteria were as follows: 1) studies focused on stroke (ischemic or hemorrhagic); access to care, processes of care, and care outcomes; 2) analyses were conducted based on ethnic/racial status; 3) participants were ≥ 18 years; and 4) studies published in peer-reviewed, English-language journals. Exclusion criteria were published abstracts, dissertations/theses (though the published articles were sought), protocol papers, literature reviews, or commentaries. Full texts of the articles were retrieved and further screened by T.L.G. and K.K.-S. for inclusion.

RESULTS

Search outcomes

The initial search yielded 1,431 records. Duplicates (n = 646) were identified and removed, yielding 703 records which were screened by title and abstract to yield 66 records. Full texts of these articles were then retrieved and screened using the aforementioned inclusion and exclusion criteria. Disagreements between reviewers were resolved through discussion and coming to consensus. Twenty-five studies were included in this review. The search outcomes are illustrated in Figure 1. A data extraction table was developed by T.L.G. and K.K.-S. to enable summarizing salient details (including quality appraisal) of each article (see Table 2).

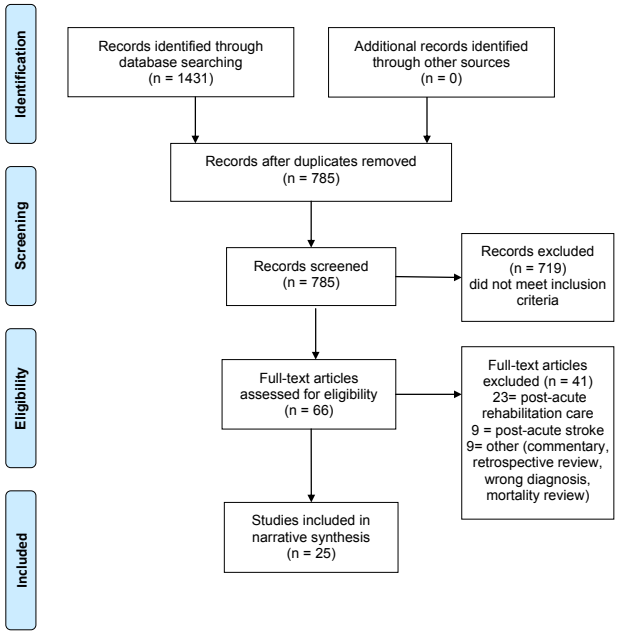

Figure 1. *PRISMA flow diagram.*

Two researchers (T.L.G. and K.K.-S.) reviewed the final selected studies to assess the study quality. The Mixed Methods Appraisal Tool (MMAT), version 2011, was used to assess the studies.[26] The MMAT (http://mixedmethodsappraisaltoolpublic.pbworks.com) uses a simple checklist approach to examine the methodological quality of research studies (quantitative, qualitative, and mixed-methods studies), but not of nonresearch articles (eg, review articles, commentaries). Using the MMAT produces a score of 1 (poor) to 4 (excellent). There was 92% interrater reliability between each reviewers' independent appraisals of the full articles. Differences in appraisals were resolved after discussion between the reviewers.

Included studies focused predominantly on blacks (n = 23), Hispanics (n = 20), and Asians/Pacific Islanders (n = 8), relative to whites who resided in the United States or United Kingdom.[16,17,27–48] One study, conducted in the Netherlands, was focused on white versus nonwhite stroke patients.[49] Another study, conducted in Canada, was focused on Chinese and south Asian stroke patients.[50] Twenty-three of the 25 studies were retrospective and all were based on large databases.[16,27–39,41–50] Sample sizes ranged from 510[49] to 2,145,800,[27] and most studies focused on acute ischemic stroke patients. On the whole, the findings were variable with regard to ethnic/racial differences in the outcomes of interest, except for black stroke patients for whom the findings more consistently demonstrated a disparity in care access. The quality of the studies, based on the MMAT scores, was generally excellent (ie, 4 stars). However, there was great variation noted in the adjustments made during study analyses

TABLE 2

DATA EXTRACTION

Author (y) Country	*Purpose*	*Research Method/ Design*	*Sample*	*Outcomes*	*Results*	*Conclusions*	*MMAT*
Addo, J. (2011) UK	To examine potential ethnic differences in time trends in receipt of effective acute stroke care.	Retrospective; Stroke registry; 1995–2009	3,800 first-time ischemic stroke or primary intracerebral hemorrhage; n = 2,754 (72.5%) white, n = 741 (19.5%) black, 305 (8.0%) other/unknown	Acute care interventions; Admission to hospital; care on a stroke unit; medication use	Blacks were more likely admitted to stroke unit (OR = 1.76, 95% CI 1.35–2.29, $P < .001$), and receive occupational therapy or physiotherapy (OR = 1.90, 95% CI 1.21–2.97, $P = .01$), relative to whites, independent of age or stroke severity.	Blacks had greater access to some care elements than whites.	****
Aparicio, HJ. (2015) USA	To examine the impact of ethnicity on recombinant tissue plasminogen activator (rt-PA) use in primary stroke centers (PSCs)	Retrospective; Nationwide inpatient sample (NIS); 2004–2010	304,152 ischemic stroke; n = 217,399 (71.5%) white, n = 45,635 (5.0%) black, n = 24,163 (7.9%) Hispanic, and n = 16,955 (5.6%) other. Overall, n = 53,693 (24.7%) of white, n = 12,517 (27.4%) of black, n = 3,904 (16.2%) of Hispanic, and n = 5,046 (29.8%) of other patients presented to PSCs.	rt-PA use	Higher proportion of patients received rt-PA at PSCs than non-PSCs in each ethnic group ($P < .001$). After adjustment for year, age, sex, insurance type, medical comorbidities, a diagnosis-related group–based mortality risk indicator, ZIP code median income, and hospital characteristics, blacks less likely to receive rt-PA than whites at both non-PSCs (AOR = 0.58, 95% CI 0.50–0.67) and PSCs (AOR = 0.63, 95% CI 0.54–0.74) and Hispanics were less likely than whites to receive rt-PA at PSCs only (AOR = 0.77, 95% CI 0.63–0.95). No interaction between ethnicity and presentation to a PSC and likelihood of receiving rt-PA ($P = .98$).	Though a significantly greater proportion of all patients received rt-PA at PSCs than non-PSCs, blacks and Hispanics were less likely than whites to receive rt-PA when presenting to PSCs. Blacks were also less likely than whites to receive rt-PA at non-PSCs.	****
Attenello, FJ. (2014) USA	To examine patient access patterns to mechanical revascularization procedures.	Retrospective; NIS; 2008	2,749 ischemic stroke and undergoing endovascular clot retrieval; 1,691 (%) whites, 181 (%) blacks, 176 (%) Hispanics, 70 %) Asian Pacific Islanders, 10 (%) Native American, 69 (%) Other	Thrombectomy use	After adjustment, blacks ($P < .001$), Hispanics ($P < .001$), Asian/Pacific Islanders ($P < .001$), and Native Americans ($P < .001$) had decreased frequency of admission to hospitals that performed high volumes of mechanical thrombectomy relative to white patients. Among treated patients, blacks ($P = .088$), Hispanics ($P = .034$), and Asian/Pacific Islanders ($P < .001$) had decreased frequency in mechanical thrombectomy procedures performed at high-volume centers when compared with whites.	Blacks, Hispanics, Asian/ Pacific Islanders, and Native Americans were less likely than whites to be admitted to high volume procedure hospitals. Blacks, Hispanics, and Asian/ Pacific Islanders had lower rates of procedures even in high-volume hospitals, relative to whites.	****

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TABLE 2

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Author (y) Country	*Purpose*	*Research Method/ Design*	*Sample*	*Outcomes*	*Results*	*Conclusions*	*MMAT*
Bekelis, K. (2017) USA	To examine access to magnet hospitals for ischemic stroke.	Retrospective; New York Statewide Planning and Research Cooperative System database; 2009–2013	176,557 ischemic stroke patients who met inclusion criteria; 32,092 were admitted to magnet hospitals; 4,624 (14.4%) blacks, and 27,468 (85.6%) nonblacks	Admission to magnet hospital	After adjustment, blacks were less likely admitted to magnet hospitals (AOR = 0.70, 95% CI 0.68–0.73) relative to nonblacks.	Blacks were less likely than nonblacks to be admitted to magnet hospitals for ischemic stroke.	****
Bhattacharya, P. (2013) USA	To examine ethnic differences in the delivery of care to patients with acute stroke in Joint Commission (JC)–certified hospitals and noncertified hospitals.	Retrospective; chart review (5-JC certified and 5-noncertified hospitals); 2006	574 acute stroke patients; 144 (25.1%) blacks, 430 (74.9%) whites	Mode of arrival, documentation of NIHSS, evaluation for thrombolytics, arrival to primary stroke center within 3 h of symptom onset, use of thrombolytics, use of endovascular interventions, dysphasia screening, use of DVT prophylaxis, assessment for rehabilitation, and provision of stroke education materials	Blacks were less likely to arrive by emergency medical services (EMS) in JC-certified hospitals ($P < .0001$), less likely to have NIHSS assessment performed/documented in noncertified hospitals ($P = .0004$), more likely to receive DVT prophylaxis in noncertified hospitals ($P < .0001$) than whites. No differences in other variables.	Some ethnic differences in receipt of evidence-based care.	****
Boehme, AK. (2014) USA	To examine the potential association of race and gender on initial stroke severity, receipt of thrombolysis, and functional outcome after acute ischemic stroke.	Retrospective registry, 2004–2011	4,925 acute ischemic stroke patients, 2,310 (46.9%) blacks; 2,346 (47.6%) women	Stroke severity, receipt of rt-PA, functional outcome	No differences in outcomes between black and white men. Fewer black than white women were treated with rt-PA (27.6% vs. 36.6%, $P < .0001$), partially due to a greater proportion of white women presenting within 3 h of symptom onset (51% vs. 45.5%, $P = .0005$). Black women were less likely than white women to have a poor functional outcome (OR = 0.85, 95% CI 0.72–1.00). After adjustment for age, stroke severity, and rt-PA use, no longer significant (AOR = 1.2, 95% CI 0.92–1.46, $P = 0$ 0.22). Black women with high stroke severity (NIHSS < 7) at admission less likely to receive rt-PA than any other race/gender group after adjusting for arriving within 3 h and admission glucose (OR = 0.66, 95% CI 0.44–0.99, $P = .0433$).	Black women were less likely treated with rtPA, partially due to their extended time to emergency department arrival.	****

Brinjikji, W. (2014) USA	To examine potential ethnic disparities in utilization of mechanical thrombectomy for acute ischemic stroke.	Retrospective; NIS; 2006–2010	1,662,379 acute ischemic stroke patients for which ethnicity data were available; 8,946 (0.4%) received mechanical thrombectomy; 1,208,157 (72.7%) whites, 282,635 (17%) blacks, 126,532 (7.6%) Hispanic, 45,055 (3.7%) Asian/Pacific Islanders.	Utilization rates of mechanical thrombectomy	After adjustment, blacks and Hispanics were less likely to receive mechanical thrombectomy (AOR = 0.52, 95% CI 0.48–0.56; OR = 0.86 95% CI 0.79–0.94 respectively) than whites.	Black and Hispanic patients were less likely to receive thrombectomy relative to whites.	****
Coutinho, JM. (2011) Netherlands	To investigate the relationship between ethnicity and receipt of thrombolysis in stroke patients.	Retrospective; single-center database review; 2003–2008	510 ischemic stroke patients; 118 (23%) nonwhite, 392 (77%) white.	Receipt of thrombolysis	Nonwhite patients received thrombolysis significantly less often than white patients (OR = 0.34, 95% CI 0.17–0.71), partly explained by a later hospital arrival. After adjustment for potential confounders, trend toward lower thrombolysis rate in nonwhites remained (AOR = 0.38, 95% CI 0.13–1.16).	Nonwhite stroke patients received thrombolysis less often than white patients, in part due to a delay in presentation.	****
Faysel, MA. (2019) USA	To examine potential disparities in t-PA use in acute ischemic stroke patients over a 5-y period.	Retrospective, New York Statewide Planning and Research Cooperative System database review; 2010–2014	32,546 and 33,190 stroke-related discharge records from 2010 and 2014, respectively; white, black, Asian, Spanish/non-Spanish Hispanic, and Other (proportions unclear)	t-PA administration	Race significantly associated with t-PA use in 2014 ($P = .002$), but not in 2010 ($P = .36$). In 2014, t-PA use was higher among 'other' patients (OR = 1.16, 95% CI 1.01–1.34, $P = .04$) and lower in blacks (OR = 0.85, 95% CI 0.75–0.96, $P = .009$) relative to whites. From 2010 to 2014, t-PA use increased for Spanish Hispanic (2.2%) and Non-Spanish/Hispanic (2%) patients.	"Other" patients had increased use, while black patients had lower use of t-PA between 2010 and 2014.	****
Fletcher, JJ. (2012) USA	To examine potential ethnic differences in ICU admission after stroke.	Retrospective, Brain Attack Surveillance in Corpus Christi (BASIC) database review; 2000–2009	1,464 intracerebral hemorrhage and acute ischemic stroke patients; 807 (55.1%) Hispanic, 657 (44.9%) whites	Admission to ICU	Trend toward Hispanics more likely admitted to ICU relative to whites in unadjusted analyses (OR = 1.22, 95 % CI 0.98–1.52). Adjusted analyses revealed no association between Hispanic ethnicity and ICU admission (AOR = 1.13, 95 % CI 0.85–1.50) relative to whites.	No overall association between ethnicity and ICU admission was observed in this community.	****
Hanchate, AD. (2013) USA	To compare inpatient mortality and LOS by race/ethnicity and socioeconomic status.	Retrospective analysis of all hospitalizations for acute ischemic stroke in all nonfederal acute care hospitals in 8 US states, in 2007	147,780 ischemic stroke patients; 99,013 (67%) white, 20,689 (14%) black, 16,256 (11%) Hispanic, 11,822 (8%) other	Mortality and hospital LOS	When adjusted for patient risk factors, blacks and Hispanics had similar mortality (AOR = 1.02, 95% CI 0.94–1.10 for blacks, AOR = 0.98, 95% CI 0.91–1.07 for Hispanics) and longer LOS (AOR = 1.36, 95% CI 1.31–1.41 for blacks, AOR = 1.19 95% CI 1.14–1.24 for Hispanics) relative to whites.	No difference between groups in risk-adjusted inpatient mortality; LOS was longer for blacks and Hispanics relative to whites.	****

(*Continued*)

TABLE 2

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Author (y) Country	*Purpose*	*Research Method/ Design*	*Sample*	*Outcomes*	*Results*	*Conclusions*	*MMAT*
Holtkamp, MD. (2018) USA	To examine potential ethnic disparities in stroke care within the military health system (MHS).	Retrospective; MHS Military Mart (M2) database; 2010–2015	3,623 ischemic stroke patients; 619 (17.1%) black, 275 (7.6%) Asian, 962 (26.5%) Other/Unknown, 1,767 (48.8%) white.	t-PA administration, disposition destination (poor destination, mortality), cost of hospitalization, length of hospital stay	After adjustment for comorbidities and demographic characteristics, there was no association between ethnicity, receipt of t-PA, poor disposition destination, or mortality, but blacks had higher cost of hospitalization ($P = .02$), relative to whites and Asians (due to increased costs for radiological studies).	No major ethnic differences in receipt of care or outcomes in the MHS universal health care system.	****
Hsia, AW. (2011) USA	To examine potential ethnic differences in receipt of t-PA for stroke.	Retrospective database review (chart abstraction, 7 acute care hospitals in District of Columbia); 2008–2009	Of 1,044 ischemic stroke patients, 973 were included in analysis; 778 (80%) blacks, 195 (20%) white; 45 (5%) of all patients treated with tPA; 26 (3%) blacks, 19 (10%) whites	Receipt of t-PA	Blacks were less likely (OR = 0.33, 95% CI 0.18–0.60) to receive t-PA relative to white. This was largely due to blacks less likely than whites to present <3 h of symptom onset (13% vs. 21%, $P = .004$).	Blacks were less likely than whites to be treated with tPA, largely due to extended time to presentation.	****
Hutton, CF. (2015) USA	To examine potential ethnic differences in helicopter emergency medical services (HEMS) transport to PSC.	Retrospective database review (67 US providers); 2004–2011.	25,332 stroke patients transported by HEMS; 8,933 (of which 8,810 had ethnicity data) stroke patients transported to PSC by HEMS; 755 (8.6%) black, 390 (4.4%) Hispanic, 1,683 (19.1%) Other, 5,982 (67.9%) white	Transport to PSC	Blacks were less likely than Hispanics, other, and whites ($P < 0.001$) to be transported to PSC by HEMS.	Blacks were less likely than any other ethnic group to be transported to a PSC by HEMS.	**
Karve SJ. (2011) USA	To examine potential racial/ethnic differences in emergency department wait time (EDWT) for patients with ischemic or hemorrhagic stroke.	Retrospective analysis of National Hospital Ambulatory Medical Care Survey-Emergency Department data, 1997–2000 and 2003–2005 (wait time data were not collected 2001–2002)	543 ED visits for ischemic and hemorrhagic stroke among adults ≥18 y, 415 (76.4%) white, 95 (17.5%) black, 33 (6.1%) Hispanic	EDWT	In unadjusted models, blacks (OR = 1.94, 95% CI 1.08–3.50), but not Hispanics (OR = 1.33, 95% CI 0.55–3.23) had longer EDWT. Differences remained when adjusted for nonambulance mode of arrival, urban hospitals, or nonemergency triage: blacks (AOR = 2.08, 95% CI 1.05–4.09) and Hispanics (AOR = 1.07, 95% CI 0.52–2.22).	Blacks, but not Hispanics, had significantly longer EDWT than whites.	**

Khan, NA. (2013) Canada	To examine potential ethnic differences in quality of care and risk of death or recurrent stroke in South Asian, East Asian, and white stroke patients.	Retrospective review of consecutive patients admitted to 12 stroke centers in Ontario, Canada, who were included in the Registry of the Canadian Stroke Network; July 2003 to March 2008.	8,997 acute and hemorrhagic stroke patients; 253 (2.8%) South Asian, 513 (5.7%) East Asian, 8,231(91.5%) white	Quality of care, risk of death, or recurrent stroke at 1 y	Quality of care and risk of death or recurrent stroke were similar among ethnic groups. Risk of death or recurrent stroke at 1 y after ischemic stroke was whites (27.6%), East Asian (24.7%, aHR 0.97, 95% CI 0.78–1.21 vs. white), and South Asian (21.9%, aHR 0.91, 95% CI 0.67–1.24 vs. white). Risk of death or recurrent stroke at 1 y after hemorrhagic stroke was higher in East Asians (35.5%) and whites (47.9%) relative to South Asians (30.2%) ($P = .002$), but not significant after adjustment for age, sex, stroke severity, and comorbid conditions (aHR 0.89, 95% CI 0.67–1.19 for East Asian vs white, 0.99 (0.54–1.81) for South Asian vs. white.	After adjustment stroke care and outcomes similar across ethnic groups.	****
Kimball, MM. (2014) USA	To examine potential ethnic differences in reduced access to or delays in receiving stroke care.	Retrospective; NIS; 2002–2008	477,474 ischemic stroke patients; ethnicity data for 349,691 patients; 64,659 (18.5%) black, 21,089 (6.0%) Hispanic, 5,187 (1.5%) Asian, 1,339 (0.4%) Native American, 8,307 (2.4%) Other, 249,110 (71.2% white)	Thrombolysis treatment, treatment in high-volume hospitals	Blacks (OR = 0.58, 95% CI 0.52–0.66), Native Americans (OR = 0.59, 95% CI 0.39–0.91) and Hispanics (OR = 0.76, 95% CI 0.64–0.91) were less likely than whites to receive thrombolysis. Native Americans were less likely to be treated at high stroke case volume hospital (OR = 0.73, 95% CI 0.65–0.83), while blacks (OR = 1.8, 95% CI 1.76–1.85) and Hispanics (OR = 1.12, 95% CI 1.08–1.17) were more likely to be treated at high stroke case volume hospital relative to whites.	Blacks, Native Americans, and Hispanics were less likely to receive rt-PA for ischemic stroke. Native Americans were less likely, while blacks and Hispanics were more likely to be treated in a high-volume stroke hospital relative to whites.	****
Kumar N. (2016) USA	To examine potential racial differences in in-hospital mortality, utilization of reperfusion therapies, LOS, associated with acute ischemic stroke	Retrospective, NIS data, 2011 and 2012	173,910 acute ischemic stroke patients; 121,737 (70%) white, 29,043 (16.7%) black, 13,043 (7.5%) Hispanic, 4,347 (2.5%) Asian/Pacific Islander, 8,697 (5%) Native American, 5,043 (2.9%) other	In-hospital mortality, receipt of rt-PA, receipt of endovascular mechanical thrombectomy (EMT), and LOS	Blacks (AOR = 0 0.71, 95% CI 0.64–0.78, $P < 0.001$) and Asian/Pacific Islanders (AOR = 0.80, 95% CI 0.66–0.97, $P = .02$) had lower in-hospital mortality compared to whites. Blacks were less likely to be treated with rtPA (AOR = 0.84, 95% CI 0.76–0.92, $P < .001$) or EMT (AOR = 0 0.73, 95% CI 0.58–0.91, $P = .01$). Even after adjustment, LOS was significantly higher for most minorities relative to whites: blacks (AOR = 1.33, 95% CI 1.27–1.38, $P < .001$), Hispanics (AOR = 1.30, 95% CI 1.23–1.37; $P < .001$), Asian/Pacific Islander (AOR = 1.26, 95% CI 1.16–1.37; $P < .001$), other (AOR = 1.25, 95% CI 1.15–1.36; $P < .001$)	Blacks and Asian/Pacific Islanders had lower in-hospital mortality relative to whites. Blacks were less likely to have reperfusion than whites. blacks, Hispanics, Asian/ Pacific Islanders, and others had longer LOS than whites.	***

(*Continued*)

TABLE 2

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Author (y) Country	*Purpose*	*Research Method/ Design*	*Sample*	*Outcomes*	*Results*	*Conclusions*	*MMAT*
Martin, KD. (2012) USA	To examine potential ethnic differences in the use of diagnostic carotid imaging and the frequency of carotid endarterectomy in elderly ischemic stroke patients.	Retrospective; National Stroke Project database; 1998–1999, 2000–2001	19,639 ischemic stroke patients; 1,974 (10%) blacks, 17,655 (90%) whites	Receipt of at least one type of carotid imaging study, and carotid endarterectomy.	No difference between blacks and whites in receipt of one type of carotid imaging study. After risk adjustment, Blacks were less likely to receive carotid imaging (AOR = 0.87, 95% CI 0.78–0.97), and more likely to receive carotid endarterectomy (AOR = 1.14, 95% CI 0.66–1.96) relative to whites.	After adjustment, there were no ethnic differences in receipt of carotid imaging studies or carotid endarterectomy in ischemic stroke patients.	*****
Mullen, MT. (2013) USA	To examine potential ethnic differences in evaluation for stroke at primary stroke centers (PSCs)	Prospective, December 2005 to January 2011	1,000 suspected stroke cases, from a cohort of 30,239 community-dwelling participants, 617 (61.7%) whites, 383 (38.3%) blacks	Evaluation at a PSC	Of 1,000 suspected strokes, 204 (20.4%) were evaluated at a PSC. No differences by race, education, or income. In multivariable analysis, subjects were less likely to be evaluated at a PSC if from a nonurban area (OR = 0.39, 95% CI 0.22–0.67) or stroke belt (OR = 0.54, 95% CI 0.38–0.77), or had prior stroke (OR = 0.46, 95% CI 0.27–0.78).	Disparities in evaluation by PSCs were not associated with race.	****
Nasr, DM. (2013) USA	To examine potential racial/ethnic disparities in administration of rt-PA and outcomes for ischemic stroke.	Retrospective review of NIS 2001–2008.	2,145,800 acute ischemic stroke patients, 47,403 received rt-PA, 1,588,267 (74.1%) whites, 342,781 (15.9%) blacks, 158,324 (7.4%) Hispanics, 56,428 (2.6%) Asian/Pacific Islanders	rt-PA utilization, discharge status (long-term care, mortality)	White patients had a higher rate of rt-PA utilization than black and Hispanic patients (2.3% vs 1.8% and 2.0%, respectively; $P = .0001$). No difference in rate of tPA utilization between whites and Asian/Pacific Islanders (2.3% vs 2.2% $P = .57$). Asian/Pacific Islanders had higher mortality (OR = 1.22, 95% CI 1.03–1.44, $P = .52$) relative to whites.	Rt-PA utilization greater in white and Asian/ Pacific Islander patients than in black and Hispanic patients. Asian/Pacific Islanders had increased risk of mortality after rt-PA administration.	****

Schwamm, L.H. (2010) USA	To examine potential ethnic differences in care among hospitalized stroke patients.	Retrospective quality improvement audit	397,257 patients with ischemic stroke admitted to hospitals participating in the Get With the Guidelines-Stroke Program, between April 2003 and September 2008; 314,230 (79.1%) white, 63.561 (16%) black, 19,466 (4.9% Hispanic	In-hospital mortality, use of intravenous thrombolytics, receipt of early antithrombotics, DVT prophylaxis, discharge antithrombotics, anticoagulation for atrial fibrillation, lipid treatment for low-density lipoprotein >100 mg/dL, smoking cessation, mortality, length of hospital stay	After adjustment for patient- and hospital-level variables, black patients had lower odds of receiving intravenous thrombolysis (AOR = 0.84, 95% CI 0.77–0.91), deep vein thrombosis prophylaxis (AOR = 0.88, 95% CI 0.83–0.92), discharge antithrombotics (AOR = 0.88; 95% CI 0.84–0.92), anticoagulants for atrial fibrillation (AOR = 0.84, 95% CI, 0.75 to 0.94), and lipid therapy (AOR = 0.91, 95% CI, 0.88–0.96), smoking cessation (AOR = 0.85, 95% CI, 0.79–0.91), and dying in-hospital (AOR = 0.90, 95% CI 0.85–0.95), relative to whites. Hispanic patients received similar care to whites in all measures. Black (AOR = 1.31, 95% CI 1.28–1.35) and Hispanic (AOR = 1.16, 95% CI 1.11–1.20) were more likely to exceed the median length of hospital stay relative to whites.	Black patients with stroke received fewer evidence-based care processes than Hispanic or white patients.	****
Shen, JJ. (2011) USA	To evaluate patterns of care relative to frequency of admission to high-quality hospitals and mortality risk for patients with stroke among varying ethnic groups.	Retrospective database study, data abstracted from the 2000 and 2006 NIS	273,532 adult stroke patients; ethnicity categorized as white, black, Hispanic, or Asian/Pacific Islander (no proportions available).	Changes in disparities in attending 4 groups of hospitals (based on quartiles of risk-adjusted mortality rate) and mortality risk across ethnicity	Black, Hispanic, and Asian/Pacific Islanders increasingly were likely to be admitted to high-quality hospitals with blacks and Hispanics, but not Asian/Pacific Islanders becoming more likely than whites to be admitted to high-quality hospitals in 2006 (blacks: OR = 1.31, 95% CI 1.27–1.35; Hispanics: OR = 1.25, 95% CI 1.19–1.29; Asian/Pacific Islanders: OR = 0.88, 95% CI 0.82–0.95) Mortality from intracerebral hemorrhagic stroke decreased in blacks, increased in Hispanics, and remained the same for Asian/Pacific Islanders, relative to whites. Mortality from occlusion of cerebral arteries decreased in blacks and increased in Hispanics and Asian/Pacific Islanders.	Outcomes improved more for blacks (higher admission to high-quality hospitals, reduced mortality) than Hispanics (higher admission to high-quality hospitals, increase in mortality) or Asian/Pacific Islanders (no change in admission to high-quality hospitals or mortality from intracerebral hemorrhagic stroke, but higher mortality for occlusion of cerebral arteries)	****

(*Continued*)

TABLE 2

CONTINUED

Author (y) Country	*Purpose*	*Research Method/ Design*	*Sample*	*Outcomes*	*Results*	*Conclusions*	*MMAT*
Siegler JE. (2013) USA	To examine potential racial disparities in treatment rates among patients with acute ischemic stroke.	Retrospective review of all patients who presented with acute ischemic stroke between July 2008 and December 2010	Of the 596 patients screened, 368 met inclusion criteria; 404 (67.8%) black, 192 (32.3%) white	Last seen normal time (LSN), ED arrival time, receipt of rt-PA	Blacks were more likely to have a longer delay from LSN to ED arrival relative to whites (median delay of 339 min versus 151 min, $P = 0.0028$). Black race was independent predictor for delayed ED arrival, after adjusting for age, sex, stroke severity, and home medication use. No differences between blacks and whites who presented within the 3-h time to receive rt-PA ($P = .98$).	No ethnic differences in receipt of rt-PA. Blacks less likely than whites to arrive at the ED within the 3-h treatment window to receive rt-PA.	****
Smith, MA. (2010) USA	To compare time to hospital arrival and EMS use for stroke care between Hispanic and white stroke patients.	Prospective analysis of The Brain Attack Surveillance in Corpus Christi (BASIC) project database, 2000–2006	1,134 ischemic stroke cases; 604 (53%) Hispanic, 530 (47%) white	Time to hospital arrival and EMS use	Hispanics were less likely than whites to arrive by EMS (OR = 0.6, 95% CI 0.4–0.8).	Ethnic differences in likelihood of arrival by EMS	****
Tataris, K. (2014) USA	To examine EMS use for stroke trends over a 6-y period and identify any racial differences.	Retrospective, using the National Hospital Ambulatory Medical Care Survey-ED (NHAMCS) dataset from 2003 to 2009	1,324 stroke patients; 1,017 (76.8%) whites, 192 (14.5%) blacks, 75 (5.7%) Hispanics, 40 (3.0%) other	EMS use	No significant change in EMS usage for stroke over the 6-y period. Black race independently associated with using EMS (OR = 1.72, 95% CI 1.16–2.29) relative to whites	No trends of increasing EMS use for stroke and blacks more likely to use EMS relative to whites.	****

MMAT = Mixed Methods Appraisal Tool.

Each article was appraised using the Mixed Methods Appraisal Tool (MMAT) which uses an easy checklist approach to examine qualitative, quantitative, and mixed methods studies. Scores vary from 25% (*, one criterion met), 50% (**, two criterion met), 75% (***, three criterion met), to 100% (****, all criteria met).

(ie, types and number of variables), rendering the study findings challenging to compare.

Narrative synthesis yielded 4 key themes related to differences in 1) transportation to hospital, emergency wait time, hospital admission, and length of stay (LOS); 2) receipt of intravenous thrombolysis; 3) receipt of mechanical-reperfusion therapies and imaging procedures; and 4) risk of death, based on ethnicity/race.

Differences in transportation to hospital, type of hospital access, admission unit, and length of stay

Differences in transportation to hospital, type of hospital access, admission unit, or LOS were examined based on patients' ethnicity/race was examined in 15 studies.[16,28–41] The results were somewhat variable with most studies revealing blacks were less likely than whites to use EMS or other emergency transport.[31,34,38] However, Tataris et al[41] found that blacks were more likely to use EMS than whites. Hutton et al also demonstrated that Hispanics and "other" ethnic/racial groups were as likely to use EMS as whites.[34] Conversely, Smith et al[40] found Hispanics were less likely to arrive by EMS than whites. Furthermore, Karve et al found black but not Hispanic stroke patients had longer emergency wait times than whites.[35]

While Mullen et al[16] found there were no ethnic/racial differences in access to primary stroke centers, Bekelis et al[30] found blacks were less likely to be admitted to magnet hospitals relative to nonblacks. Kimball et al[15] found Native Americans were less likely and blacks and Hispanics were more likely to be treated at a high-volume stroke hospital relative to whites. Shen et al[39] found blacks, Hispanics, and Asian/Pacific Islanders' access to higher quality hospitals improved over time (2000 to 2006) and blacks and Hispanics became more likely than whites to be admitted to these hospitals. However, in a later study, Attenello et al[29] found that after adjustment for clinical variables blacks, Hispanics, Asian/Pacific Islanders, and Native Americans had decreased frequency of admission to hospitals that performed high volumes of mechanical thrombectomy, relative to whites.[29]

Once admitted to hospital, Addo et al[28] found blacks were more likely than whites to be admitted to a stroke unit (independent of age or stroke severity), while Fletcher et al[32] found after adjustment for relevant clinical variables, there was no difference between Hispanics and whites in likelihood of being admitted to an ICU. Finally, blacks, Hispanics, Asian/Pacific Islanders, and "other" ethnic/racial groups tended to have longer hospital LOS than whites.[33,36,37]

Differences in receipt of intravenous thrombolysis

Receipt of intravenous thrombolysis was examined in 12 studies.[16,36–38,42–45,48–50] There were some ethnic/racial disparities in access to intravenous thrombolysis (IT). Faysel et al[48] noted a decrease in IT use in blacks and a small increase in of IT use in Hispanics between 2010 and 2014. Aparicio[42] examined if care at a primary stroke center influenced blacks and Hispanics access to IT. Blacks were less likely than whites to receive IT at both primary stroke centers and nonprimary stroke centers, whereas Hispanics were less likely to receive IT at primary stroke centers only. Boehme[43] examined potential differences in black and white men's and women's access to IT. Though there were no differences in access to IT between black and white men, black women were less likely to receive IT than white women. Other authors found that minority ethnic/racial status (ie, black, Native Americans, Hispanics, nonwhite other) was related to nonreceipt of IT relative to whites.[16,27,36,37,44,49] Some authors who identified ethnic/racial differences in access to IT also indicated that this was largely due to a delay in patients' prehospital delay in accessing care.[43,44,49] Interestingly, Siegler found when studying patients who presented within 3 hours of symptom onset, there was no difference in IT access between blacks and whites.[38] Conversely, Holtkamp[45] and Khan et al (the only Canadian study)[50] found no difference between ethnic/racial groups; and Nasr found no difference for Asian/Pacific Islanders in access to IT relative to whites.[27]

Differences in receipt of mechanical reperfusion therapies and carotid imaging procedures

Access to mechanical thrombectomy was examined in 3 studies,[29,36,46] in which blacks consistently had reduced access relative to whites. Attenello et al[29] found blacks, Hispanics, and Asian/Pacific Islanders, but not Native Americans or "others," had less access to mechanical thrombectomy, relative to whites. Brinjikie[46] found blacks and Hispanics, but not Asian/Pacific Islanders, had less access to mechanical thrombectomy relative to whites, whereas Kumar found blacks but not Hispanics, Asian/Pacific Islanders, Native Americans, or "others" had less access relative to whites.[36] Finally, Martin et al[47] found black patients were less likely to receive carotid imaging but were as likely to receive carotid endarterectomy as white patients.

Differences in risk of death

Mortality was examined in 6 studies.[27,33,36,37,39,50] Despite the numerous findings described previously of disparities particularly associated with black and Hispanic ethnicity/race, on the whole, black and Hispanic patients had similar or lower risk of death as whites.[27,33,36,37] Risk of death was variable for Asian/Pacific Islanders with one study demonstrating higher[27] and another study demonstrating lower[36] rates of death relative to whites. Khan et al[50] studied whites, Asians, and south Asians and demonstrated no differences in risk of death or recurrent stroke. Finally, Shen et al[39] demonstrated risk of death from intracerebral stroke decreased for blacks, increased for Hispanics, and remained the same for Asian/Pacific Islanders relative to whites over time (2000 to 2006). Similarly, they examined risk of death from ischemic stroke and demonstrated a decrease for blacks, but an increase for both Hispanics and Asian/Pacific Islanders.

Additional concerns

Though not widely studied, other outcomes related to care access were examined in 4 of the reviewed studies. Blacks were less likely to 1) be evaluated at primary stroke centers if rural-living or lived in the "stroke belt"[17]; 2) have a National Institutes of Health Stroke Scale assessment performed and documented at non–Joint Commission–certified hospitals[31]; 3) receive

occupational or physiotherapy independent of age or stroke severity[28]; or 4) receive deep vein thrombosis prophylaxis, discharge anti-thrombotics, anticoagulants for atrial fibrillation, lipid-lowering therapy, or smoking cessation treatment,[37] relative to whites. Though not clear, these concerns may be related to place of residence and socioeconomic status. Alternatively, in Canada's public health care system, quality of care (thrombolysis, diagnostic imaging, antithrombotic medications, rehabilitation services) was similar among white, south Asian, and Asian ethnic/racial groups.[50]

DISCUSSION

There were disparities, based on ethnicity/race (particularly for black patients), in access to stroke-related care, but little disparity in mortality. This narrative synthesis yielded 4 key themes related to differences in 1) transportation to hospital, emergency wait time, hospital admission, and length of stay; 2) receipt of intravenous thrombolysis; 3) receipt of mechanical-reperfusion therapies and imaging procedures; and 4) risk of death, based on ethnicity/race. Much of the disparity between ethnic/racial groups relative to whites, associated with receipt of intravenous thrombolysis or mechanical reperfusion therapies and imaging procedures, was due to a delay in care-seeking, particularly with black stroke patients. Ethnic/racial differences in care-seeking behaviors are not uncommon in other acute disease states such as acute coronary syndrome.[6,51]

Gender/sex differences in care access are common across all ethnicities/races. One study included in this systematic review revealed black women were less likely to receive tPA compared to black or white men, and white women.[43] This was attributed largely to a longer delay in care seeking by black women. Women are known to delay care seeking in acute coronary syndrome, and particularly so when from an ethnic minority group.[52]

Previous studies have also indicated that a lower socioeconomic status and language differences between patients and health care providers can contribute to health care disparities.[53–57] The results from this review show that a lower socioeconomic status can result in higher stroke-related mortality rates in patients, irrespective of cultural/ethnic differences.[33] Results from one study also demonstrated that language differences do not contribute to stroke-related health disparities.[40] More studies need to be conducted to evaluate these findings at a microlevel. It is possible that a subpopulation within an ethnic group (eg, older patients, new immigrants, non–English-speaking patients) could have different access to health care and resulting stroke-related outcomes compared to other patients within the same ethnic group (eg, younger patients, second-generation immigrants, English-speaking patients).

Although this systematic review provides a comprehensive understanding of the impact of ethnic/racial status on access to care after onset of symptoms related to stroke, there were some important contextual factors that were not considered in most studies. The influence of geographic location of hospitals (eg, urban vs rural) may influence the ethnic mix of patients presenting with stroke and the availability of specialized care. Furthermore, whether specialized stroke teams are available in hospitals may also influence treatment and care access, regardless of the patients' ethnicity/race. These factors should be considered in future analyses. Most studies included in this review were focused on black patients. More studies need to be conducted, which evaluate access to stroke-related care among other ethnic groups. In addition, the current data indicate mixed results regarding the impact of ethno-cultural status on access to stroke-related care. Further work should focus on determining internal and external factors that can lead to contrasting results within an ethnic group. As indicated in an AHA/AHS Scientific Statement,[3] definitions of ethnicity/race need to be made consistent. Modeling of outcomes (eg, particularly with choice of covariates) also needs to be made consistent. Finally, we noted though the literature included in this review was more contemporary, the data from less contemporary databases were occasionally used. It is important that future research be based on contemporary data and analyses undertaken reflecting the suggestions given previously.

CONCLUSION

There is a paucity of literature focused on testing interventions aimed at reducing ethnic/racial disparities in cardiovascular health care.[1] Delivering stroke-related health information to ethnic minorities in a culturally sensitive and relevant manner may help overcome barriers to care access.[58] Health education and awareness programs that especially target ethnic/racial minority patients (particularly women) could result in reducing these disparities.

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