Published in final edited form as:
Stroke. 2008 May ; 39(5): 1514–1519. doi:10.1161/STROKEAHA.107.501254.

Racial and Ethnic Differences in Postacute Rehabilitation Outcomes After Stroke in the United States

Kenneth J. Ottenbacher, PhD, **Joanna Campbell, PhD**, **Yong-Fang Kuo, PhD**, **Anne Deutsch, CRRN, PhD, RN**, **Glenn V. Ostir, PhD**, and **Carl V. Granger, MD**
From The University of Texas Medical Branch, Galveston, Texas (K.J.O., J.C., Y.-F.K., G.V.O.); Rehabilitation Institute of Chicago, Northwestern University, Chicago, Ill (A.D.); and Uniform Data System for Medical Rehabilitation, University of Buffalo, NY (C.V.G.).

Abstract

Background and Purpose—Incidence, prevalence, and mortality for stroke vary by race and ethnicity with higher rates for blacks compared with non-Hispanic whites. Little information is available regarding differences in postacute care outcomes for racial and ethnic groups after a stroke.

Methods—A retrospective analysis was conducted of 161 692 patients from the Uniform Data System for Medical Rehabilitation who received inpatient medical rehabilitation after a first stroke in 2002 and 2003. Multivariable models examined the effects of race and ethnicity on length of stay, functional status, rehabilitation efficiency, and discharge setting.

Results—The mean age was 70.97 years (SD=12.87), 53% were female, and 76% were non-Hispanic white. Mean length of stay was similar for all groups ranging from 17.39 days (SD=10.86) to 17.93 (SD=10.59). Non-Hispanic white patients had higher admission and discharge functional status ratings compared with patients in the minority groups ($P<0.01$). Differences in functional status across racial/ethnic groups were related to age ($F=20.49$, $P<0.001$); the older the comparison group, the greater the difference in functional status. Non-Hispanic whites were discharged home less often than blacks (OR=0.64, 95% CI=0.62 to 0.66), Hispanics (OR=0.58, 95% CI=0.55 to 0.62), or other minority groups (OR=0.67, 95% CI=0.57 to 0.67).

Conclusions—The findings suggest racial and ethnic disparities exist in postacute care outcomes for persons with stroke.

Keywords

cerebrovascular accident; ethnic groups; treatment outcome

Black Americans are twice as likely to experience a stroke as non-Hispanic whites and are twice as likely to die from a first stroke.[1–3] Hispanic Americans also have a higher incidence of first-time stroke than non-Hispanic whites (1.7 times greater) and are more likely to experience a hemorrhagic stroke.[4] Recent data indicate age-adjusted incidence of first ischemic

Correspondence to Kenneth J. Ottenbacher, PhD, 301 University Blvd., Galveston, TX 77555-1137. E-mail kottenba@utmb.edu.

Disclosures

C.V.G. is employed by the Uniform Data Services for Medical Rehabilitation, which is the largest nongovernmental national registry of standardized information on medical rehabilitation inpatients in the United States and has been used by rehabilitation facilities since 1987. The data used in this study were taken from the UDSMR database. FIM is a trademark owned by the UB Foundation Activities, Inc.

stroke per 100 000 persons is approximately 90 for non-Hispanic whites, 150 for Hispanics, and 190 for blacks.[2]

The effectiveness of postacute rehabilitation programs to reduce long-term disability is influenced by age, severity and type of stroke, early initiation of treatment, and educational level.[5] Because there are racial and ethnic difference in the incidence, type, and severity of stroke, it is logical to assume that there may be racial and ethnic differences in postacute care outcomes.[3,6]

The purpose of our study is to examine poststroke outcomes across different racial and ethnic groups. We hypothesize that non-Hispanic white racial status will be an independent predictor of functional independence and that functional status will be higher in non-Hispanic whites than other racial/ethnic groups after controlling for relevant covariates. Based on access to health care and other resources, we also hypothesize that discharge setting (home versus not home) will vary across racial and ethnic groups with non-Hispanic whites discharged home more frequently.

Methods

Source of Data

Data are from the Uniform Data System for Medical Rehabilitation (UDSMR). The UDSMR is the largest nongovernmental national registry of standardized information on rehabilitation inpatients in the United States[7] and includes sociodemographic variables from the medical record, International Classification of Diseases, 9th Revision, Clinical Modification codes, facility characteristics, patient prehospital living arrangements and marital status, predisability employment, discharge disposition, length of stay (LOS), source of payment, and hospital charges. In addition, scores on a standardized measure of basic daily living skills, the Functional Independence Measure (FIM Instrument), are recorded at admission and discharge. All FIM instrument items are scored into one of 7 levels of function ranging from complete dependence (level 1) to complete independence (level 7). Total ratings range from 18 to 126 and are reported as Motor FIM (self-care, sphincter control, transfers, locomotion—13 items) and Cognitive FIM (communication, social cognition—5 items).[8–11]

Facilities administer FIM items according to a protocol required by the Centers for Medicare and Medicaid Services.[12] The interrater and test–retest reliability of the data collection process and FIM items has been examined by independent researchers and consistently produced intraclass correlation coefficients between 0.86 and 0.99.[12,13] The study was reviewed and approved by the Institutional Review Board.

Study Sample

Admission, discharge, and follow-up data were reviewed for 178 ,055 patients receiving inpatient medical rehabilitation after a first stroke in 2002 and 2003 (International Classification of Diseases, 9th Revision, Clinical Modification codes 430, 430.1, 431.0 to 434.9, 436.0 to 438.99). The data were from 828 hospitals in 50 states. We used clinical criteria developed in previous research on case mix groups to exclude patients whose rehabilitation was atypical.[14] We excluded patients with missing or out of range values including a logarithm of LOS that was 3 SDs or more above the mean for the impairment group (n=3577) and cases with incorrect rehabilitation impairment categories or International Classification of Diseases, 9th Revision codes (n=641). In addition, we excluded patients who were younger than 30 years of age (n=1602), were readmissions or transfers from another rehabilitation facility (n=4011), or were admitted for evaluation only (n=1181). Patients not living at home at time of stroke

onset were not included in the sample (n=5351). The remaining 161 692 patients comprised the sample and represented 90.8% of the usable patient records from the original sample.

Independent Variable

Race/Ethnicity—Race/ethnicity was obtained from the medical record and coded as Non-Hispanic white, black, Hispanic, and others. The racial/ethnic status was confirmed by the hospital staff member completing the FIM instrument items. Due to small numbers for Asians, American Indians, Hawaiians and Pacific Islanders, and Alaskan Natives, they were collapsed into one category.

Dependent Variables

Functional Status—Functional status was based on ratings from the 18 FIM instrument items described previously. The rehabilitation facilities routinely administer the FIM instrument at admission and discharge.

Length of Stay—LOS was calculated as the total number of inpatient rehabilitation days. This did not include any rehabilitation days from the acute care hospital stay. According to Centers for Medicare and Medicaid Services criteria, a single admission includes patients who are transferred from inpatient rehabilitation to acute care and then back to inpatient rehabilitation within 3 days. If the readmission to acute care occurred after 3 days, the case was considered a new admission and excluded from the sample (see criteria for patient exclusion previously).

Efficiency—Efficiency was defined as the change in functional status (total FIM rating) from admission to discharge divided by the LOS; the shorter the LOS for a given change in FIM rating, the higher the efficiency rating.

Discharge Setting—Living setting was coded as home, board and care, transitional living, intermediate care, skilled nursing facility, hospital, rehabilitation facility, and other. These categories were collapsed to home and not home for statistical analyses.

Covariates

Covariates included gender, age, marital status (married versus not married), and primary payment source (Medicare, Medicaid, and commercial insurance). Case severity was assessed using admission FIM instrument ratings and the number of comorbidities. Additional covariates were type of stroke (hemorrhagic or nonhemorrhagic) and the time from stroke onset to rehabilitation admission in days. LOS was a covariate in statistical models in which LOS was not the dependent variable. We selected these covariates based on their established relationship with stroke outcomes and our previous research using the UDSMR database.[1,15]

Statistical Analysis

We used descriptive statistics to examine sociodemographic and patient characteristics. We assessed bivariate differences for continuous and categorical variables using one-way analyses of variance with post hoc tests and χ^2 tests, respectively. Hierarchical multivariable linear regression was used to estimate the effects of race/ ethnicity on FIM ratings at discharge, inpatient LOS, and FIM efficiency. Interaction terms for age and race/ethnicity were included in the model. We examined the effects of race/ethnicity on discharge setting using logistic regression. Regression diagnostics were computed and collinearity among variables examined. Bivariate comparisons used a significance level of $P<0.01$, and adjustments were made using a modified Bonferroni correction.[16] All statistical tests were conducted using SAS (version 9.0) or SPSS (version 14.0) software.

Results

Descriptive Statistics

Table 1 reports significant differences by race/ethnicity in several sociodemographic variables. Blacks, Hispanics, and other minority groups were significantly younger than non-Hispanic white patients at admission. Non-Hispanic white patients were more likely to be married, less likely to have Medicaid insurance, and were less likely to have experienced a hemorrhagic stroke. Time from stroke onset to inpatient rehabilitation admission varied significantly across the groups with non-Hispanic whites having the shortest interval (mean=10.35 days [SD=12.18]) and Hispanics the longest (11.96 days [SD=11.22]). This difference remained significant after adjusting for age and type of stroke. For example, the time from onset to rehabilitation for persons with hemorrhagic stroke varied across ethnic groups: 15.22 days (SD=15.18) for non-Hispanic white patients, 16.85 days (SD=16.19) for black patients, and 16.66 days (SD=15.31) for Hispanic patients.

Continuous Outcome Measures

Average length of stay was similar for all patient groups ranging from 17.39 days (SD=10.86) for non-Hispanic whites to 17.93 days (SD=10.25) for other minority groups. The unadjusted admission FIM ratings were highest for non-Hispanic white patients with the largest difference between non-Hispanic whites (58.82 [SD=20.16]) and Hispanic patients (55.82 [SD=20.14]). Discharge FIM ratings were also significantly different between non-Hispanic whites (81.54 [SD=24.52]) and Hispanics (79.43 [SD=24.65]). Similar differences in FIM ratings were found between non-Hispanic whites and black patients at admission (58.01 [SD=20.03]) and discharge (80.23 [SD=25.13]).

Table 2 presents the hierarchical regression models for the 3 continuous dependent variables: LOS, FIM efficiency, and FIM discharge ratings. Each regression model was computed using a hierarchal method of variable entry in which socio-demographic and patient characteristics (gender, age, marital status, hemorrhagic versus nonhemorrhagic stroke, and number of comorbidities) were entered followed by treatment-related covariates (insurance coverage, time from stroke onset to rehabilitation admission, and admission FIM rating). The final regression models were generated by adding the race/ethnicity variable to the equations. Nonrace/ethnicity variables that were significant ($P<0.01$) across all 3 dependent variables included age, number of comorbidities, time from onset to rehabilitation admission, marital status, and admission FIM rating. LOS was a significant predictor for FIM efficiency and discharge FIM ratings. Race/ethnicity was a significant variable in the equations for efficiency ($R^2=0.21$) and discharge FIM ($R^2=0.68$) after adjustment for the covariates listed previously.

We further examined the relationship between race/ethnicity and age on functional status by analyzing mean admission and discharge FIM ratings across the age quartiles (see Table 3). The differences in admission and discharge FIM ratings were smallest between the racial/ethnic groups for patients in the youngest quartile (30 to 62 years) and increased across the age quartiles with the largest differences in the oldest quartiles. This relationship did not change when covariates listed in Table 2 were included in the analysis (results not shown). There was a 7.83-point difference in discharge FIM ratings between non-Hispanic white patients (mean 76.93, SD=24.68) and Hispanic patients (mean 69.10, SD=25.29) in the oldest quartile. There was a similar difference (6.74 points) between non-Hispanic white and black patients in the oldest quartile. In contrast, the differences in discharge FIM ratings between non-Hispanic white and Hispanic patients and non-Hispanic white and black patients in the youngest quartiles were 1.68 points and 1.76 points, respectively.

Categorical Outcome Measures

The unadjusted analyses revealed a significant difference in the percent of patients discharged to home with 66% of non-Hispanic white patients discharged home versus 74% for blacks, 74% for Hispanics, and 76% for other minority groups. These differences remained significant after adjusting for age, gender, marital status, insurance coverage, hemorrhagic versus nonhemorrhagic stroke, onset time from stroke to rehabilitation, LOS, admission FIM ratings, and number of comorbidities. Non-Hispanic whites are less likely to be discharged to home compared with other racial/ethnic groups. With non-Hispanic whites as the reference group, the adjusted ORs were 0.64 (95% CI=0.62 to 0.66) for blacks, 0.58 (95% CI=0.55 to 0.62) for Hispanics, and 0.67 (95% CI=0.57 to 0.67) for other minority groups.

Discussion

Consistent with previous research,[6,17] we found non-Hispanic whites who undergo rehabilitation for a stroke were older, less likely to have Medicaid, and less likely to have had a hemorrhagic stroke. As hypothesized, we found statistically significant differences in the functional independence of blacks and Hispanics when compared with non-Hispanic whites. These differences continued to exist at admission and discharge after adjustment for relevant covariates. The differences in functional independence were smallest between non-Hispanic white and the “other” minority groups. Age was an important mediating variable in the relationship between FIM discharge rating and racial/ethnic group. The differences increased significantly as the patients became older with the largest differences approaching 8 FIM points between non-Hispanic white and Hispanic patients in the oldest quartile. The rehabilitation (FIM instrument) efficiency was significantly larger for non-Hispanic white patients compared with black patients. Not only did non-Hispanic white patients enter medical rehabilitation with higher FIM instrument ratings, but they also made larger gains after adjusting for covariates (see Table 1).

Research on the clinical significance of changes in FIM ratings has demonstrated that each 1-point increase in the total FIM instrument rating is associated with an average of between 3 and 6 minutes of daily help required from another person.[11,18–20] There is variation in the amount of help required based on whether the change occurs in the low or high end of the FIM scale.[13] The amount of help required (minutes per change in FIM point) also varied based on severity and impairment type. These “burden of care” studies have been conducted involving patients with traumatic brain injury, spinal cord injury, multiple sclerosis, and stroke.[11,18–20] If an average of 4 minutes per FIM point is assumed, the difference at discharge of 8 FIM points between non-Hispanic white and Hispanic patients translates to approximately 32 minutes per day or 224 minutes (3.7 hours) per week of additional help from another person. Over a period of 6 months, a person of Hispanic ethnicity would require 96 additional hours of assistance provided by another person.

An obvious question is why is there a difference in functional independence ratings occurred among the racial/ethnic groups after controlling for confounding factors such as age, gender, type of stroke, martial status, and number of comorbidities. Other uncontrolled factors such as socioeconomic status and educational level should have had little direct impact over the relatively short period of inpatient medical rehabilitation. Potential explanations that require further investigation include the type, duration, and intensity of rehabilitation therapy provided to patients. Little research has been done on this topic, but at least one investigation has reported variation in the type and amount of occupational and physical therapy provided to older adults based on racial/ethnic grouping after controlling for level of disability and medical diagnosis.[21] Other studies, however, have found no racial/ethnic difference in the amount of rehabilitation therapy for older patients with stroke[22] or found increases in types of therapy associated with more severe motor deficits.[23] These studies involved smaller sample

sizes[21] or specialized patient populations (Veterans' Administration hospitals).[22] Other possible explanations include personality-related variables such as attitudes toward health services, incentive to engage in the demanding activities associated with medical rehabilitation, and compliance with treatment programs and exercises. Research on health locus of control suggests that members of minority populations (eg, blacks) are more likely to express an external locus of control related to health beliefs and behaviors,[24] whereas internal locus of control has been identified as a predictor of rehabilitation motivation and treatment success.[25] External locus of control has also been demonstrated to increase in old age.[26] These areas of future research may begin to increase our understanding of difference in functional outcomes among racial and ethnic groups.

We found significant differences in discharge to home versus not home across the racial and ethnic groups. Sixty-six percent of non-Hispanic white patients were discharged home compared with approximately 75% for all other (minority) groups. Discharge home is usually viewed as a positive outcome and is considered an indicator of quality of care. Discharge disposition is a complex variable with many potential mediating factors. It is possible that the family support and social network structure for blacks, Hispanics, and other minority groups is more extensive than for non-Hispanic whites and allows for increased home placement after stroke rehabilitation. Patient and family preferences play an important role in discharge planning and placement. Blacks and Hispanics tend to view nursing homes negatively and the percent of persons from these racial and ethnic groups in such facilities is low.[27] Although discharge to home is considered a positive outcome, there may be cases in which it is not appropriate but alternatives are not available for a variety of reasons, including financial resources. In our sample, non-Hispanic whites were less likely to receive Medicaid insurance, which is one indicator of socioeconomic status. This is an area that requires additional research to understand how differences in discharge setting are related to functional independence, financial independence, and other social support factors.

Study Strengths and Limitations

The large national sample representing patients from more than 800 hospitals in the United States is a strength of our investigation. Another strength is the use of a standardized and validated measure of functional independence—the FIM instrument.[7] However, as an observational study based on a large cohort of data analyzed retrospectively, our investigation has several limitations. Although the UDSMR data set has been extensively examined and compared with the Medicare claims files,[28] selection bias remains a potential limitation, particularly for persons younger than 65 years of age not represented in the Medicare files. A related limitation is the small subsamples of persons from "other" minority populations that are not Hispanic or black. We combined persons from the other minority groups into one category, but this is a less than ideal solution. The "other" group was primarily Asian (2.1% of total sample) followed by Native Americans (0.5%), Hawaiian and Pacific Islanders (0.4%), and Alaskan Natives (0.1%). The data for the Asians appeared to be more like the non-Hispanic whites in regard to functional independence, whereas the other members of this group displayed outcomes similar to blacks and Hispanics. The numbers were too small to make statistical comparisons among these racial and ethnic groups, and this is an area in need of further investigation.

The UDSMR data set does not include information regarding the type, intensity, or duration of services received by patients during the acute medical hospitalization or their inpatient rehabilitation stay. This limitation reduced our ability to speculate about why patients from minority backgrounds had significantly longer times between the stroke event and admission to medical rehabilitation. This discrepancy existed both for patients with ischemic and hemorrhagic stroke across racial and ethnic groups. Although the time from event to

rehabilitation admission differed across groups, it did not appear to impact LOS, which was similar across all groups. The differences in time from stroke onset and rehabilitation admission may be associated with other outcomes not examined in our study, and this is an important topic for future research.

A final limitation is the lack of information on the amount and type of follow-up services received by persons who have experienced a stroke and are also members of racial and ethnic minority groups. Follow-up data would be useful to determine if the disparity in discharge setting persists over time or if there are differences in downstream institutional placement or hospitalization readmission across racial/ethnic groups.

Conclusion

The Global Stroke Initiative[29] states that, "Despite the enormous and growing burden of stroke … the disease does not receive the attention it deserves." In the United States, very little attention has been devoted to poststroke outcomes in disadvantaged populations. In a recent review, Stansbury and colleagues[3] summarized the evidence regarding ethnic disparities in stroke and concluded that unambiguous evidence exists for greater morbidity and mortality in blacks, but that evidence for disparities in postacute care across ethnic/racial groups is less conclusive We found significant differences in rehabilitation outcomes across racial/ethnic groups.

In discussions of healthcare services provided to disadvantaged populations, the distinction is frequently made between differences in health care versus disparities.[30] Differences may be related to the appropriateness or effectiveness of an intervention or patient preferences. Our investigation suggests the presence of disparities in poststroke outcomes for persons from minority populations. Additional research is required to confirm these disparities and begin exploring how they can be reduced or eliminated.

Acknowledgements

Sources of Funding

K.J.O. and G.V.O. were supported by research funding from the National Institutes of Health during the period of this study—grants R01-AG17638 and K02-AG019736 (K.J.O.) and K01-HD046682 (G.V.O.).

References

1. Heart Disease and Stroke Statistics—2007 Update. Dallas, TX: American Heart Association; 2007.
2. Thom T, Haase N, Rosamond W, Howard VJ, Rumsfeld J, Manolio T, Zheng ZJ, Flegal K, O'Donnell C, Kittner S, Lloyd-Jones D, Goff DC Jr, Hong Y, Adams R, Friday G, Furie K, Gorelick P, Kissela B, Marler J, Meigs J, Roger V, Sidney S, Sorlie P, Steinberger J, Wasserthiel-Smoller S, Wilson M, Wolf P. Heart disease and stroke statistics—2006 update: a report from the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Circulation 2006;113:e85–e151. [PubMed: 16407573]
3. Stansbury J, Jia H, Williams L, Vogel W, Duncan P. Ethnic disparities in stroke: epidemiology, acute care, and post-acute outcomes. Stroke 2005;36:374–386. [PubMed: 15637317]
4. 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. [PubMed: 15769776]
5. Barnes, M.; Dobkin, B.; Bogousslavsky, J. Recovery After Stroke. New York: Cambridge; 2005.
6. Bhandari VK, Kushel M, Price L, Schillinger D. Racial disparities in outcomes of inpatient stroke rehabilitation. Arch Phys Med Rehabil 2005;86:2081–2086. [PubMed: 16271552]

7. Guide for the Uniform Data System for Medical Rehabilitation. Buffalo, NY: State University of New York at Buffalo; 1997 Version 5.1.
8. Hamilton BB, Laughlin JA, Fiedler RC, Granger CV. Interrater reliability of the 7-level functional independence measure (FIM). Scand J Rehabil Med 1994;26:115–119. [PubMed: 7801060]
9. Ottenbacher KJ, Hsu Y, Granger CV, Fiedler RC. The reliability of the functional independence measure: a quantitative review. Arch Phys Med Rehabil 1996;77:1226–1232. [PubMed: 8976303]
10. Stineman MG, Shea JA, Jette A, Tassoni CJ, Ottenbacher KJ, Fiedler R, Granger CV. The Functional Independence Measure: tests of scaling assumptions, structure, and reliability across 20 diverse impairment categories. Arch Phys Med Rehabil 1996;77:1101–1108. [PubMed: 8931518]
11. Granger CV, Cotter AC, Hamilton BB, Fiedler RC. Functional assessment scales: a study of persons after stroke. Arch Phys Med Rehabil 1993;74:133–138. [PubMed: 8431095]
12. Ottenbacher KJ, Mann WC, Granger CV, Tomita M, Hurren D, Charvat B. Inter-rater agreement and stability of functional assessment in the community-based elderly. Arch Phys Med Rehabil 1994;75:1297–1301. [PubMed: 7993167]
13. Segal ME, Gillard M, Schall R. Telephone and in-person proxy agreement between stroke patients and caregivers for the functional independence measure. Am J Phys Med Rehabil 1996;75:208–212. [PubMed: 8663929]
14. Stineman MG, Escarce JJ, Goin JE, Hamilton BB, Granger CV, Williams SV. A case-mix classification system for medical rehabilitation. Med Care 1994;32:366–379. [PubMed: 8139301]
15. Ottenbacher KJ, Smith PM, Illig SB, Linn RT, Ostir GV, Granger CV. Trends in length of stay, living setting, functional outcome, and mortality following medical rehabilitation. JAMA 2004;292:1687–1695. [PubMed: 15479933]
16. Benjamini Y, Hochberg Y. Controlling the false discovery rate: a practical and powerful approach to multiple testing. J R Stat Soc Ser B Methodol 1995;57:289–300.
17. Barnes, MP.; Dobkin, BH. Recovery After Stroke. Cambridge, New York: Cambridge University Press; 2005.
18. Granger CV, Cotter AC, Hamilton BB, Fiedler RC, Hens MM. Functional assessment scales: a study of persons with multiple sclerosis. Arch Phys Med Rehabil 1990;71:870–875. [PubMed: 2222154]
19. Granger CV, Divan N, Fiedler RC. Functional assessment scales. A study of persons after traumatic brain injury. Am J Phys Med Rehabil 1995;74:107–113. [PubMed: 7710723]
20. Hamilton BB, Deutsch A, Russell C, Fiedler RC, Granger CV. Relation of disability costs to function: spinal cord injury. Arch Phys Med Rehabil 1999;80:385–391. [PubMed: 10206599]
21. Mayer-Oakes S, Heenig H, Atchison K, Lubben J, DeJong G, Schweitzer S. Patient-related predictors of rehabilitation use for community dwelling older Americans. J Am Geriatr Soc 1992;40:336–342. [PubMed: 1556360]
22. Horner R, Hoenig H, Sloane R, Rubenstein L, Kahn K. Racial differences in the utilization of inpatient rehabilitation services among elderly stroke patients. Stroke 1997;28:19–25. [PubMed: 8996482]
23. Horner R, Swanson J, Bosworth H, Matchar D. Effects of race and poverty on the process and outcome of inpatient rehabilitation services among stroke patients. Stroke 2003;34:1027–1031. [PubMed: 12624220]
24. Escarce, J.; Puffer, F. Black-White Differences in the Use of Medical Care by the Elderly: A Contemporary Analysis. Washington, DC: National Academies Press; 1997.
25. Finlyason M, Rourke B. Locus of control as a predictor variable in rehabilitation medicine. J Clin Psychol 1978;34:367–368. [PubMed: 681510]
26. Galanos A, Strauss R, Pieper C. Sociodemographic correlates of health beliefs among black and white community dwelling elderly. Int J Aging Hum Dev 1994;38:339–350. [PubMed: 7960181]
27. Miller B, McFall S, Campbell RT. Changes in sources of community long-term care among African American and white frail older persons. J Gerontol 1994;49:S14–S24. [PubMed: 8282985]
28. Carter GM, Relles DA, Ridgeway GK, Rimes CM. Measuring function for Medicare inpatient rehabilitation payment. Health Care Financ Rev 2003;24:25–44. [PubMed: 12894633]
29. Bonita R, Mendis S, Truelsen T, Bogousslavsky J, Toole J, Yatsu F. The global stroke initiative. Lancet Neurol 2004;3:391–393. [PubMed: 15207791]

30. Smedley, BD.; Stith, AY.; Nelson, AR., editors. Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care (Institute of Medicine). Washington, DC: National Academy Press; 2003.

Table 1

Patient Characteristics and Outcomes by Race/Ethnicity for the Full Sample

Variables*	Non-Hispanic White	Black	Hispanic	Other	Total
N (%)	123 537 (76)	25 334 (16)	7994 (5)	4827 (3)	161 692 (100)
Female	53%	56%†	48%†	49%†	53%
Married	53%	37%†	52%	59%†	50%
Medicare	76%	61%†	58%†	50%†	72%
Medicaid	3%	10%†	13%†	15%†	5%
Hemorrhagic stroke‡	13%	17%†	16%†	19%†	14%
Discharged to home	66%	74%†	74%†	76%†	68%
Continuous Variables	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Age, mean (SD)	72.55 (12.32)	65.25†(13.26)	67.02†(13.33)	67.19†(13.05)	70.97 (12.87)
Admission FIM total	58.82 (20.16)	58.01†(20.03)	55.82†(20.14)	57.06†(19.96)	58.51 (20.15)
Discharge FIM total	81.54 (24.52)	80.23†(25.13)	79.43†(24.65)	81.77 (23.95)	81.25 (24.16)
Length of stay, days	17.39 (10.86)	17.45 (10.03)	17.92†(10.22)	17.93†(10.59)	17.44 (10.50)
Efficiency	1.61 (1.66)	1.53†(1.60)	1.57 (1.44)	1.59 (1.59)	1.57 (1.64)
Onset to admission	10.35 (12.13)	10.74†(11.97)	11.96†(11.22)	11.45†(12.87)	10.53 (12.18)
No. of comorbidities	7.09 (2.79)	6.43†(2.91)	6.48†(2.96)	6.07†(3.03)	6.93 (2.84)

*Categorical variables reported as percentage; continuous variables reported as mean (SD). Bivariate differences in categorical variables examined with χ^2 tests; bivariate difference in continuous variables examined with one-way analysis of variance and Dunnett's post hoc tests. Non-Hispanic white served as the reference group for all bivariate comparisons.

†$P<0.01$ on 2-tailed test (reference group is non-Hispanic white).

‡Hemorrhagic stroke=International Classification of Diseases, 9th Revision of 430.0 to 432.9.

Table 2

Coefficients for Race and Hispanic Ethnicity for Multiple Regression Equations With Dependent Variables of LOS, FIM Efficiency, and Discharge FIM Instrument Ratings (N=161 692)

Models	**Model 1**†	**Model 2**†	**Model 3**†
Variables	LOS	FIM efficiency	FIM discharge
Race	b (SE)	b (SE)	b (SE)
White versus all other groups	0.41 (0.23)	0.09 (0.02)*	1.15 (0.09)*
Black versus white	−0.25 (0.22)	−0.12 (0.03)*	−1.72 (0.10)*
Hispanic versus white	−0.18 (0.24)	−0.06 (0.04)	−0.96 (0.19)*
Otherversus white	0.27 (0.17)	−0.02 (0.01)	−0.27 (0.13)
R^2 (for entire model)	0.14	0.21	0.68

*Significant at $P<0.01$.

†Variables in regression models were entered as blocks. The first block included gender, age, hemorrhagic versus nonhemorrhagic stroke, marital status, no. of comorbiditites. The second block included admission FIM instrument ratings, insurance variables (Medicare, Medicaid, commercial), and time from stroke onset to inpatient rehabilitation admission. Models 2 and 3 also included LOS as a covariate in the second block. The third block included the racial/ethnic variables (non-Hispanic white, black, Hispanic, and other).

Table 3

Comparison of Admission and Discharge FIM Instrument Rating Across Racial and Ethnic Groups by Age Quartiles (N 161 692)

Variables	Quartile 1 30 to 62 Years Mean (SD)	Quartile 2 62 to 73 Years Mean (SD)	Quartile 3 73 to 80 Years Mean (SD)	Quartile 4* 80 to 105 Years Mean (SD)
Non-Hispanic white (n=123 537)				
Age, mean (SD)	53.27 (7.32)	68.60 (3.00)	77.09 (2.10)	85.47 (3.67)
Admission FIM	61.24 (21.10)	59.28 (20.35)	58.42 (19.80)	57.07 (19.45)
Discharge FIM	87.92 (22.90)	82.88 (24.32)	80.36 (24.56)	76.93 (24.68)
Black (n=25 334)				
Age	52.21 (7.36)	68.09 (2.97)	76.80 (2.12)	85.50 (3.96)
Admission FIM	61.09 (20.34)	57.87 (19.54)	54.96 (19.54)	52.44 (19.91)
Discharge FIM	86.16 (23.75)	79.66 (24.49)	74.74 (25.51)	70.19 (25.27)
Hispanic (n=7994)				
Age	51.89 (7.73)	68.26 (2.98)	76.85 (2.15)	85.46 (3.83)
Admission FIM	59.04 (20.65)	56.82 (19.57)	52.98 (19.15)	50.58 (19.52)
Discharge FIM	86.24 (22.50)	80.27 (23.98)	74.56 (24.89)	69.10 (25.29)
Other† (n=4827)				
Age	52.69 (7.44)	68.08 (3.03)	76.84 (2.08)	85.32 (3.74)
Admission FIM	60.97 (20.87)	58.88 (20.15)	57.75 (19.79)	56.43 (19.48)
Discharge FIM	86.94 (22.28)	83.28 (22.93)	77.99 (24.33)	72.47 (25.35)

*Highest age varied for racial/ethnic groups: non-Hispanic white=104 years, black=105 years, Hispanic=102 years, other minority groups=101 years.

†Other=Asian, Native American, Alaska Native, and Hawaiian and Pacific Islander.