Effect of Socioeconomic Status on Treatment and Mortality After Stroke

Moira K. Kapral, MD, MSc, FRCP; Hua Wang, PhD; Muhammad Mamdani, PharmD, MA, MPH; Jack V. Tu, MD, PhD, FRCP

Background and Purpose—Socioeconomic status is associated with increased mortality from ischemic heart disease. We undertook a study to determine whether a similar association exists between socioeconomic status and stroke mortality.

Methods—We linked hospital discharge abstracts and vital-status data for all patients with acute stroke admitted to hospitals in Ontario between April 1994 and March 1997. Socioeconomic status for each patient was inferred on the basis of median neighborhood income. We determined the risk of death at 30 days and 1 year; secondary analyses compared the use of medications, inpatient rehabilitation services, and carotid endarterectomy by socioeconomic status. We used multivariate analyses to adjust for age, sex, stroke type, comorbid conditions, and hospital and physician characteristics.

Results—The study sample consisted of 38 945 patients. Each $10 000 increase in median neighborhood income was associated with a 9% reduction in the hazard of death at 30 days (adjusted hazard ratio 0.91, 95% CI 0.87 to 0.96) and a 5% reduction in the hazard of death at 1 year (adjusted hazard ratio 0.95, 95% CI 0.92 to 0.99). Patients in the lowest income quintile were less likely than those in the highest to receive in-hospital physiotherapy (58% versus 61%, \(P\lt 0.001\)), occupational therapy (36% versus 47%, \(P\lt 0.001\)), and speech pathology (21% versus 28%, \(P\lt 0.001\)). There were no differences in the use of medications or carotid endarterectomy based on socioeconomic status. Waiting times for carotid surgery, however, were significantly longer in the lowest income quintile than the highest (90 days versus 60 days, \(P\lt 0.002\)).

Conclusions—Socioeconomic status affects mortality and access to some health services after stroke, even in a country with a universal health insurance program. Understanding and reducing these socioeconomic disparities should be a priority for future research. (Stroke. 2002;33:268-275.)

Key Words: social class ■ stroke

Socioeconomic status been shown to affect overall health status, with lower socioeconomic status associated with a decreased life expectancy and an increased prevalence of such medical conditions as diabetes, hypertension, and obesity.1,2 A growing body of literature suggests that lower socioeconomic status may result in reduced access to care for a variety of medical services, including physician visits, cancer screening, and invasive cardiac procedures.8–10 In the setting of stroke, several population-based studies have documented an inverse relationship between socioeconomic status and overall stroke mortality rates.1,3–7 It is not known whether this is due to differences in stroke incidence or stroke case fatality rates.

In Canada, all necessary hospital and physician services are covered by the federal–provincial health insurance plan. In theory, this universal access to medically necessary care should decrease the effect of socioeconomic status on health care and outcomes. A number of Canadian studies, however, have documented a persistent association between lower socioeconomic status and increased mortality from ischemic heart disease, as well as decreased access to cardiac interventions such as coronary angiography.10,11 It is not known whether similar differences exist in the area of stroke and cerebrovascular disease.

We undertook a study to determine whether socioeconomic status affects 30-day and 1-year mortality after stroke, using administrative data from the province of Ontario on all patients admitted with stroke between 1994 and 1997. The goal was to determine stroke case-fatality rates; the study was received February 13, 2001; final revision received August 20, 2001; accepted October 15, 2001.

From the Institute for Clinical Evaluative Sciences (M.K.K., H.W., M.M., J.V.T.), Division of General Internal Medicine and Clinical Epidemiology, and Women’s Health Program, University Health Network (M.K.K), Clinical Epidemiology and Health Care Research Program and Division of General Internal Medicine, Sunnybrook and Women’s College Health Sciences Centre (J.V.T.), Department of Medicine, University of Toronto (M.K.K., M.M., J.V.T.), and the Department of Public Health Sciences, University of Toronto (J.V.T.), Toronto, Ontario, Canada.

The Institute for Clinical Evaluative Sciences is supported by the Ontario Ministry of Health. Neither the findings nor their interpretation should be attributed to any supporting or sponsoring agencies.

Reprint requests to Dr Moira K. Kapral, Toronto General Hospital, 200 Elizabeth St, ENG-246, Toronto, Ontario, Canada M5G 2C4. E-mail moira.kapral@uhn.on.ca

© 2002 American Heart Association, Inc.

Stroke is available at http://www.strokeaha.org

268
not designed to assess the association between socioeconomic status and stroke incidence. In addition, we examined the association between socioeconomic status and access to physicians and institutions with expertise in stroke care. We also evaluated whether socioeconomic status affects rates of carotid endarterectomy and waiting times for carotid surgery after a stroke.

Methods

Data Sources

The database maintained by the Canadian Institute for Health Information (CIHI) provided information on patient demographics; admission diagnoses; comorbidity; in-hospital procedures; use of physiotherapy, occupational therapy, and speech pathology; specialty of attending physician; length of stay; in-hospital mortality; and discharge destination. The validity of the CIHI database has been evaluated in 7 reabstraction studies and has been found to have an accuracy rate of 97% to 99% for hospital demographic data, including sex, age, most responsible physician, admission and discharge dates, and discharge destination. Validation studies have also established an accuracy rate of 90% for the diagnosis of stroke based on ICD-9 codes 431, 434, and 436. Medication use was determined from the Ontario Drug Benefits (ODB) database, which contains data on all outpatient postdischarge prescriptions filled in Ontario in patients ≥65 years old. Medication data were not available for younger patients. Data on 30-day and 1-year mortality, regardless of place of death, were obtained from the Ontario Registered Persons Database. Socioeconomic status was inferred on the basis of neighborhood income from 1996 Canadian census data. We calculated the median income for each neighborhood area using the first 3 digits of the postal code (Forward Sortation Area) and inferred patients’ incomes on the basis of their principal residence.

Patient Cohort

We created a cohort of stroke patients by identifying all patients admitted to acute care hospitals in the province of Ontario with a diagnosis of stroke between 1994 and 1997, using ICD-9 codes 431, 434, and 436. Exclusion criteria were age <20 or >105 years, nonresidents of Ontario, patients transferred from another acute care facility, and strokes that occurred as an in-hospital complication. Also excluded were persons who had had an admission for stroke within the past year.

Hospital and Physician Characteristics

In the setting of stroke, hospital and physician characteristics may influence the likelihood of the patient’s receiving thrombolysis, undergoing such investigations as CT and echoangiography, and receiving care in a dedicated stroke unit. These factors may affect short- and long-term stroke outcomes. To adjust for hospital factors, we categorized hospitals with respect to hospital volume (the number of patients with stroke admitted to the facility annually), teaching or nonteaching status, and urban or rural location. In addition, hospitals were classified by the availability of stroke care resources as level 1 (no resources specific to stroke care), level 2 (both CT and neurologist or clinician with stroke expertise available), and level 3 (CT, MRI, angiography, neurologist, and neurosurgeon all available). Attending physicians were identified as general practitioners, general internists, neurologists, and other physicians.

Severity of Illness

Stroke severity may affect the use of medications and procedures as well as short- and long-term mortality. Administrative data do not contain indicators of stroke severity, such as level of consciousness and functional status. We were able, however, to adjust for other important clinical predictors, including age, sex, comorbid illness, and stroke type (hemorrhagic versus nonhemorrhagic). Comorbid illness was summarized according to the modified Charlson-Deyo index score, which is a weighted summary score based on the presence or absence of 17 medical conditions. A score of zero indicates that no comorbid illness is present, and higher scores indicate a greater burden of comorbidity.

Interventions

We identified carotid endarterectomy procedures in the CIHI database using the Canadian Classification of Diagnostic, Therapeutic, and Surgical Procedures (CCP) code 50.12. Rates of endarterectomy in patients in the study cohort were examined for up to 1 year after the index stroke admission; the data did not allow us to determine whether surgery was ipsilateral or contralateral to the stroke event. As a surrogate marker for waiting time, we calculated the number of days between the index admission date and the date of surgery. Use of physiotherapy, occupational therapy, and speech pathology during the acute stroke admission was identified from the CIHI database. We identified outpatient prescriptions filled for aspirin, ticlopidine, and warfarin in stroke survivors ≥65 years old within 90 days of discharge using the ODB database.

Outcome Measures

Length of stay and discharge destination were obtained from the CIHI database. Thirty-day and 1-year mortalities were obtained from the Ontario Registered Persons Database.

Statistical Analysis

Neighborhoods were divided into quintiles according to the median personal income in that Forward Sortation Area. Detailed methods of income quintile grouping were reported in a previous article using Canada Census data. Descriptive statistics were conducted to provide information on characteristics of patients, hospitals, and physicians as well as crude outcomes within each income quintile. Linear trends across income quintiles for major exposure and outcomes were tested with a Mantel-Haenszel χ² test for categorical data and a weighted linear regression analysis for continuous data. Thirty-day and 1-year mortality were also assessed by use of Kaplan-Meier plots and the log-rank test.

Cox proportional-hazards models were developed to determine the relationship of neighborhood median income to 30-day and 1-year mortality, after adjustment for age, sex, comorbid conditions, stroke type, and hospital and physician characteristics. Variables were selected on the basis of backward stepwise regression and comparison of the −2 log likelihoods of the Cox proportional-hazards model. A value of \( P < 0.05 \) was considered statistically significant in the analyses. However, patient age, sex, and income were forced into the multivariable models regardless of statistical significance. SAS (version 6.12) was used for all data analyses.

Results

Patient Characteristics

The study group consisted of 38,945 patients, 51% of whom were women (Table 1). The mean age was 74 years. There was no significant difference in average age or sex by income quintile. Hemorrhagic stroke was less common in the lowest income quintile than in the highest (9% versus 12%, \( P < 0.001 \)). The proportion of patients with acute stroke was higher in the lower income quintiles than in the higher income quintiles, consistent with a higher stroke disease burden with lower socioeconomic status. Patients in the lowest income quintile were less likely than those in the highest quintile to be admitted to hospitals that were high volume (61% versus 84%, \( P < 0.001 \)), teaching hospitals (19% versus 25%, \( P < 0.001 \)), or level 3 hospitals (14% versus 27%, \( P < 0.001 \)). The majority of patients were admitted to a hospital that was in an income quintile similar to that of their primary address. Hospitals located in the lowest income quintiles were more likely than those in the highest income quintiles to be rural (37% versus 27%,
Patients in the lowest income quintile were less likely than those in the highest income quintile to receive physiotherapy (58% versus 61%, \( P<0.001 \)), occupational therapy (36% versus 47%, \( P<0.001 \)), and speech–language therapy (21% versus 28%, \( P<0.001 \)). There was no difference in the proportion of elderly patients prescribed antiplatelet agents or warfarin based on socioeconomic status (\( \approx 60\% \) of all patients) (Table 2). Overall, 1.4% of patients underwent carotid endarterectomy in the year after their admission for stroke, and there was no significant difference in surgical rates based on socioeconomic status. The median waiting time for carotid surgery, however, was significantly longer with lower socioeconomic status (90 days for those in the lowest income quintile versus 62 days for those in the highest, \( P=0.002 \)).
### TABLE 2. Stroke Treatment and Outcomes According to Quintile of Neighborhood Median Income

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Income Quintile</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Endarterectomy, n (%)</td>
<td>113 (1.2)</td>
<td>117 (1.3)</td>
</tr>
<tr>
<td>Entire stroke cohort</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonhemorrhagic stroke</td>
<td>113 (1.3)</td>
<td>117 (1.4)</td>
</tr>
<tr>
<td>Waiting time for endarterectomy†</td>
<td>112.1 ± 88.9</td>
<td>106.4 ± 85.6</td>
</tr>
<tr>
<td>Mean: SD, d</td>
<td>90 (46–157)</td>
<td>89 (42–147)</td>
</tr>
<tr>
<td>Median (interquartile range)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any antplatelet or anticoagulant agents, ‡ n (%)</td>
<td>3346 (58.8)</td>
<td>3228 (58.4)</td>
</tr>
<tr>
<td>Aspirin, n (%)</td>
<td>2010 (35.3)</td>
<td>1861 (33.7)</td>
</tr>
<tr>
<td>Ticlopidine, n (%)</td>
<td>766 (13.4)</td>
<td>696 (12.6)</td>
</tr>
<tr>
<td>Warfarin, n (%)</td>
<td>940 (16.5)</td>
<td>849 (15.1)</td>
</tr>
<tr>
<td>Physiotherapy,§ n (%)</td>
<td>5397 (57.8)</td>
<td>5144 (57.8)</td>
</tr>
<tr>
<td>Occupational therapy,§ n (%)</td>
<td>3370 (36.1)</td>
<td>2959 (33.2)</td>
</tr>
<tr>
<td>Speech pathology,§ n (%)</td>
<td>1956 (20.9)</td>
<td>1738 (19.5)</td>
</tr>
<tr>
<td>Length of stay</td>
<td>20.5 ± 31.9</td>
<td>18.2 ± 28.7</td>
</tr>
<tr>
<td>Mean: SD, d</td>
<td>10 (5–23)</td>
<td>9 (4–20)</td>
</tr>
<tr>
<td>Median (interquartile range)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discharge destination, n (%)</td>
<td>321 (4.4)</td>
<td>272 (3.9)</td>
</tr>
<tr>
<td>Acute care hospital</td>
<td>811 (11.2)</td>
<td>942 (13.5)</td>
</tr>
<tr>
<td>Chronic care hospital</td>
<td>1007 (13.9)</td>
<td>984 (14.1)</td>
</tr>
<tr>
<td>Rehabilitation hospital</td>
<td>717 (9.9)</td>
<td>622 (8.9)</td>
</tr>
<tr>
<td>Nursing home</td>
<td>1095 (15.1)</td>
<td>927 (13.3)</td>
</tr>
<tr>
<td>Home care program</td>
<td>3313 (45.6)</td>
<td>3226 (46.3)</td>
</tr>
</tbody>
</table>

*P values are based on the test for linear trend across income quintiles.
†Waiting time for carotid endarterectomy corresponds to the number of days between the index admission date and the date of surgery.
§Outpatient prescriptions in patients ≥65 years old.
¶Patient physiotherapy, occupational therapy, and speech pathology during the stroke admission.

### Length of Stay and Discharge Destination

The median length of stay was 10 days, and there was no significant difference based on socioeconomic status (Table 2). Overall, 47% of patients were discharged home. Patients in the lowest income quintile were less likely than those in the highest quintile to be discharged home (46% versus 52%, P<0.001).

### Mortality

The overall crude 30-day and 1-year mortality rates were 19% and 33%, respectively. Thirty-day mortality was higher in those in the lowest income quintile than in the highest income quintile (20% versus 17%, P<0.002). One-year mortality was also higher in the lowest than the highest income quintile (34% versus 31%, P<0.001). After adjustment for age, sex, comorbid conditions, and hospital characteristics, each $10 000 increase in median neighborhood income was associated with a 9% reduction in the hazard of death at 30 days (adjusted hazard ratio 0.91, 95% CI 0.87 to 0.96, P<0.001) and a 5% reduction in the hazard of death at 1 year (adjusted hazard ratio 0.95, 95% CI 0.92 to 0.99, P=0.009) (Table 3). The adjusted survival curves for 30-day and 1-year mortality demonstrate a significant mortality difference between those in the highest and lowest income quintiles (Figures 1 and 2).

### Discussion

We found that in Ontario, the largest province in Canada’s universal healthcare system, socioeconomic status was inversely related to mortality after stroke. Specifically, for every $10 000 increase in median neighborhood income, there was a 9% decrease in 30-day mortality and a 5% decrease in 1-year mortality after stroke, even after adjustment for age, sex, comorbid conditions, and hospital and physician characteristics. In addition, we found that patients in the lower income quintiles were less likely to have access to hospitals with neurologists and such imaging modalities as CT and MRI, were less likely to receive rehabilitation services during their stroke admission, and had longer waiting times for carotid endarterectomy after stroke. We found no significant difference, however, based on socioeconomic status in rates of carotid endarterectomy after stroke or in the use of medications for secondary stroke prevention in elderly patients.

To the best of our knowledge, this association between socioeconomic status and stroke case-fatality rates has not
been reported previously. Our findings, however, are in accord with previous population-based studies that have documented higher overall stroke mortality with lower socioeconomic status,1,3–7,15 as well as geographic and economic inequities in access to carotid endarterectomy. 16,17 The documentation of a stroke mortality gradient in a country with universal health care is consistent with a previous international study that did not find a clear association between egalitarian healthcare policies in different countries and the magnitude of stroke mortality differences based on socioeconomic status.3 Indeed, other Canadian studies of patients with various medical conditions confirm a persistence of a mortality/therapeutic gradient with socioeconomic status, despite universal health care.8,10,11

This study was not designed to identify the reasons for income-related differences in access to care and mortality. It is likely, however, that much of the observed disparity in access to specialized hospitals and physicians is related to the distribution of specialized resources in more affluent urban

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Thirty-Day Mortality</th>
<th>One-Year Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Adjusted Hazard Ratio (95% CI)</td>
<td>P</td>
</tr>
<tr>
<td>Neighbourhood median income (for each $10 000 increase)</td>
<td>0.91 (0.87–0.96)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Age (for each additional year)</td>
<td>1.05 (1.04–1.05)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Female sex</td>
<td>0.96 (0.91–1.00)</td>
<td>0.057</td>
</tr>
<tr>
<td>Hemorrhagic stroke</td>
<td>3.70 (3.49–3.92)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Charlson-Deyo comorbidity index score</td>
<td>1.12 (1.09–1.16)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Specialty of attending physician</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General practitioner*</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Internist</td>
<td>1.27 (1.20–1.35)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Neurologist</td>
<td>0.76 (0.69–0.83)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Other</td>
<td>1.34 (1.25–1.45)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hospital volume</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low*</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>1.17 (1.06–1.29)</td>
<td>0.002</td>
</tr>
<tr>
<td>High</td>
<td>0.98 (0.88–1.09)</td>
<td>0.716</td>
</tr>
<tr>
<td>Teaching hospital</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No*</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>0.84 (0.78–0.91)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hospital level†</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1*</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.94 (0.88–1.00)</td>
<td>0.057</td>
</tr>
<tr>
<td>3</td>
<td>1.02 (0.94–1.11)</td>
<td>0.603</td>
</tr>
</tbody>
</table>

*This represents the reference group.
†Hospital level was not a significant predictor of 1-year mortality and thus was not included in the final model.

Figure 1. Adjusted survival curves (30-day) by income quintile. Income quintiles are numbered 1 to 5, from lowest to highest. The difference between survival curves for income quintiles 1 and 5 was significant (P<0.001).

Figure 2. Adjusted survival curves (1-year) by income quintile. Income quintiles are numbered 1 to 5, from lowest to highest. The difference between survival curves for income quintiles 1 and 5 was significant (P=<0.019).
neighborhoods. Wealthier neighborhoods may be more attractive for specialist physicians to locate in and may also be more effective in lobbying the government for advanced medical technologies for their neighborhood hospitals. Explanations for the higher mortality seen in patients with lower income are less clear and are unlikely to be related solely to access to stroke care. Although we found an association between variations in hospital and physician characteristics and clinical outcomes, socioeconomic status remained a significant predictor of mortality even after adjustment for these factors. Other potential explanations for the higher mortality observed with lower socioeconomic status include greater disease severity or an increased prevalence of cerebrovascular disease risk factors and other comorbid conditions.\textsuperscript{2,18} In addition, medication adherence, stress, social isolation, and other unmeasured factors may all be important income-related determinants of survival after acute stroke.\textsuperscript{19}

Several study limitations merit comment. Our primary outcome measure was mortality, and we did not have information on other important outcomes, such as recovery, community reintegration, and functional status after stroke. We were unable to control for stroke severity; however, there is no documented association between this and socioeconomic status. We lacked detailed information on the specifics of the stroke care provided and were unable to assess the use of interventions known to improve stroke outcomes, such as stroke units and thrombolytic therapy.\textsuperscript{20,21} A recent survey, however, showed that only 4\% of Ontario hospitals had stroke units, and thrombolytic therapy was not approved at the time of this study.\textsuperscript{22} We did not have information on the prevalence or severity of carotid stenosis in the various income quintiles, which could influence rates of surgery. On the basis of the current literature, it is not known whether this is likely to be a relevant concern. Our medication database included only patients >65 years old who received medications free of charge through the ODB program. This would have diluted our ability to detect variations in drug use on the basis of socioeconomic status and ability to pay, because it is likely that differences in medication use would have been more marked in younger patients without medication benefit plans. Finally, we used the Forward Sortation Area as a surrogate for socioeconomic status, so that individual income was inferred from median neighborhood income. Previous studies, however, have used this method of ascribing individual socioeconomic status, and data support the validity of this approach.\textsuperscript{23}

In conclusion, we found that stroke patients with lower socioeconomic status had increased mortality and decreased access to some healthcare resources, despite a goal of universal access to health care for all Canadian citizens. Health policy and planning initiatives that aim to increase the availability of specialized stroke care for patients in rural or less affluent neighborhoods may be an important strategy to reduce the differences in patient outcomes related to socioeconomic status.

Acknowledgments
Dr Tu was supported in part by a Canadian Institutes for Health Research New Investigator career award. This work was funded in part by an operating grant (T4495) from the Heart and Stroke Foundation of Ontario. Dr Kapral was supported in part by the Women’s Health Program at University Health Network.

References
Socioeconomic status (SES) has been linked to overall mortality as well as cardiovascular disease morbidity and mortality in numerous studies. Patterns in the distribution of income, occupation, and educational levels within populations result in gradients in the distribution of morbidity and mortality. The disparities in social conditions such as class, education, income, and occupation may reflect underlying inequalities in the utilization of social support structures, health care systems, disbursement of wealth, and knowledge. These disparities have been associated with gradients in overall and disease-specific mortality rates despite controlling for important biological risk factors. Further, evidence is accumulating which demonstrates that racial differences in disease-specific mortality may be partially explained by underlying social disparities. Studies utilizing the National Longitudinal Mortality Study have estimated that SES accounted for as much as 37% to 67% of excess risk among black women for diseases such as ischemic heart disease and diabetes, and 30% to 55% among black men for lung and stomach cancer and stroke.

Stroke epidemiological studies have identified hypertension, diabetes, atrial fibrillation, coronary artery disease, heavy alcohol use, and physical inactivity as important stroke risk factors. Data specifically investigating the relationship between social conditions and stroke risk are more difficult to find. A number of studies have examined population level patterns of stroke mortality using SES indicators such as median family income, educational levels, or occupational categories. These SES indicators were associated with a strong inverse relationship with stroke mortality. This gradient was particularly strong among blacks; in one study, stroke mortality rates in the lowest SES quartile were 50% greater than those in the upper quartile. The ecological design of many of these studies, however, limits the ability to investigate causal associations in the absence of individual-specific SES indicators. Data from longitudinal studies are sparse.

Two important prospective studies have shown a strong association between socioeconomic status and stroke. In the Rotterdam Study, stroke incidence and prevalence were greatest among lower income and occupational levels after the adjustment of traditional risk factors. The FINMONICA Stroke Register investigated the impact of income and educational levels on stroke incidence, case fatality, and prognosis after stroke. Stroke incidence among the lowest income groups was significantly and consistently greater than in higher income groups. Case-fatality rates at 28 days were greater in men with the lowest income levels, but no difference was seen by income levels among women. Data from FINMONICA suggest that low SES accounts for nearly one third of the stroke incidence and more than half of the ischemic stroke mortality.

In this article, Kapral et al present an analysis focused on the association between neighborhood median income levels and poststroke mortality. They confirm the inverse relationship between income and stroke mortality, finding that each $10,000 increase in median household income per census tract results in a 9% decrease in 30-day mortality poststroke and a 5% decrease in 1-year mortality. This study is unique in that the authors sought to clarify the relationship between income and stroke mortality in a population with access to the universal health care plan found in the Canadian Health System. Kapral et al provide additional information suggesting that disparities in utilization of health services, such as physical therapy poststroke, are influenced by income.

Universal health care systems are generally thought to decrease health care disparities through improved access to care. There is an expectation that given the equal access to health care across income, educational, and occupational groups, differentials in stroke mortality in this study should have been minimized. These data suggested that despite relative equity in health care access, disparities in mortality by income continued to exist.

The measurement of SES is complex and is often limited by the nature of the information collected. Variables such as educational level, income, and occupational status are most frequently used to define the “social status.” These variables may be biased by self-report, differences in educational norms, or misclassification of employment responsibilities. Social conditions at both the individual level and the population level may independently impact on stroke mortality as well as risk of stroke. The use of neighborhood socioeconomic characteristics, such as median household income or proportion of community living below poverty level, may contribute an additional level of information about population level stress on stroke mortality. In the article presented here, median family income obtained from census tract data are used to approximate SES. In the ARIC study, characteristics reflecting poorer neighborhoods were associated with increased prevalence of coronary heart disease and risk factors. Further, the use of a single social indicator to represent all social conditions may be flawed in that different social conditions may work through a multitude of different mechanisms. Less frequently have studies included multiple measures of SES or multiple social conditions, each of which may independently contribute to disease mortality and morbidity. Adjusting for one individual social factor, such as educational level, may not be adequate to account for disparities in mortality or mortality.

The mechanisms by which social conditions impact on stroke risk and stroke mortality are still unclear. Several studies suggest that sociodemographic variables exert pressure by creating differentials in access to knowledge, wealth, power, and prestige. For example, lower educational attainment may cause miscommunication between patient and
physician, leading to poorer compliance of antihypertensives agents, resulting in uncontrolled hypertension and increased stroke risk. Lower income may result in inadequate living conditions, increased stress, greater distance to health resources, and underdiagnosis of severe cardiovascular disease. Finally, disparities in mortality may exist because of the inequalities in the distribution of resources in the community. In addition to individual sociocultural variables predicting disparities in mortality, neighborhood or community environments may provide additional pressures including poverty, pollution, violence, and isolation, which may increase stroke risk and produce poorer stroke outcomes. Kapral et al document the continued impact of social conditions on stroke mortality, suggesting that the role of social conditions as casual agents needs considerably more attention. Further development of a model for stroke risk and stroke mortality that accounts for both conventional or biological stroke risk factors is needed, as are specific social conditions that can independently increase the public health burden of stroke. Identification of key social conditions associated with stroke risk and prognosis will result in more effective health policy in both the United States and the international community.

Bernadette Boden-Albala, MPH, Guest Editor
Department of Neurology
Columbia University College of Physicians and Surgeons
Division of Sociomedical Science
Columbia University Mailman School of Public Health
New York, New York

Ralph L. Sacco, MD, MS, Guest Editor
Department of Neurology
Columbia University College of Physicians and Surgeons
Division of Epidemiology
Columbia University Mailman School of Public Health
New York, New York

References
Effect of Socioeconomic Status on Treatment and Mortality After Stroke
Moira K. Kapral, Hua Wang, Muhammad Mamdani and Jack V. Tu

Stroke. 2002;33:268-275
doi: 10.1161/hs0102.101169
Stroke is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2002 American Heart Association, Inc. All rights reserved.
Print ISSN: 0039-2499. Online ISSN: 1524-4628

The online version of this article, along with updated information and services, is located on the
World Wide Web at:
http://stroke.ahajournals.org/content/33/1/268

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in Stroke can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to Stroke is online at:
http://stroke.ahajournals.org/subscriptions/