Ischemic Stroke in South Asians
A Review of the Epidemiology, Pathophysiology, and Ethnicity-Related Clinical Features

Ashan Gunarathne, MRCP; Jeetesh V. Patel, PhD; Brian Gammon, PhD; Paramjit S. Gill, FRCGP; Elizabeth A. Hughes, FRCP; Gregory Y.H. Lip, MD

Background and Purpose—Within the United Kingdom, mortality from stroke is higher among South Asians compared to European whites. The reasons for this excess cerebrovascular risk in South Asians remain unclear. The aim of this review is to present a comprehensive and systematic overview of the available literature relating to ischemic stroke among South Asian populations identifying distinct features of stroke epidemiology in this group.

Summary of Review—A high frequency of lacunar strokes is a familiar pattern among South Asians, which suggests a greater prevalence of small-vessel disease in South Asians. This may be a consequence of abnormal metabolic and glycemic processes. In addition, stroke mortality among South Asians appears to be explained by glycemic status, which is an independent predictor of long-term stroke mortality. Within India, there is a perceptible rural–urban gradient in stroke prevalence, underlying the dangers of the rapid transition in socioeconomic circumstances seen across the Indian subcontinent.

Conclusions—This review emphasizes the importance of further research into ischemic stroke for South Asians given their higher cardiovascular disease burden and necessity for targeted healthcare approaches. (Stroke. 2009;40:e415-e423.)

Key Words: arterial stiffness ■ blood pressure ■ cardiovascular disease ■ diabetes ■ epidemiology ■ pathophysiology ■ South Asian ■ stroke

Stroke is a continuing yet preventable cause of significant morbidity and mortality in the Western world1 and will rapidly reach epidemic proportions in modernizing countries such as those across Asia.2,3 Of particular concern is that mortality from ischemic stroke in the United Kingdom is at least 1.5 times more common among those of South Asian origin4 when compared with the general population. One striking observation among the global diaspora of South Asians is that stroke is not common except for migrants living in the United Kingdom.5

Why is this increased stroke mortality evident among South Asian subjects in the United Kingdom? Cultural and socioeconomic factors may account for part of this excess. Rates of cardiovascular disease (CVD) in Fiji,6 Singapore,7 and South Africa8 are highest among migrant Indians but are largely explained by the excess of coronary heart disease. In the United Kingdom, CVD among South Asian migrants is due to both heart disease and stroke, suggesting that an environmental basis may, in part, underlie the increased risk of stroke in this population.

An examination of those modifiable risk factors that appear particularly prevalent among ethnic minority groups (South Asians in particular) may explain how a rapid transition from subsistence living to a “Westernized lifestyle” may provide exposure needed for activation of inherent ethnic traits culminating in ischemic stroke. In addition, rates of stroke in both urban and rural India are lower than those seen in metropolitan cities.9 The excess of CVD mortality among South Asians in the United Kingdom is maligned with diabetes mellitus and hypertension, both of which show unique patterns of individual susceptibility and severity in this population.10 Although there have been two comprehensive reviews on stroke epidemiology in 199211 and 200312 highlighting both geographical and ethnic variations in stroke mortality and incidence and case fatality rates, neither of these reviews include studies on South Asians. Hence, there is a pressing need for a comprehensive review of stroke epidemiology in the South Asian population, who are known to carry an increased burden of CVD and inequitable health therein.13

This review article deals with the epidemiology of ischemic stroke in people originating from the Indian subcontinent—“South Asians”—with particular attention to the increased risk that is manifest among migrants living in the United Kingdom. A secondary objective of this review is to make evident those environmental exposures that promote an
increased risk of ischemic stroke among South Asians, thereby furthering understanding of the pathophysiology of this disease and allowing application of preventive strategies.

**Methodology**

In the preparation of this review, the term “South Asian” was used to represent people originating from the Indian subcontinent (India, Sri Lanka, Pakistan, Nepal, and Bangladesh). A MEDLINE and EMBASE search using the terms (MeSH): (South Asians) OR (Indians, Sri Lankans, Bangladeshi, Pakistani, Nepalese) AND (Stroke) OR (Cerebrovascular Accidents) was performed. Due to the paucity of published articles in peer-reviewed journals between the period selected initially (1990 to 2005), the literature search was extended to include articles published between the years 1940 and 2005, including selected published abstracts from South Asian countries, studies with different study designs and variable stroke rates. The conclusions drawn from this review are limited by a lack of population-based longitudinal studies. Inclusion of such studies would have led to increased validity of inferences concerning the prevalence of CVD in the target population. In total, 33 articles were found based on 28 cross-sectional and 5 prospective studies describing at least one demographic, etiologic, or psychosocial aspect of stroke epidemiology. No formal statistical analysis (such as meta-analyses) was used, and data were analyzed descriptively because of the methodological heterogeneity across studies and quality limitations (as proposed by Feign et al).

**Incidence of Ischemic Stroke in South Asians**

The calculation of stroke incidence among South Asian populations is hampered by the lack of population-based studies. Data concerning the incidence of stroke in this population group are based on 4 studies. The first epidemiological study of stroke in India compared incidence rates between urban and rural populations over a 2-year period in which crude incidence rates in the former were double that of the latter. A similar study by Bhattacharya et al reported an average annual incidence rate was 123.57 per 100,000 persons. The incidence of stroke in this study was considerably higher than that of Western studies conducted during the same time period. Agestandardized stroke incidence rates were marginally higher in the female population. In common with Western studies, age-specific incidence rates showed a progressive increase in incidence more specifically in the fifth to seventh decades. One study that compared stroke incidence rates among South Asians living at moderate altitudes with that of individuals living at lower altitudes in India showed lower incidence rates among those living at a relatively higher altitude. The reason for this apparent discrepancy is not clear. Differences in altitudes are also likely to be apparent in migrants living in different countries across the globe, but it is unclear whether this could explain differences in stroke rates between migrant and nonmigrant South Asians.

Hsu et al have reported a population-based stroke study in migrant South Asians (n=74) in the United Kingdom, where crude incidence rates (111.18 per 100,000 persons) as well as age-specific incidence rates were comparable to the white population. However, the indirect sampling method used in this study may have promoted an underestimation of the incidence rates among South Asians.

None of these studies fulfill the ideal criteria for incidence studies nor are the studies intercomparable (different study designs, lack of case ascertainment methods). Nonetheless, incidence stroke rates would appear to be increasing exponentially from 13 per 100,000 persons (in 1969) to 123 per 100,000 (in 1993) in South Asians, whereas rates for Western populations have declined. According to the World Health Organization Global Burden of Diseases Study, it is estimated that the annual stroke incidence is

### Table 1. Studies Comparing Stroke Incidence Rates Among South Asians

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Method of Diagnosis of Stroke</th>
<th>Study Methodology/Case Ascertainment</th>
<th>Sample Population</th>
<th>Investigated Main Epidemiological Aspect</th>
<th>Key Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hsu et al</td>
<td>1996</td>
<td>WHO definition</td>
<td>Prospective general practitioner</td>
<td>UK, Leicester</td>
<td>Comparison of stroke incidence rates</td>
<td>Stroke incidence rates were similar between 2 ethnic groups; 28-day stroke</td>
</tr>
<tr>
<td></td>
<td></td>
<td>registry-based case monitoring</td>
<td>(n=129 225)</td>
<td>incidence rates</td>
<td>between SA versus EW</td>
<td>mortality rates were higher in EW; actual incidence figures are not</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td>mentioned; age-specific rates showed a proportional increase with age</td>
</tr>
<tr>
<td>Bhattacharya et</td>
<td>1993</td>
<td>WHO definition</td>
<td>Prospective door-to-door survey</td>
<td>India, West Bengal</td>
<td>Stroke incidence rates in India</td>
<td>Age-adjusted rate: 262 per 100 000; females had higher rates (274) compared</td>
</tr>
<tr>
<td>all</td>
<td></td>
<td></td>
<td>(n=20 842)</td>
<td></td>
<td></td>
<td>with males (253); age-specific rates showed a proportional increase with age</td>
</tr>
<tr>
<td>SunderRao</td>
<td>1971</td>
<td>Prospective</td>
<td>Unclear</td>
<td>India, Madras</td>
<td>Comparison of stroke incidence rates</td>
<td>Crude incidence rate: 13 per 100 000; age-adjusted rates are not available;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(n=258 576)</td>
<td></td>
<td>between urban versus rural population</td>
<td>males had higher rates (15.2) compared with females (10.8) and urban rates</td>
</tr>
<tr>
<td>Mahajan et</td>
<td>2004</td>
<td>CT diagnosis</td>
<td>Prospective study based on</td>
<td>India, Himalaya</td>
<td>Stroke “incidence rates” at high altitudes</td>
<td>Males had higher rates compared with females and rates were higher than low</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>consecutive hospital admissions</td>
<td>(high altitude;</td>
<td></td>
<td>altitudes; incidence rates are based on hospital admission rates, therefore</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>n=not</td>
<td></td>
<td>not comparable with other studies</td>
</tr>
</tbody>
</table>

WHO indicates World Health Organization; SA, South Asian; EW, European whites.
projected to increase in 2015 to 91 per 100 000 and in 2030 to 98 per 100 000, particularly among Asian populations in developing countries. Hence, there is an urgent need to identify those factors and environmental exposures that have accelerated stroke risk among South Asians in the United Kingdom, because this will provide considerable insight for the prevention of stroke at a global level.

Prevalence of Ischemic Stroke in South Asians

The prevalence studies which are included in this review (Table 2) are mostly conducted in different areas of India (1968 to 2001). However, there are no stroke prevalence data available from other countries of the Indian subcontinent except Pakistan. Three studies have compared stroke prevalence between migrant South Asians and other ethnic groups. The crude prevalence rates of stroke among South Asians living in India vary from 52 to 842 per 100 000 for all ages (Supplemental Table I, available online at http://stroke.ahajournals.org). Age-specific prevalence rates show an exponential rise with age in all studies.

Similar to stroke studies within Western countries, with the exception of one study, all other studies concur that prevalence rates have increased 3- to 5-fold over the last 4 decades. More importantly, rates of stroke prevalence have been demonstrated to have significant heterogeneity across studies carried out in different parts of India. For example, the study carried out by Bharucha et al reported a prevalence of $42$ per 100 000 compared with the 147 per 100 000 reported by Banergee et al using a similar study design during the same period. In addition, the prevalence of stroke in urban India appears to be higher than that seen in rural areas such as Haryana where the prevalence rate was only 92 per 100 000.

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There are 2 studies that have compared the prevalence rates of stroke in South Asians with that of other Asians and Europeans using a direct approach. The study by Venketasubramaniam et al compared the prevalence of stroke among migrant South Asians when compared with Chinese and Malays and found that crude as well as age-adjusted prevalence rates were similar among all ethnic groups. The response rate of this study was only 67% and it remains unclear whether this apparent similarity between the ethnic groups depicts epidemiological reality. A Canadian study by Anand et al demonstrated...
cross-sectional studies based on the national census data in the South Asian population. According to the 3 Asian population (Supplemental Table II).

understanding of rates of ischemic stroke mortality in the South Kingdom and official statistical audits from India contribute to an understanding of rates of ischemic stroke mortality in the South Asian population. In addition, rates reported in the Indian studies also appear to be lower than reported rates in other Asian as well as Western studies. Although the reasons for this disparity may well be multifactorial, part of the explanation rests with higher mortality rates and the consequent underestimation of prevalence rates in the South Asian population.

Stroke Mortality in South Asians

Ischemic strokes accounts for >10% of all deaths globally and are the third most common cause of mortality in developed countries. There are ethnic variations reported in stroke mortality, mainly comparing whites and African-Caribbeans living in developed countries. A small number of cross sectional studies from the United Kingdom and official statistical audits from India contribute to an understanding of rates of ischemic stroke mortality in the South Asian population (Supplemental Table II). Official census data from the United Kingdom in 1981, 1991, and 2001 have persistently shown inequalities in ischemic stroke mortality among the South Asian population. According to the 3 cross-sectional studies, based on the national census data in the United Kingdom, the average standard mortality ratios (SMR) in South Asians were 55% and 41% higher in males and females, respectively, when compared with the white population (Figure 1). The average SMR for the South Asians between the ages of 20 and 69 years was 155 for males and 141 for females. Although rates of mortality from stroke have been declining in the UK population as a whole between 1970 to 1992, among South Asians, the rate of decline was 10 times less than the white population.

Gill et al reported intraethnic variation in ischemic stroke mortality in South Asians whereby Bangladeshi-born men living in the United Kingdom had the highest mortality rate (SMR, 201) compared with other South Asian populations (SMR, 155). There were no significant gender differences reported in the stroke mortality rate among the South Asian population except among the Bangladeshi population, in which males had a significantly higher SMR compared with females.

Recently, we reported significantly higher 30-day ischemic stroke mortality in the South Asians compared with white European and African-Caribbean groups in the United Kingdom. In addition, South Asians with diabetes were also demonstrated to have higher long-term stroke mortality. The findings of this analysis are contradicted by the findings of a 1-year ischemic stroke mortality study in which ischemic stroke mortality was significantly lower in South Asians compared with the white population. Thus, South Asian stroke survivors may have a poorer short-term prognosis but better long-term survival when compared with whites. Reasons for this disparity may be related to the severity of the disease and other contributory factors such as age and cardiovascular profile.

There are limited studies that report ischemic stroke mortality rates in the Indian subcontinent. Short-term (30-day) stroke mortality in a rural hospital-based study was 32% in 1968, which declined to 12% in 1982. The Global Burden of Disease study reported that 61 900 deaths (6.5% of all deaths) were accounted for by strokes in the year 1990. These studies also highlight the increased burden of disease in South Asian populations when compared with that seen in Western populations.

There is no significant evidence to support the assertion that stroke mortality rates in the migrant South Asian population differ when compared with nonmigrant populations in their country of origin, mainly due to lack of comparison studies between these 2 groups. However, higher rates of stroke mortality in migrant South Asians in the United Kingdom are consistent with reported higher risk of coronary heart disease in these subjects.

Predictors of Stroke Severity in South Asians

Ethnicity has been reported as an independent predictor of stroke severity. Evidence from US-based studies reveals a direct relationship between stroke severity and other contributory factors such as in-hospital mortality, duration of stay, poor Glasgow Coma Scale score, and incontinence during acute presentation. Although the Leicestershire Stroke Study reported a significant association between development of incontinence during the acute stage and 28-day stroke morbidity in South Asians, there is limited information on the impact of South Asian ethnicity on stroke severity.
Type of Stroke
Population-based studies that have examined the incidence of stroke subtypes in ethnic groups have shown significant differences in the type of stroke in the white population compared with that of the black population.43-48 Most South Asian stroke studies do not enumerate the stroke classification or type of infarction, perhaps due to limited imaging facilities in South Asian countries. This may also be explained by the limited number of population-based studies because available information is not sufficient to allow an accurate diagnosis to be made. Of the few available studies (Table 2), one Pakistan-based stroke study showed prevalence rates of 66% for ischemic strokes, 21% for intracerebral hemorrhage, and 8.3% for subarachnoid hemorrhage.29 One study (carried out in India) also showed a significant increase in the prevalence of hemorrhagic strokes of 32%.46 Two other studies from South Asian countries also showed similar distribution of stroke subtypes.31,47

In the absence of direct comparative studies, prevalence rates from the 3 previously mentioned studies imply a higher risk of hemorrhagic stroke in the South Asian population compared with that of the white population (21%-64 versus 6.4%-9%). The only 2 South Asian studies that classified their stroke population according to the TOAST taxonomy found a higher prevalence of lacunar strokes (42.7% and 68%) compared with large vessel infarctions (26% and 10%).50,51 Although a higher occurrence of lacunar infarctions in the South Asian population has not been previously highlighted, the increased prevalence of diabetes and hypertension in the South Asian population probably accounts for this excess risk of developing small vessel disease.52 Further studies are therefore necessary to directly examine small vessel structure and function and its relationship to other novel risk factors (eg, metabolic and inflammatory mediators) to determine disease pathogenesis among South Asian stroke survivors and the wider South Asian population.

Cardiovascular Risk Profile
Hypertension, diabetes mellitus, dyslipidemia, and atrial fibrillation are the most common known risk factors in stroke etiology. The prevalence of these risk factors is known to differ among various ethnic groups36 and is also associated with manifestations of different stroke subtypes.48,57 Also, South Asian migrants have been reported to have a higher prevalence of central obesity, hyperinsulinemia, hypertension, hypertriglyceridemia, and low high-density lipoprotein cholesterol, but less hypercholesterolemia and general obesity relative to the general UK population.55 These cross-sectional studies highlight the ethnic variations observed in stroke prevalence and their inferred association with cardiovascular risk factor profiles5 but should not be taken to explain disease causality.

Hypertension
Migrant South Asian populations in the United Kingdom are known to have a higher risk for hypertension.59-61 The prevalence of hypertension in the South Asian population has been reported to be in the region of 30% and is also reported to be significantly higher compared with the white population.60 Elevated blood pressure is the most significant known risk factor for stroke in terms of strength of association and consistency of findings (risk of stroke in the presence of hypertension is increased 3-fold).62 Higher prevalence rates of hypertension have also been reported in 2 other comparative South Asian stroke studies in the United Arab Emirates and Singapore where rates were more than 70%.3,4,24

Although large studies in stroke are lacking, the disproportionately higher coronary heart disease mortality rates in South Asians in Britain have been related to hypertension.63 However, mean blood pressure levels, the use of antihypertensive therapy, and secular trends in blood pressure among South Asians appear to be comparable with white European counterparts.64 Longitudinal studies also show that hypertension is a strong risk factor for coronary heart disease in Indians living elsewhere.65 The possibility remains that migration from the Indian subcontinent to the United Kingdom, and UK residence therein, confers an adverse physiological response to the effects of high blood pressure in this group, which may explain a greater prevalence of hypertension-related morbidity in South Asians.

Recently, we reported that healthy South Asians had greater arterial stiffness compared with age, gender, and CVD risk factor matched whites.66 It appears that there is an adverse and disproportionate impact of the mean arterial pressure on the vascular system in South Asians. The reasons for this adverse impact on the vascular system appear to be multifactorial and include genetic susceptibility and the simultaneous presence of other metabolic, inflammatory, and oxidative stress-related abnormalities, which cause a synchronized impact on the vascular system. Such cumulative stressors can reduce the effectiveness of protective mechanisms, thereby allowing pathological processes such as atherosclerosis to become operative, which in turn increases the risk of stroke and coronary heart disease.

Diabetes Mellitus
The presence of diabetes is much higher among persons with stroke and is the second most common risk factor in stroke. Glycemia is associated with poorer clinical outcomes in patients with acute ischemic stroke.67 Diabetes is a continuing global epidemic, particularly concentrated within the Indian subcontinent68,69 such that dispersed migrant populations consistently show a major propensity to develop the disease.30-32 Their diabetes prevalence that is much higher (approximately 10% to 15%) compared with the general British population (approximately 4%60) and appears to equal rates in some parts of India.73 Among resident Indians, rates of diabetes appear to be associated with urbanization,74 reportedly lower in rural parts of India.75 However, a direct comparison of Indian migrants to rural contemporaries in villages of origin in India showed no differences in the rates of glucose intolerance.56 Moreover, despite varied lifestyle approaches, cross-sectional studies from Fiji70 and Tanzania71 also question whether urbanization has a role to explain the high prevalence of diabetes among Indian populations. Hence, not only is diabetes more common among South Asians compared with other ethnic groups,72 but it is likely that this is a hereditable risk factor in this population.

Diabetes among South Asian patients with stroke explains poorer survival in this group68 and a greater incidence of CVD outcomes among South Asian patients with hypertension.69 Although the presence of diabetes calls for more stringent management of blood pressure, the underlying pathophysiology that accelerates the risk of stroke is not clear. Moreover, the magnitude of cerebrovascular risk from diabetes may differ between migrant and nonmigrant populations of South Asians, especially those living in the United Kingdom.

Atrial Fibrillation
The prevalence of atrial fibrillation in patients with stroke ranges from 10% to 29% in population-based studies.12 For example, OXVASC, 16%; France Dijon, 29%; Manhattan, 19%; West Birmingham, 10%; South London, 21%. In a registry analysis, the West Birmingham stroke project reported a lower prevalence of atrial fibrillation in the South Asian population compared with that of whites (11.8% versus 34.6%).39 Compared with other risk factors, the prevalence of atrial fibrillation in South Asians has remained fairly similar over the last decade and has been shown to have minimal impact on the stroke outcomes.5 However, the reasons for this observed disparity have not been fully explained and warrant further investigation.

Dyslipidemia
Hyperlipidemia is a common risk factor that is present in >25% of patients with stroke. South Asians are known to have an atherogenic lipid profile, which includes raised triglycerides, low high-density lipoprotein cholesterol100 and raised lipoprotein(a) levels. In 2 South Asian stroke studies, >50% of the patients with stroke had elevated cholesterol levels.51,52 In whites, the prevalence of hyperlipidemia ranges from 28.7% (Dijon, France) to 29.5% (Oxford) and 32% (Manhattan).13 A similar trend has been reported in South Asians in the United Arab Emirates, where hyperlipidemia has become the second most modifiable risk factor after hypertension. However,
recent evidence suggests that low high-density lipoprotein levels in South Asians may be more important than higher cholesterol levels in the etiology of CVD.68 Coronary heart disease and heart failure are also important risk factors in stroke. It is well known that South Asians in the United Kingdom are more prone to premature, more extensive coronary heart disease, which also carries a poorer prognosis.10

Moreover, recent evidence suggests the role of novel risk actors in determining stroke etiology. For example, elevated lipoprotein(a) and higher C-reactive protein and homocysteine concentrations, which are particularly raised among migrant South Asians, are believed to further enhance the risk of developing CVD.81,82 We recently compared the secular trends in CVD risk profiles in a large South Asian stroke population in the United Kingdom compared with African-Caribbean and white Europeans83 and showed a significant trend toward increase in hypertension in all ethnic groups and, in particular, the prevalence of hyperlipidemia has increased, especially among South Asians (Figure 3). In addition, South Asian stroke survivors were found to have significantly higher apolipoprotein B to A1 ratios and higher lipoprotein (a) compared with ethnically matched healthy control subjects.83 This study highlights the importance of dyslipidemic management in the treatment and prevention of stroke in a multiethnic population, even where the underlying basis for disease etiology appears to be different.

**Stroke Management**

Variations in standards of stroke management are held to vary depending on the ethnicity of the sufferer.84 Like with other ethnicity-related epidemiological data concerning stroke, most of the evidence comes from literature comparing black, Hispanic, and white populations in the United States.85 In the majority of reported studies, ethnic minority groups appeared to enjoy a lower standard of care when compared with the indigenous white population.86 Nevertheless, there are inconsistencies in all stages of the data at different levels of stroke management (from acute presentation, imaging, pharmacological treatment, and rehabilitation to patient discharge). Indeed, Bhopal suggests that, in the United Kingdom, the standards of care for stroke survivors during all phases of the illness are lamentably poor, whatever one’s ethnicity.87

There are only a small number of studies that examine issues of stroke management in the migrant South Asian population in the United Kingdom.91,92 There have been no studies available for analysis from any South Asian countries. It is held that there are delays in access to health care that affect the South Asian population and result in South Asians being less likely to receive appropriate treatment.93 This is despite the fact that, as Hsu et al94 demonstrated, South Asians were more likely seek early hospital treatment after an acute stroke compared with whites.

One of the contributory factors compounding poor standards of stroke care, particularly among South Asians, is the existence of barriers to communication, which can delay treatment as a result of an inability to express symptoms or communicate effectively, which results in a consequent inability to establish a medical history of the event. Feder et al85 also described the influence of the socioeconomic status of South Asians and its influence on the provision of culturally appropriate and sensitive health care. In common with the ethnic minority groups in the United States, South Asian patients with stroke in the United Kingdom are also more likely to have radiological investigations than the whites.91 Possible explanations include atypical presentation on admission and the unreliability of clinical symptoms entailing the deferment of a correct clinical diagnosis until further investigations are carried out. In addition, Bangladeshi stroke subjects were inadequately treated for lipid abnormalities when compared with the whites.92 There was, however, no disparity observed in the pattern of referrals for rehabilitation or carotid endarterectomies.93

The evidence from the United States85 as well as in the United Kingdom91 suggests that the management of CVD among ethnic minority groups, including South Asians, was hampered by lack of adequate service provision. This situation is made worse because of nonindividualized treatment strategies and a relatively small number of trials involving South Asians, particularly in cardiovascular research.85 Current treatment strategies may promote poorer health outcomes among marginalized groups because they are a distillation of the assumptions of the majority population. This relative lack of proactiveness may have a profound impact on both the general population and South Asian migrants who, because of higher CVD risk, do not enjoy the advantage of a more leisurely approach to CVD management.

**Conclusion**

The incidence of stroke appears to be excessively higher in South Asians, when compared with whites, and this differ-
ence in risk continues to increase. The comparable rates of stroke prevalence between South Asians and whites indicate poorer survival in the former. Studies from India as well as the United Kingdom indicate a significant heterogeneity of stroke epidemiology even within the South Asian population. In India, for example, there is a perceptible rural–urban gradient in stroke prevalence, which can be partly explained by adverse socioeconomic circumstances, dietary habits, and lifestyle habits that have been transformed, particularly during last 2 decades. There are no reported migration-related studies to examine the impact of migration on stroke incidence in South Asians, particularly those living in western Europe.

The prevalence of hemorrhagic stroke among South Asians is higher compared with whites. This may be intimately associated with higher prevalence of hypertension. However, the increased prevalence of lacunar strokes appears to suggest a greater prevalence of small vessel disease in South Asians, which may be a consequence of abnormal metabolic and glycemic processes. The majority of outcome studies indicate higher stroke mortality in South Asians and glycemic status appears to be an independent predictor of long-term stroke mortality. More studies are, however, needed to explain the poorer short-term survival rate among South Asian patients with stroke.

There is now sufficient evidence to support the phenomenon of aberrant cardiovascular profiles in South Asian stroke survivors. Diabetes, hypertension, and hyperlipidemia are risk factors in >25% of the patients. More importantly, the prevalence of hypertension and hyperlipidemia has significantly increased during the last decade. The clustering effect of these risk factors on vessel wall characteristics in South Asians appears to contribute to their higher burden of disease and differing manifestations of stroke in this population. More studies are urgently needed, however, to explain these pathophysiological abnormalities and related stroke outcomes. There are limited data with which to examine the differences of stroke management South Asian stroke survivors. Available data appear to support the existence of inequalities in the standard of care available to the South Asian population in the United Kingdom. However, the existence of barriers to communication and other issues rather than ethnicity per se may serve to obfuscate the cause of lower standards of care among South Asians.

The current lack of data regarding the exact relationship of stroke prevalence to environmental, genetic, and socioeconomic factors means that considerable numbers of marginalized groups will continue to bear an unacceptably high burden of mortality and morbidity from specific diseases such as CVD. This remains as a poor reflection on healthcare systems because most, if not all, of the risk factors are reducible as is the economic burden of CVD. One can but reiterate the necessity of culturally sensitive management toward complex and disabling disease conditions such as stroke to minimize inequity of care, reinforcing the need for a greater number of hypothesis-driven studies that address specific elements of CVD in a coordinated manner, which allows full exchange of information while minimizing duplication of both studies and findings.

Disclosures

None.

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