Poverty and Stroke in India
A Time to Act

Jeyaraj D. Pandian, DM; Velandai Srikanth, FRACP; Stephen J. Read, FRACP; Amanda G. Thrift, PhD

Abstract—In developed countries, the predominant health problems are those lifestyle-related illnesses associated with increased wealth. In contrast, diseases occurring in developing countries can largely be attributed to poverty, poor healthcare infrastructure, and limited access to care. However, many developing countries such as India have undergone economic and demographic growth in recent years resulting in a transition from diseases caused by poverty toward chronic, noncommunicable, lifestyle-related diseases. Despite this recent rapid economic growth, a large proportion of the Indian population lives in poverty. Although risk factors for stroke in urban Indian populations are similar to developed nations, it is likely that they may be quite different among those afflicted by poverty. Furthermore, treatment options for stroke are fewer in developing countries like India. Well-organized stroke services and emergency transport services are lacking, many treatments are unaffordable, and sociocultural factors may influence access to medical care for many stroke victims. Most stroke centers are currently in the private sector and establishing such centers in the public sector will require enormous capital investment. Given the limited resources available for hospital treatments, it would be logical to place a greater emphasis on effective populationwide interventions to control or reduce exposure to leading stroke risk factors. There also needs to be a concerted effort to ensure access to stroke care programs that are tailored to suit Indian communities and are accessible to the large majority of the population, namely the poor. (Stroke. 2007;38:3063-3069.)

Key Words: burden ■ developing country ■ India ■ poverty ■ stroke

“Poverty is the worst form of violence.”
—Mahatma Gandhi

In the past, the diseases that have occurred among people in developed and developing countries have largely been attributed to the socioeconomic status of each country. In developed countries, the predominant health problems have been those associated with increased wealth leading to lifestyle habits that contribute to certain diseases, particularly cardiovascular disease. In contrast, diseases occurring among people in developing countries have been attributed to poverty and relate to poor nutrition, a higher incidence of infectious diseases, poor healthcare infrastructure, and limited access to care, all of which lead to reduced lifespans. However, in recent years, there has been increasing economic and demographic development in developing countries resulting in a shift from diseases caused by poverty toward chronic, noncommunicable, lifestyle-related diseases. As a consequence, these developing countries are now experiencing high rates of both infectious and chronic diseases.

India is a developing country with much diversity in culture, language, and food habits. Significant economic development has occurred with, for example, a boom in the information technology industry. This coexists with starvation, malnutrition, and high maternal and child mortality rates. In this review, we address the issue of poverty, its coexistence with rapidly increasing affluence, and the relationship between these factors and stroke in India. We conclude with some typical scenarios of stroke care that highlight the stark contrast between poverty and affluence that is so evident in India.

Poverty and Economic Development in India
Poverty, in different forms, has been plaguing the human race since ancient times. The evil face of poverty varies between developed and developing countries and between rural and urban areas. It may be evident as homelessness or starvation. In India, poverty estimates are currently derived from the household consumer expenditure data collected by the National Sample Survey Organization every fifth year. These estimates use consumer expenditure data, ie, the purchasing power of the population to afford 2400 kilocalories of food in...
rural areas and 2100 kilocalories of food in urban areas. From data obtained in 1999 to 2000, the poverty line has been calculated to be Rupees (Rs) 327 per month (US $7.25) per household in rural India and Rs 454 per month (US $10.07) per household for urban India.1 The World Bank defines poverty as earning less than US $1 per day.4 Based on these figures, approximately 37% of rural and 31% of the urban Indian population live below the poverty line.4 A limitation of this definition of poverty is that it is based only on the need for food. Other basic human needs such as shelter, clothing, and education are not considered in this definition. Of the 4.4 billion people in developing countries, nearly three fifths lack access to sanitation, one third do not have clean water, approximately one fifth lack access to health care of any kind, and one fifth do not have enough dietary energy and protein.5 Therefore, if we consider that poverty occurs when people live everyday without 3 basic meals, shelter, safe drinking water, clothing, and education, the true extent of poverty in India may well be greater than these estimates.

In recent years, there has been an enormous growth in Indian economy at an average of 8% per annum.6–9 The country is rapidly creating world class businesses in knowledge-based industries such as software, information technology services, and pharmaceuticals.6 These companies, which emerged with little government assistance, have helped the growth of the Indian economy. India ranks as one of the 3 largest emerging markets in terms of economic size and stockmarket capitalization.7 There are now approximately 100 companies in India with a market value of more than $1 billion, and more than 1000 companies have significant foreign investment. Economic analysts predict that if the present economic growth is sustained, then India would become the third largest major economic power by 2025.9 This economic growth might pave the way for a diminution of poverty in India.

Poverty and Stroke Burden

In 2005, chronic disease accounted for 35 million (60%) of the 58 million deaths that occurred worldwide.10 Heart disease was responsible for 11.7 of these deaths and stroke, the second most common cause of death, caused 5.8 million. Forty percent of stroke deaths occurred in people <70 years of age.11 Globally, approximately 15 million new acute stroke events occur every year, and approximately 55 million people have had a stroke at some time in the past. Two thirds of these individuals live in low- and middle-income countries such as India.7 By 2050, it is anticipated that 80% of stroke events will occur in people living in these regions.11,12

The emergence of vascular diseases in developing countries has been attributed to changes in the demographic structure of the population as well as to epidemiological transitions.1 Historically, transitions that occur with economic development have evolved over hundreds to thousands of years and have involved change from high mortality and minimal population growth to increased lifespans and receding pandemics.3 The final progression is then onto degenerative and man-made diseases such as cardiovascular disease resulting from major social and economic changes.1 The important issue with these transitions in developing countries such as India is that the decline in infectious diseases is far outweighed by the rapid increase in chronic diseases.3 Therefore, these countries are experiencing high rates of both infectious and chronic diseases. In the 20th century, the pace of this change has increased markedly with urbanization, free trade and economic globalization, foreign investment, and promotional marketing.13 However, little is understood about the direct impact of poverty on the rates of cardiovascular disease in India.

Results of mainly cross-sectional surveys provide evidence for a greater risk of coronary heart disease in Indian people from higher social classes than in those from lower social classes.14 Although a number of such surveys have been performed on coronary heart disease,15–22 there are scant data on the burden of stroke from population-based studies in India.23–31 In a study of causes of mortality in rural Andhra Pradesh, South India, chronic diseases were the leading cause of death.12 Diseases of the circulatory system (32%), with comparable proportions of ischemic heart disease (14%) and cerebrovascular disease (13%), were responsible for the majority of deaths.32 In a recent incidence study of stroke in urban Kolkata, North India, the standardized incidence rate (145.3 per 100 000 persons/year) and 30-day case fatality rate (41%) were greater than estimates from developed nations.27 These figures may reflect a poor understanding and control of risk factors such as hypertension in this community.

In the Kolkata study, the prevalence and incidence of stroke were both greater among slum-dwellers than nonslum-dwellers, although this was not statistically different.27 This may suggest that poverty has some influence on the occurrence of stroke, but clearly more data are required from larger samples of rural and urban populations in India. Better measurement of the socioeconomic burden of stroke may help to tease out this issue in more detail. Interestingly, the Kolkata study sample consisted of mainly younger people (>80% were aged <60 years) who are active in the workforce. When stroke occurs in the main income earner in the household, there may be enormous consequences for the welfare of the family.27

There are other areas where information is lacking. For example, there is limited information on poststroke disability in the Indian subcontinent.31,33 Furthermore, the economic burden caused by stroke in India has not been explored. The only data on the economic burden of stroke in the developing world comes from China, where the costs for in-hospital care per patient were estimated to be Yuan 5857 (US $732) for patients without health insurance and Yuan 10 407 (US $10 407) for patients with health insurance.34 Thus, it seems that the limited health resources were overused unnecessarily by insured patients.34

Poverty and Stroke Risk Factors in India

The risk factors underlying cardiovascular disease among more affluent urban Indian populations follow similar patterns to those observed in developed nations.2 In the INTER-HEART study, abnormal lipids, smoking, hypertension, diabetes, abdominal obesity, psychosocial factors, lesser consumption of fruits and vegetables, alcohol, and physical inactivity accounted for most of the risk of myocardial
infarction. In fact, hypertension is projected to be one of the major risk factors underlying the global burden of disease in 2020. The World Health Organization STEPs program implemented in India through the Indian Collaborative Acute Stroke Study (ICASS) showed a high prevalence of vascular risk factors in many metropolitan cities.

A recent vascular risk factor survey in a less affluent rural community in Andhra Pradesh, South India (mean annual income per household approximately US $1.60/d) showed a high prevalence of risk factors such as smoking (20%), hypertension (20%), diabetes (3.7%), and overweight (17%) as compared with previously reported studies from rural India. However, the risk factor levels identified in these villages are still below those typically observed in urban parts of India.

To our knowledge, there are no published data on the prevalence of vascular risk factors in those afflicted by poverty (mean annual income <US $1/day). It is possible that the pattern of vascular risk in this section of the population is different from the pattern in the more urbanized section of Indian society. Infectious diseases, like HIV, tuberculosis, and cerebral malaria, may lead to cerebrovascular diseases among the rural community and these possibilities should be explored. There is evidence that fetal and early postnatal undernutrition may be associated with health outcomes such as coronary heart disease, stroke, type 2 diabetes, and the metabolic syndrome, all of which have been shown to be increased in low-birth-weight babies. In addition, low socioeconomic status has been found to be related to increased carotid intima media thickness as well as several stroke risk factors, including physical inactivity, smoking, diabetes, heavy alcohol consumption, high blood pressure, and diet.

There are few studies of risk factors for stroke in Indian populations. In a hospital-based study among young stroke patients (15 to 45 years) in Thiruvananthapuram, South India, high prevalences of smoking, systolic hypertension, high fasting blood glucose level, and lower high-density lipoprotein cholesterol were seen. Importantly, the presence of the metabolic syndrome was strongly associated with stroke when compared with both community (OR: 4.76, 95% CI: 1.93 to 11.76) and hospital controls (2.09, 95% CI: 1.06 to 4.13). In another hospital-based case–control study from Nagpur, Central India, hypertension, serum total cholesterol, use of anticoagulants and antiplatelet agents, history of transient ischemic attack (presumably reflecting the presence of hypertension or antiplatelet/anticoagulant use), and alcohol intake were significant risk factors for hemorrhagic stroke.

There is clearly a need to study risk factors for stroke in more detail in different socioeconomic strata while paying attention to mechanisms such as carotid disease, intracranial artery stenosis, and cardioembolism.

Poverty and Delivery of Stroke Care Services
Poverty may affect stroke care services in various ways. In this section, we identify the issues in delivering stroke care by looking at 2 real life scenarios that one of the authors (J.D.P.) has encountered in India.

Scenario 1
A 50-year-old wealthy businessman living in a city developed acute weakness of the right face, arm, and leg. Fortunately, he reached the emergency department of a private tertiary referral center using his personal car within 30 minutes of stroke onset. The acute stroke team performed the relevant screening investigations, including a noncontrast CT scan, within 45 minutes of hospital arrival. He was eligible to receive intravenous recombinant tissue plasminogen activator (rtPA). The neurologist discussed the cost of rtPA with the patient and his relatives. Consent was given by the patient for rtPA as well as an undertaking for the timely payment of the cost of the drug. The patient received rtPA and showed some early improvement after 24 hours. He underwent investigations for stroke risk factors, including carotid ultrasound, MRI, and MR angiography. A physiotherapist assessed him and planned the future course of his rehabilitation. He was started on an antiplatelet drug, antihypertensive, and a statin. Within 1 week, he was discharged home and attended outpatient physiotherapy. At 1 month, he had improved to become independent in self-care. The total cost of his treatment was approximately Rs 100 000 (US $2083), the cost of rtPA being a large component of this (Rs 75 000 [US $1562]).

Scenario 2
A 45-year-old shopkeeper living in a village experienced sudden-onset right hemiataxia and dysarthria. He hired a local private car and reached the district government hospital 6 hours after stroke onset. Because the hospital CT scanner was not functioning, the physician on duty referred him for a CT scan in a private center. The patient’s relatives hired another private car to transport him to and from the scan. After 2 hours, he returned to the district hospital and received conventional treatment with aspirin. Within 1 week, he was discharged home without any physiotherapy. At 1 month follow-up, he had severe disability and his wife became his caregiver. His oldest son, who was in the tenth grade, discontinued his studies and took over the shop to support the family.

These are typical scenarios that occur in low-income and middle-income countries, particularly India. Based on these, we can identify a few important issues in delivering stroke care in India.

Infrastructure
Developing countries spend only 2% to 15% of gross domestic product on health. The out-of-pocket expenditure varies from 20% to 80% of the total health expenditure. In most developing countries, total health spending is low (less than US $45 per person per year in 25 countries with incomes below US $1000 gross domestic product per capita). The budget allocation to health care is often meager, most of which goes to establishment and running costs. With infectious diseases still endemic, noncommunicable diseases are a lower priority for governments of these countries. Well-organized stroke services are virtually absent in the government sector in India. Most stroke centers are in the private sector and almost always situated in urban areas.
capital investment required from the government for establishing centers in the public sector is enormous and thus nonviable.52

Specific Stroke Treatments

Figure 1 shows the stroke centers in developing countries that have the resources to give rtPA. Stroke thrombolysis is being given in a few developing countries such as China, India, Argentina, Brazil, and Thailand.47–57 Centers with resources to give rtPA in India are situated predominantly in major metropolitan cities. In a study from a private sector tertiary referral hospital in Northwest India, 489 patients with stroke were screened for rtPA between September 2001 and November 2003.57 Seventy-two (14.7%) presented within a 3-hour window and 38 (7.7%) had an ischemic stroke. Sixteen patients (3.3%) did not meet the inclusion criteria for thrombolysis and only 5 patients (1%) received rtPA because the remainder could not afford the drug.57 In a similar attempt to initiate intravenous rtPA therapy in a rural catchment area in India, only 20 of 64 (31%) patients reached the hospital within 3 hours. Of these, only 7 patients were found eligible for thrombolysis, but none could afford rtPA.58 Therefore, the cost of the drug, as well as the lack of stroke unit infrastructure, present important barriers in the effective utilization of rtPA in the Indian population.52,57–59 The relative costs of rtPA in developing nations are presented in the Table.

The approximate cost of the secondary prevention of stroke in India is Rs 500 (US $10) per month (using 2 antihypertensive agents, one antiplatelet agent, and a statin).57 People from middle-income and upper-income categories may be

### Table. Cost of rtPA in Developing Countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Local Currency</th>
<th>Cost of Actilyse*</th>
<th>Cost in US $</th>
<th>Percent Per Capita Gross National Product US $</th>
</tr>
</thead>
<tbody>
<tr>
<td>India</td>
<td>Rupee</td>
<td>55 500.00</td>
<td>1217.1</td>
<td>0.5</td>
</tr>
<tr>
<td>China</td>
<td>Yuan Renminbi</td>
<td>9586.00</td>
<td>1269.3</td>
<td>1</td>
</tr>
<tr>
<td>Argentina</td>
<td>Argentina Peso</td>
<td>4810.00</td>
<td>1586.4</td>
<td>8</td>
</tr>
<tr>
<td>Mexico</td>
<td>Mexico Peso</td>
<td>24 059.60</td>
<td>2306.4</td>
<td>6</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>Koruna</td>
<td>32 919.83</td>
<td>1458.2</td>
<td>...</td>
</tr>
<tr>
<td>Turkey</td>
<td>Lira</td>
<td>1919.00</td>
<td>1480.7</td>
<td>...</td>
</tr>
</tbody>
</table>

*Cost in local currency.
Source: Boehringer Ingelheim.
Cost of Actilyse is calculated for a body weight of 70 kg. In countries where only 50-mg Actilyse vials are available, the cost for 2 vials is considered.
The price of Actilyse is reflective of the price to the patient including local taxes. Price in India includes custom duty and distribution/trade margin, which is very high.
provide a cure for paralysis. In Northwest India, 7% of patients believed that oil massage would improve stroke and another 3% believed in witchcraft, faith healing, homoeopathic, or ayurvedic treatment (Indian traditional medicine). These are, as yet, untested therapies.

Future Challenges

Stroke must be a priority on the health agenda in India and other developing countries. The experience of high-income nations clearly shows what can be achieved with sustained interventions. If there were a 2% reduction per annum in stroke mortality due to better management, this would result in 6.4 million fewer deaths from stroke between 2005 and 2015 with most deaths averted and years of life gained in low- and middle-income countries. Given the limited resources available for hospital treatments in developing countries, it would be logical to place an emphasis on effective population-wide interventions to control or reduce exposure to major risk factors such as raised blood pressure, smoking, high cholesterol, low fruit and vegetable intake, physical inactivity, and alcohol excess. Population-wide efforts to reduce salt intake and tobacco use through multiple economic and educational policies and programs have been suggested as cost-effective primary prevention interventions in developing countries. More research also needs to be undertaken to assess the efficacy of indigenous medicines commonly used by people in India. At the same time, there needs to be a concerted effort to ensure access to stroke care programs that are tailored to suit Indian communities and are accessible to the poor (the largest part of the population). Such preventive and stroke care strategies require a substantial commitment of resources from government, nongovernment organizations, and the developed world in order to be implemented and effective.

Disclosures

None.

References


Poverty and Stroke in India: A Time to Act
Jeyaraj D. Pandian, Velandai Srikanth, Stephen J. Read and Amanda G. Thrift

*Stroke.* 2007;38:3063-3069; originally published online October 22, 2007; doi: 10.1161/STROKEAHA.107.496869

*Stroke* is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2007 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/38/11/3063

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/