1   Tuomilehto J, Lindstrom J, Eriksson JG, et al, for the Finnish Diabetes Prevention Study Group. Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. *N Engl J Med* 2001; **344:** 1343–50.

2   Diabetes Prevention Program Research Group. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *N Engl J Med* 2002; **346:** 393–403.

3   Chaisson JL, Josse RG, Gomis R, Hanefeld M, Karasik A, Laakso M, for the STOP-NIDDM Research Group. Acarbose for prevention of type 2 diabetes mellitus: the STOP-NIDDM randomised trial. *Lancet* 2002; **359:** 2072–77.

4   Buchanan TA, Xiang AH, Peters RK, et al. Preservation of pancreatic β-cell function and prevention of type 2 diabetes by pharmacological treatment of insulin resistance in high-risk Hispanic women. *Diabetes* 2002; **51:** 2796–803.

5   DREAM Trial Investigators. Effect of rosiglitazone on the frequency of diabetes in patients with impaired glucose tolerance or impaired fasting glucose: randomised controlled trial. *Lancet* 2006; **368:** 1096–105.

6   Torgerson JS, Hauptman J, Boldrin MN, Sjostrom L. Xenical in the prevention of diabetes in obese subjects (XENDOS) study. *Diabetes Care* 2004; **27:** 155–61.

7   Buchanan TA. (How) Can we prevent type 2 diabetes? *Diabetes* 2007; **56:** 1502–07.

8   The Nateglinide and Valsartan in Impaired Glucose Tolerance Outcomes Research (NAVIGATOR) Study Group. Effect of nateglinide on the incidence of diabetes and cardiovascular events. *N Engl J Med* 2010; **362:** 1477–90.

9   Zinman B, Harris SB, Neuman J, et al. Low-dose combination therapy with rosiglitazone and metformin to prevent type 2 diabetes mellitus (CANOE trial): a double-blind randomised controlled study. *Lancet* 2010; published online June 3. DOI:10.1016/S0140-6736(10)60490-4.

10   Hazzard WR, Crockford PM, Buchanan KD, Vance JE, Chen R, Williams RH. A double antibody immunoassay for glucagon. *Diabetes* 1968; **17:** 179–86.

11   Xiang A, Peters RK, Kjo SL, et al. Effect of pioglitazone on pancreatic β-cell function and diabetes risk in Hispanic women with prior gestational diabetes. *Diabetes* 2006; **55:** 517–22.

Reducing the global burden of stroke: INTERSTROKE

Stroke is the second leading cause of death globally, with more than 85% of deaths from stroke occurring in developing countries.[1,2] However, there has been little research to identify the causes of stroke in low-income and middle-income countries. An understanding of the risk factors for stroke in these countries is crucial to determine priorities and strategies for reversing the rapidly rising rates of stroke mortality in developing countries. In *The Lancet* today, the INTERSTROKE investigators[3] report the initial findings from their phase 1 case-control study of risk factors for stroke in 22 countries worldwide. The findings suggest that ten key risk factors explain 90% of the population-attributable risk for stroke, and that the risk factors for stroke are similar to those previously identified for myocardial infarction in the related INTERHEART study (table).[4]

The INTERSTROKE investigators classified participants into five regions: high-income countries, South America, southeast Asia (including China), India, and Africa. They found that a self-reported history of hypertension or acute blood pressure of higher than 160/90 mm Hg was the most important risk factor for both ischaemic and intracerebral haemorrhagic stroke. Whilst hypertension is well established as the most important cause of stroke in high-income countries, INTERSTROKE confirms that it is also the most important risk factor for stroke in developing countries.[5] This finding is particularly relevant because it highlights the need for health authorities in these regions to develop strategies to screen the general population for high blood pressure and, if necessary, offer affordable treatment to reduce the burden of stroke. It also provides an impetus to develop population-wide strategies to reduce the salt content in the diet of individuals in these countries.[6]

Smoking and abdominal obesity, as measured by waist-to-hip ratio, were also identified as important risk factors for stroke. Current smokers had a significantly

	INTERSTROKE (all stroke; 3000 cases, 3000 controls)[3]*	INTERHEART (acute myocardial infarction; 15 152 cases, 14 820 controls)[4]†
Hypertension	34·6% (30·4–39·1)	17·9% (15·7–20·4)
Smoking	18·9% (15·3–23·1)	35·7% (32·5–39·1)
Waist-to-hip ratio (abdominal obesity)	26·5% (18·8–36·0)	20·1% (15·3–26·0)
Diet		
Diet risk score	18·8% (11·2–29·7)	..
Fruits and vegetables daily	..	13·7% (9·9–18·6)
Regular physical activity	28·5% (14·5–48·5)	12·2% (5·5–25·1)
Diabetes	5·0% (2·6–9·5)	9·9% (8·5–11·5)
Alcohol intake	3·8% (0·9–14·4)	6·7% (2·0–20·2)
Psychosocial factors		
All psychosocial factors	..	32·5% (25·1–40·8)
Psychosocial stress	4·6% (2·1–9·6)	..
Depression	5·2% (2·7–9·8)	..
Cardiac causes	6·7% (4·8–9·1)	..
Ratio of apolipoproteins B to A1	24·9% (15·7–37·1)	49·2% (43·8–54·5)

Data are population-attributable risk (99% CI). *Adjusted for all stroke risk factors apart from ratio of apolipoproteins B to A1. †Adjusted for all myocardial infarction risk factors. ‡See original article for definition of risk factor and methods used to calculate population-attributable risk.

***Table:* Comparison of the population-attributable risk (99% CI) for common risk factors‡ in the INTERSTROKE and INTERHEART studies**

higher risk of stroke in all regions, which reinforces the need to reduce the high smoking rates in countries such as China and India through tough anti-smoking policies if a growing stroke and coronary disease epidemic is to be averted.[7,8] The identification of waist-to-hip ratio (as opposed to body-mass index) as a risk factor for stroke is consistent with previous INTERHEART findings for myocardial infarction, and provides further evidence that this ratio might be a better measure of obesity to identify individuals at high risk for these disorders.[9] A surprising finding was the relatively low prevalence of cardiac causes of stroke (eg, atrial fibrillation, rheumatic heart disease) in China and India compared with high-income countries, but this result may reflect, in part, lower rates of cardiac diagnostic testing.

Identifying the causes of stroke across many diverse regions with a standardised approach is a difficult research undertaking for many reasons. Although a large international prospective cohort study might be the ideal, one would need to enrol a very large sample in view of the relatively low incidence of stroke in the general population, and the challenges of the long follow-up required would be considerable. A more efficient approach is to use a matched case-control design, as in INTERSTROKE, in which patients (or their proxies if they could not communicate) in hospital with acute stroke were interviewed and examined for possible risk factors, and results compared with a control population matched for age and sex from the hospital or the community.[10] Such a design can yield useful information but selection or recall biases might occur in terms of the individuals (or their proxies) who agree to take part as either cases or controls.[11,12] The INTERSTROKE investigators were aware of these limitations and did sensitivity analyses that showed that their findings were generally consistent between respondents (patient or proxies) and between hospital and community controls.

Phase 1 of INTERSTROKE suggests that hypertension, smoking, abdominal obesity, physical inactivity, and diet are the most important modifiable risk factors for stroke. These important findings should help to inform stroke prevention strategies around the world and to reduce the global burden of stroke.

Jack V Tu

Institute for Clinical Evaluative Sciences, Sunnybrook Schulich Heart Centre, University of Toronto, Toronto, ON, Canada M4N 3M5
tu@ices.on.ca

1   Johnston SC, Mendis S, Mathers CD. Global variation in stroke burden and mortality: estimates from monitoring, surveillance, and modelling. *Lancet Neurol* 2009; **8:** 345–54.
2   Strong K, Mathers C, Bonita R. Preventing stroke: saving lives around the world. *Lancet Neurol* 2007; **6:** 182–87.
3   O'Donnell MJ, Xavier D, Liu L, et al, on behalf of the INTERSTROKE investigators. Risk factors for ischaemic and intracerebral haemorrhagic stroke in 22 countries (the INTERSTROKE study): a case-control study. *Lancet* 2010; published online June 18. DOI:10.1016/S0140-6736(10)60834-3.
4   Yusuf S, Hawken S, Ôunpuu S, et al, on behalf of the INTERHEART Study Investigators. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. *Lancet* 2004; **364:** 937–52.
5   Lawes CM, Bennett DA, Feigin VL, Rodgers A. Blood pressure and stroke: an overview of published reviews. *Stroke* 2004; **35:** 776–85.
6   Asaria P, Chisholm D, Mathers C, Ezzati M, Beaglehole R. Chronic disease prevention: health effects and financial costs of strategies to reduce salt intake and control tobacco use. *Lancet* 2007; **370:** 2044–53.
7   Gu D, Kelly TN, Wu X, et al. Mortality attributable to smoking in China. *N Engl J Med* 2009; **360:** 150–59.
8   Jha P, Jacob B, Gajalakshmi V, et al, for the RGI-CGHR Investigators. A nationally representative case-control study of smoking and death in India. *N Engl J Med* 2008; **358:** 1137–47.
9   Yusuf S, Hawken S, Ôunpuu S, et al, on behalf of the INTERHEART Study Investigators. Obesity and the risk of myocardial infarction in 27 000 participants from 52 countries: a case-control study. *Lancet* 2005; **366:** 1640–49.
10 O'Donnell M, Xavier D, Diener C, et al. Rationale and design of INTERSTROKE: a global case-control study of risk factors for stroke. *Neuroepidemiology* 2010; **35:** 36–44.
11 Tu JV, Willison DJ, Silver FL, et al, for the Investigators in the Registry of the Canadian Stroke Network. Impracticality of informed consent in the Registry of the Canadian Stroke Network. *N Engl J Med* 2004; **350:** 1414–21.
12 Schulz UG, Rothwell PM. Differences in vascular risk factors between etiological subtypes of ischemic stroke: importance of population-based studies. *Stroke* 2003; **34:** 2050–59.

Public health research funding: independence is important

The Diet and Health Research Industry Club (DRINC) is a £10 million (US$16·7 million, €11·2 million), 5-year partnership between the UK's Biotechnology and Biological Sciences Research Council (BBSRC) and a consortium of leading companies.[1] DRINC's goal is to generate high-quality research into diet and health while enhancing the international competitiveness of the UK's food industry and its ability to develop healthier foods. Research includes design of foods with enhanced nutritional properties and assessment of the health benefits of bioactive ingredients. The companies involved, which include Cadbury, Coca Cola, Nestlé,