The distribution and burden of 5 conventional risk factors (elevated blood pressure, high total cholesterol, diabetes, obesity/overweight and smoking) for cardiovascular diseases (CVD) were reviewed in 10 selected Asian countries, in addition to the United Kingdom and the United States. Over the past 3 decades, age-standardized systolic blood pressure was on the decline in high-income countries but on the rise in low- to middle-income countries. Similar patterns were observed for total cholesterol levels, although the absolute levels remained higher in high-income countries. A pronounced increase in the prevalence of diabetes mellitus was seen in most of the Asian countries, corresponding to an increase in the levels of body mass index. The number of smokers declined markedly with time, particularly in men, in some selected Asian countries (Japan, Singapore, China, Vietnam). However, the prevalence of current smokers for all countries in 2011 remained excessive. The population-attributable risks for stroke and ischemic heart were highest for high blood pressure, followed by total cholesterol, obesity, and smoking. Evidence suggests that in both Asia and the West, no country is in sufficient control of any of these factors and that intervention programs to alter their effect on CVD are of equal importance. (Circ J 2013; 77: 2851–2859)

Key Words: Blood pressure; Body mass index; Diabetes mellitus; Smoking; Total cholesterol

Cardiovascular diseases (CVDs) have multiple risk factors. Conventional risk factors include elevated blood pressure (BP), high serum cholesterol, diabetes mellitus (DM), and tobacco use. According to the INTERHEART study, the joint contribution of hypertension, adverse lipid profiles, DM, smoking and obesity accounted for nearly 80% of CVD. Modification of these conventional risk factors plays a significant role in both primary and secondary prevention for CVD.

It has been well documented that these risk factors generally act similarly in both Western and Asian countries. However, the distribution of each risk factor may differ not only between Asia and other areas of the world but also within Asia itself. In this review, we describe the prevalence and trends of the conventional CVD risk factors in different regions of Asia. We focused on 4 metabolic risk factors (BP, total cholesterol (TC), DM, and obesity) and 1 behavioral risk factor (smoking) because of their strong associations with CVD. We also examined the effect of each risk factor on CVD death. For comparison with Western countries, we included similar data from the United Kingdom (UK) and the United States (USA).
Risk Factors for CVD in Asian Populations

Blood Pressure

Among the established risk factors, hypertension and elevated BP have the greatest effect on CVD risk in Asia. In the Asia-Pacific region, 66% of deaths from CVD could be attributed to hypertension. 25

Figure 1 presents the 30-year change in mean systolic BP (SBP) from 1980. 12 For both men and women, mean SBP levels decreased over time in high-income countries in Asia, in a pattern similar to that in the UK and USA. Levels of SBP dropped considerably from 1980 to 1990 (2.5–5.0 mmHg per decade for men and 3.0–5.6 mmHg per decade for women), followed by more moderate declines in the next 20 years (0.6–1.8 mmHg per decade for men and 2.6–3.6 mmHg per decade for women). In contrast, low- and middle-income countries experienced a rise in mean SBP, being most evident in Southeast Asia (Vietnam and Myanmar) over the past 20 years (1.6–2.5 mmHg per decade for men and 0.7–2.7 mmHg per decade for women). In all the selected countries, women had lower SBP levels than men. Substantial differences by sex were seen in Vietnam, Japan, and Mongolia, with a difference ranging from 3.6 to 8.5 mmHg. A similar sex-difference was observed in the UK and USA. In 1980, female SBP in China was similar to that in the USA, but began to rise after 1990 to levels that exceeded the USA values by 5 mmHg in 2008.

Cross-Sectional SBP Levels in 2008  In 2008, the highest SBP levels were observed among men and women in Mongolia and Kazakhstan (2 middle-income countries in Central Asia). In contrast, the SBP levels in most of the high-income countries (Japan, Singapore, Kuwait, the UK) tended to fall in the middle to low ranges among all 12 countries. Levels were lower in Bangladesh and India (South Asia) and in Myanmar and Vietnam (Southeast Asia). Although the cross-sectional SBP levels in these latter countries were equal to or slightly higher than the USA, 30-year trends were on the rise with no sign of abating.

The observed decline in SBP in high-income countries such as Japan, the UK, and USA are likely related to greater access to health care and awareness programs that emphasize BP control and reductions in dietary salt intake, and increased pharmacological intervention. 26–29 However, even in such developed countries, treatment rates and BP control rates among treated patients are far from acceptable: approximately up to
witnessed rises in mean TC over the years, although their levels differ in the absolute sense. South Asian countries had smaller declines. For the remaining countries, including East and Southeast Asia, mean TC levels rose for both sexes.

Cross-Sectional TC Levels in 2008

In 2008, TC levels generally corresponded with income levels of a country. For example, high-income countries tended to have the highest TC levels (ranging from 5.2–5.3 mmol/L [200–205 mg/dl]) for both sexes. First and second highest among low- and middle-income countries were Kazakhstan and Mongolia (in Central Asia) with TC levels ranging from 4.9–4.7 mmol/L (189–181 mg/dl). Low-income countries (ie, Myanmar and Bangladesh) had TC levels <4.5 mmol/L (174 mg/dl). TC levels in women were higher than in men, but the differences were modest (0–0.2 mmol/L [0–7.7 mg/dl]).

The rise in TC levels in Asia is attributable in part to changes in dietary patterns. Nutritional transitions toward a higher intake of fat, foods from animal sources and processed foods have been observed. Japan is an example of a high-income country that has experienced increases in TC levels beginning as early as the 1950s.

Statin treatment to lower serum cholesterol has shown a significant benefit in preventing CVD in Caucasian as well as Asian populations. Regardless of notable improvements in recent decades, however, the prevalence of statin use remains low even in the UK and USA where more than 50% of patients at moderate to high risk of CVD are estimated to receive suboptimal statin treatment. Japan has an example of a high-income country that has experienced increases in TC levels beginning as early as the 1950s.

In the REACH study of treatment intensity of individuals with atherothrombosis, patients were generally undertreated with statins in many regions of the world, including Japan, the Middle East and Asia.

65% and 35% in Japan and 73% and 69% in the USA respectively. In other low- and middle-income Asian countries, undiagnosed and untreated hypertension is likely more common, considering the background conditions of limited access to effective treatments and care for chronic diseases.

Evidence from a large community-dwelling sample of 65,000 Japanese men and women suggests that a considerable proportion of CVD deaths could have been avoided had proper measures been taken to maintain healthy BP levels (systolic/diastolic BP <120/80 mmHg) through their lifestyle (Figure 2). This illustrates the importance of primary prevention of hypertension regardless of age.

Serum Cholesterol

Dyslipidemia is a prominent risk factor that promotes the development of atherosclerotic CVD, especially coronary artery disease (CAD). Lipid profiles that include low-density lipoprotein-cholesterol (LDL-C) or the ratio of TC to high-density lipoprotein-cholesterol (HDL-C) are often the preferred measure of CVD risk in basic CVD screening. However, data on LDL-C and HDL-C are scarce in most Asian countries and often only the TC value is available. Regardless, TC remains a good predictor of CVD, and even TC levels lower than guidelines from the Adult Treatment Panel III have been associated with an increased incidence of CAD. Therefore, TC levels were used as an indicator of dyslipidemia among the selected countries for this report.

Between 1980 and 2008, mean TC decreased with varying degrees in most countries (Figure 3). Greater falls in serum TC occurred in high-income countries (except Japan), in Central Asia, the UK and USA for both sexes. Japan and China
Diabetes Mellitus

DM is growing as a worldwide pandemic. DM places an individual at higher risk of morbidity and mortality from a variety of disease outcomes. In the pooling of 97 prospective studies, DM was shown to increase the risk of death by up to 3-fold compared with its absence. In addition to CVD as a cause of death, other causes include kidney disease, mental illness, cancer, and sepsis. In the current report, DM is defined as a fasting plasma glucose level ≥7 mmol/L (126 mg/dl) or receipt of hypoglycemic therapy or physician diagnosis.

Figure 4 shows the change in DM prevalence in the selected countries from 1980 to 2008. During this period, prevalence increased in the Asian samples, more so in high-income vs. low- and middle-income regions. Singapore was the only country that experienced a decline in DM prevalence and it was remarkable (from 13.2% to the present rate of 5.4%). The most pronounced rise in DM occurred in Kuwaiti men and women, followed by Japanese men and Bangladeshi women. The prevalence of DM in these samples almost doubled over time.

Cross-Sectional DM Prevalence in 2008  In 2008, the prevalence of DM among the Asian countries ranged from 6.1% to 17.0% for men and from 4.7% to 14.8% for women. DM remained less prevalent in Japan, Myanmar and Vietnam. It is noteworthy that the prevalence of DM in most of the Asian countries was higher than in the UK, for both men and women.

The cause of DM has been attributed to a variety of modifiable social and lifestyle factors. In particular, rising rates of obesity have been implicated as a major factor that has contributed to the current DM epidemic. Obesity alone, however, does not fully explain the relatively larger burden of DM in Asia compared with Western countries. The risk of type 2 diabetes may start at a lower body mass index (BMI) for Asians than for Europeans because of the greater frequency in Asia of abdominal obesity and visceral fat accumulation. Other factors that are more dominant in Asia include an increased risk of gestational diabetes combined with an increased exposure to poor nutrition during the perinatal period and overnutrition in later life.

Obesity  Obesity results from high energy intake (from diet) and low energy expenditure (determined by basal metabolic rate, physical activity, and food-induced thermogenesis). As a result of this imbalance, obesity has become a major healthcare concern in both developed and developing coun-
of the total global burden of diseases are caused by smoking. Smoking is causally associated with CVD, cancer, chronic respiratory disease, and probably DM. Among low- and middle-income countries, it is estimated that more than three-quarters of the current global burden of diseases are caused by smoking.

Figure 6 shows the prevalence of current tobacco smokers aged ≥15 years in 2011 (defined as smoking at the time of the survey, including daily and non-daily smoking). For men, current smoking exceeded 30% in all of the selected Asian countries except for India (25%). In some low- and middle-income countries (Vietnam, Mongolia, China and Bangladesh), smoking prevalence was as high as 50%. Differences in smoking prevalence between low- and middle-income countries and high-income countries were modest.

Smoking was more common by men than by women in Asia, but the ratio of male-to-female smokers differed across countries, ranging from 3:1 in Japan to more than 10:1 in countries such as Bangladesh, Vietnam, and China. In contrast, the ratio was close to 1:1 in the UK and USA, a possible consequence of greater financial independence among more Westernized women.

Figure 7 shows the changes in daily smoking in 4 Asian countries (Japan, Singapore, China and Vietnam) and the UK and USA that were observed from 1984 to 2010. Smoking prevalence in men fell markedly in most countries. For example, from 1990 to 2009, smoking by men more than halved in

![Figure 4](Figure4.png)

The 30-year trends in age-standardized diabetes prevalence (%) in the selected countries for men (A) and women (B). The countries are grouped by income level: high (circle), middle (square) and low (triangle).
In contrast, migration effects could change risk factors in a beneficial direction. For example, prevalence of hypertension and smoking could decline with migration to the West. Rates of obesity, DM and elevated serum cholesterol, however, could increase. Chinese migrants living in Mauritius had a higher prevalence of CAD, with higher cholesterol levels than those in Beijing, China. Although the latter represents an adverse effect from migration, Chinese migration to Canada resulted in rates of stroke that were similar to general rates for Canadians. Given that Canada has one of the lowest rates of stroke in the world, this provides further evidence that the effect of environmental changes on disease is real.

Migration Effects
Other than genetic predisposition, environmental and lifestyle exposures can have important effects on the development of CVD. Studies in Asian samples after migration to Western countries have generally shown a significant change in the risk of CVD. The ERA JUMP study, comparing 3 community-based samples of 300 men each, showed that Japanese-Americans in the USA had a greater frequency of coronary artery calcification and a thicker carotid intima media than Japanese in Japan and even Caucasian men in the USA. The considerably high estimates observed in the Japanese Americans as compared with Japanese in Japan provide evidence of the importance of the environment on influencing the development of atherosclerotic disease vs. genetic factors. It further suggests that atherosclerosis is highly preventable.

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Effect of Each Risk Factor on CVD in Asian Populations
To assess the effect of the risk factors on CVD, we used population-attributable fractions (PAFs) reported by the Global Burden Disease (GBD) Project on the global burden of disease. Because of the paucity of pertinent data for PAF of mortality from CVD, countries were grouped into a broader categorization than in previous sections (based on classification by the World
Figure 6. Age-standardized prevalence estimates for current tobacco smoking among all persons (A) or categorized by sex (B): men (upper bar) and women (lower bar) aged 15 years and more, 2011. Estimates for Singapore and USA were for 2009.18

Figure 7. Change in daily smoking prevalence in selected countries for men (A) and women (B).
Bank). According to this classification, all the Asian low- and middle-income countries were grouped into 4 categories (East Asia and Pacific, Europe and Central Asia, Middle East and North Africa, and South Asia), with high-income countries as a 5th category. Within each category, PAFs were calculated for the percent of fatal ischemic heart disease (IHD) and stroke that could be attributed to each of the 4 risk factors, except for DM (which was listed as a disease outcome by the GBD). Table shows that high BP has large effect on CVD deaths in the Asian regions, accounting for PAF of 39–61% of IHD and 49–69% of stroke. High cholesterol had the second highest effect, particularly for IHD, in Asia. Although the PAFs of smoking for IHD and stroke were lower than those of high cholesterol or obesity, it is noteworthy that the effect of smoking on all-cause death, as mentioned earlier, is large.55–58

Eastern Europe and Central Asia faced a significantly larger burden of CVD linked to the 4 conventional risk factors compared with the other regions of Asia. Nearly 70% of stroke deaths in this region were related to high BP, compared with 50% in East Asia-Pacific and 49% in South Asia. The effect of being overweight or obese was also high in Eastern Europe and Central Asia, where nearly one-quarter of deaths from fatal IHD were attributable. This finding corresponds with a recent systemic review in the Middle East, suggesting that the 4 risk factors (plus DM) are key determinants of CVD.59

Asia has certain characteristics that may affect the pattern of risk factors on CVD burden. Approximately half of the world’s population lives in the low- and middle-income countries of East Asia and the Pacific (30%) and South Asia (20%).54 Limited access to health care among these countries poses enormous challenges to global health.58 Rapid epidemiologic transitions, shifting from a predominance of nutritional deficiencies and infectious diseases to noncommunicable disease, have also been observed in these regions.60 Although communicable diseases continue to occur with high prevalence, the effect that CVD will have on the limited healthcare resources in these countries is expected to increase.

### Conclusions

In this review of 5 leading CVD risk factors in 10 Asian countries and the UK and USA, we observed opposing trends across the selected countries for BP and TC (declines in high-income countries and increases in some low- and middle-income countries). Regardless of the favorable changes in some countries, the effect of these 2 risk factors on the PAFs for CVD remains high. In contrast, both obesity and DM have increased with time in almost all of the countries. These latter risk factors are likely to contribute more fully to a corresponding increase in the healthcare burden imposed by CVD. Smoking prevalence also remains excessively high, particularly among Asian men. Findings suggest that the effects of all risk factors on CVD have not diminished in importance over time. As a problem that is shared globally, coordinated efforts to design worldwide campaigns to develop policy and programs for the promotion of healthy lifestyles (including smoking cessation, improvements in nutrition, and encouragement of physical activity) are clearly warranted.

### References


