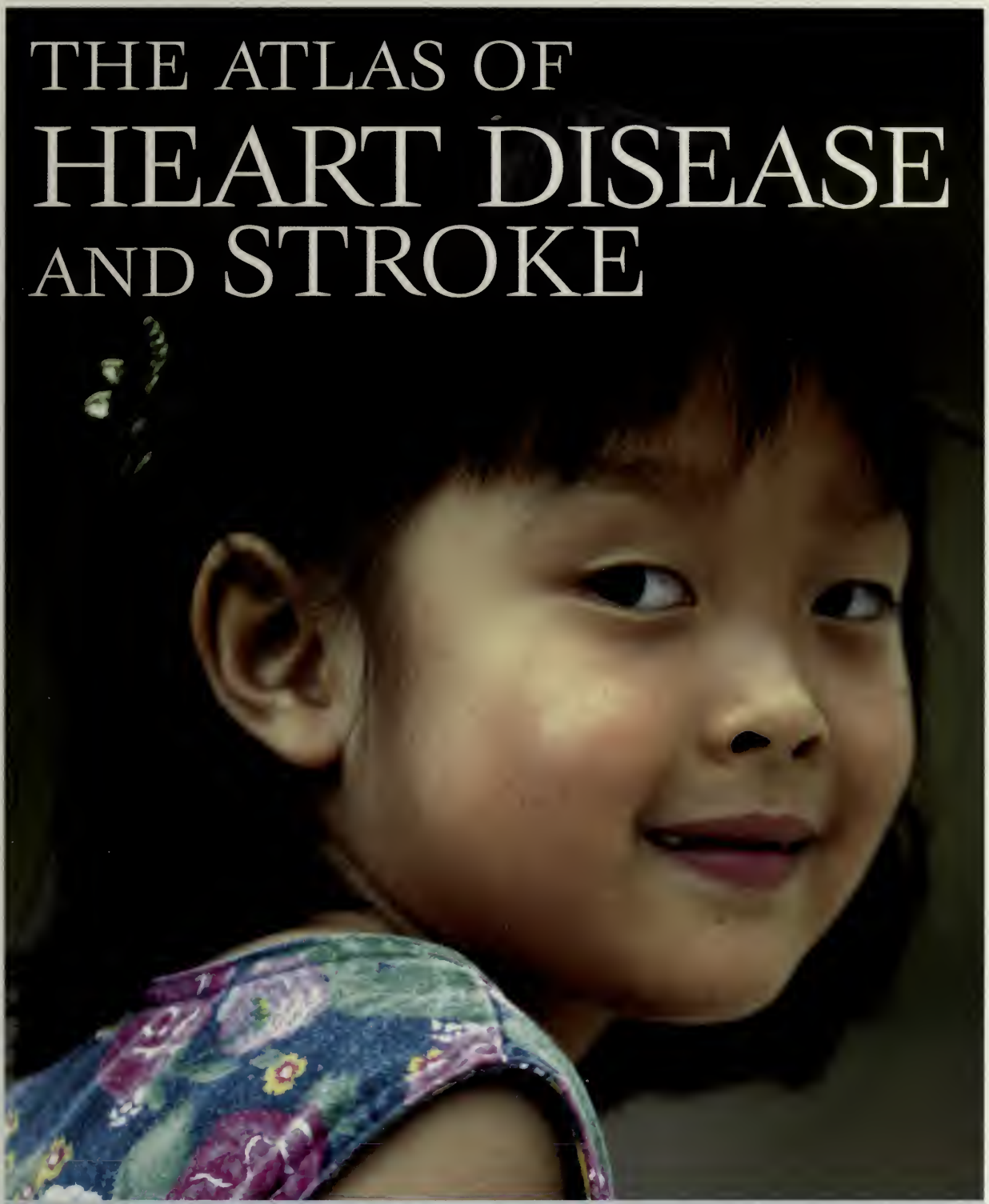
THE ATLAS OF HEART DISEASE AND STROKE



DR JUDITH MACKAY AND DR GEORGE A. MENSAH

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The Atlas of Heart Disease and Stroke

World Health Organization
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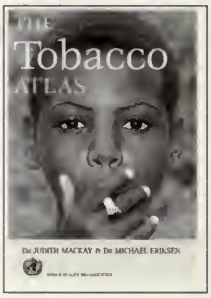

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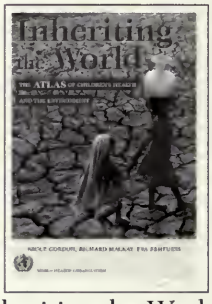

Inheriting the World:
The Atlas of Children's Health and the Environment

The Atlas of Heart Disease and Stroke

Dr Judith Mackay and Dr George A. Mensah

with

Dr Shanthi Mendis and Dr Kurt Greenlund

World Health Organization

Geneva

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Foreword

A message from

Dr LEE Jong-Wook
Director-General
World Health Organization

Heart disease and stroke are currently the leading cause of death in all developed countries and in most developing countries. There were approximately 17 million deaths due to cardiovascular disease in 2003 – one-third of all deaths in the world.

It is disturbing to note that at least 75% of deaths from heart disease and stroke now occur in the poorer regions of the world, which also face major threats from communicable diseases. These regions thus suffer under the so-called "double burden" of disease. If preventive action is not taken urgently, heart disease and stroke – which are already major public health problems – will rapidly advance across regions and social classes to reach epidemic proportions worldwide.

We know that the major risk factors for heart disease and stroke are high blood pressure, high blood cholesterol, tobacco use, physical inactivity, unhealthy diet and obesity. Many of these risk factors result from unhealthy lifestyles. These unhealthy lifestyle habits, which are linked to urbanization, often start in childhood and youth, encouraged by the influence of mass advertising and social pressures. This underscores the importance of targeting children and young people in all programmes that aim to prevent heart disease and stroke.

Prevention and control of heart disease and stroke in developing countries represent a challenging task. There are a number of major barriers to progress, including lack of reliable epidemiological information, inaccessibility of health care, shortages of trained manpower and resources, and misconceptions about heart disease and stroke among policy-makers and the public.

However, the good news is that knowledge about the causes of heart disease and stroke is growing, and various countries are gaining experience in translating this knowledge into effective action.

I believe that our efforts to control heart disease and stroke can only succeed if they are focused at country level. Current WHO activities in this area are based on the WHO Global Strategy for the Prevention and Control of Noncommunicable Disease, which was adopted by the World Health Assembly in 2000. Our goals are to:

- provide guidance to countries on policy, legislative and financial measures that can help prevent cardiovascular disease;
- assess and track the magnitude of the cardiovascular disease epidemic and its social, economic, behavioural and political determinants in developing countries;
- reduce cardiovascular risk factors and their determinants and promote cardiovascular health for all age groups;
- strengthen the health care of people with cardiovascular disease by developing norms and guidelines for cost-effective interventions.

To achieve these goals, WHO has developed standardized approaches to strengthen national surveillance systems for key risk factors. Further, WHO has initiated programmes at country level to scale up health care for those with established cardiovascular disease and to introduce affordable and innovative approaches for managing cardiovascular risk factors and cardiovascular disease in low-resource settings.

WHO is also in the process of addressing some of the main risk factors for cardiovascular disease through global action, such as the Framework Convention on Tobacco Control and the Global Strategy on Diet, Physical Activity and Health. These strategies will help countries in their efforts to develop and implement policies to reduce the burden of cardiovascular disease.

We recognize that advocacy, resource mobilization, capacity development, and research are necessary to galvanize global action against the causes of cardiovascular disease. WHO is working with other UN agencies, research institutions, nongovernmental organizations, the private sector and civil society to promote these activities. Together we can move the global public health agenda forward to avert unnecessary deaths and suffering due to this eminently preventable disease.

Preface

"We have the scientific knowledge to create a world
in which most heart disease and stroke could be eliminated."
The Victoria Declaration on Heart Health, 1992

"Change before you have to."
Jack Welch,
former Chairman and Chief Executive Officer of
General Electric, USA (1935–)

Heart disease and stroke, the main cardiovascular diseases, are truly global epidemics. They deserve the attention of governments, policy-makers, national and international organizations, committed individuals and families everywhere.

Heart disease and stroke are no longer diseases of old men in developed countries. They are also diseases of women, young adults, and even children. They affect the wealthy and the poor. Already they claim more lives in developing than developed countries. The Asian girl on the cover is at risk, as are many children and young adults throughout the world.

The risk factors for heart disease and stroke begin in youth, and most can be prevented or controlled. Yet, worldwide, most people who have risk factors are either not treated or are inadequately treated. Special attention to high blood pressure, high blood cholesterol, tobacco and other major risk factors is crucial.

Cardiovascular diseases are more than just health problems: both the diseases and their underlying causes have major financial implications for governments, businesses and individuals. The "globesity" epidemic is causing international concern. The tobacco epidemic is linked to smuggling, big business and politics. If people are to be encouraged to take regular physical activity, commitment is needed from both individuals and society. The prevention and control of high blood pressure and high blood cholesterol require action from governments and the pharmaceutical industry, not just individual patients.

Research achievements in the field of heart disease and stroke have been phenomenal. We know a lot today, but as Goethe put it, "knowing is not enough, we must apply." We must apply what we already know, and translate the best science into practice for the benefit of all, worldwide.

The good news, as stated most eloquently in the Victoria Declaration on Heart Health more than a decade ago, is that we know what we need to do to eliminate most heart disease and stroke. What is needed now is the combination of necessary resources and political will on a global scale to take effective action. Now is the time to act – and to change before we have to.

Judith Mackay, Hong Kong SAR, China
George A. Mensah, Atlanta, GA, USA

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5 Risk factor: blood pressure Yussuf Saloojee, tobacco control advocate, South Africa.

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7 Risk factor: tobacco Omar Shafey, Manager, International Tobacco Surveillance, American Cancer Society, USA.

8 Risk factor: physical inactivity Krishnan Anand, Associate Professor, Centre for Community Medicine, All India Institute of Medical Sciences, India.

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CARDIOVASCULAR DISEASE

"When man is serene, the pulse of the heart flows and connects, just as pearls are joined together or like a string of red jade, then one can talk about a healthy heart."

The Yellow Emperor's *Canon of Internal Medicine,* 2500 BCE

1 Types of cardiovascular disease

"All the knowledge I possess everyone else can acquire, but my heart is all my own."
Johann Wolfgang von Goethe
The Sorrows of Young Werther 1774

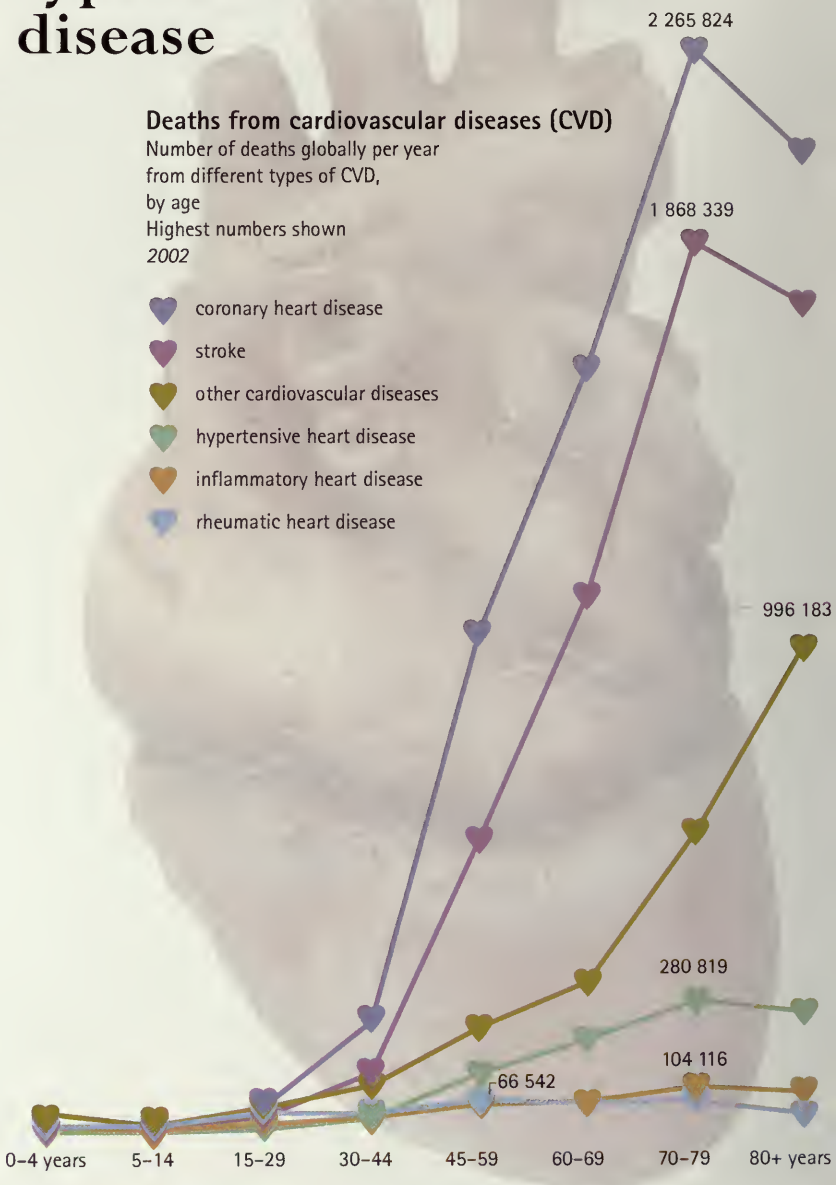
The human heart is only the size of a fist, but it is the strongest muscle in the human body.

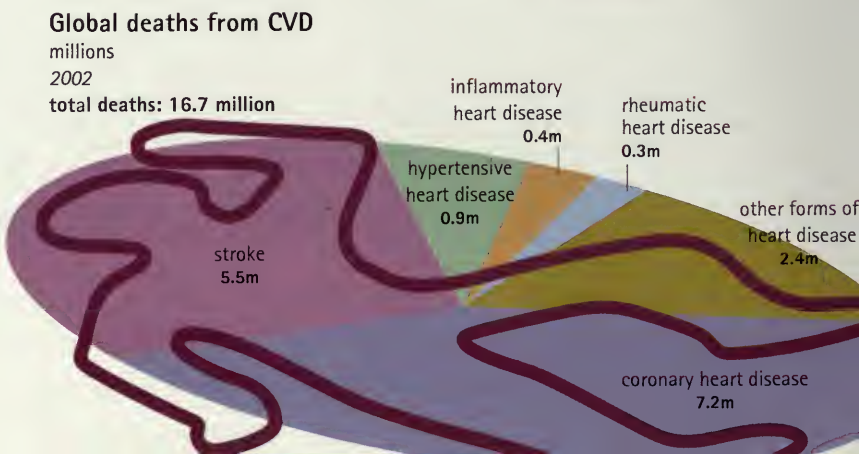
The heart starts to beat in the uterus long before birth, usually by 21 to 28 days after conception. The average heart beats about 100 000 times daily or about two and a half billion times over a 70 year lifetime.

With every heartbeat, the heart pumps blood around the body. It beats approximately 70 times a minute, although this rate can double during exercise or at times of extreme emotion.

Blood is pumped out from the left chambers of the heart. It is transported through arteries of ever-decreasing size, finally reaching the capillaries in all the tissues, such as the skin and other body organs. Having delivered its oxygen and nutrients and having collected waste products, blood is brought back to the right chambers of the heart through a system of ever-enlarging veins. During the circulation through the liver, waste products are removed.

This remarkable system is vulnerable to breakdown and assault from a variety of factors, many of which can be prevented and treated. Risk factors will be explored on pages 24–43.





Stroke

Strokes are caused by disruption of the blood supply to the brain. This may result from either blockage (ischaemic stroke) or rupture of a blood vessel (haemorrhagic stroke).
Risk factors High blood pressure, atrial fibrillation (a heart rhythm disorder), high blood cholesterol, tobacco use, unhealthy diet, physical inactivity, diabetes, and advancing age.

Coronary heart disease kills more than 7 million people each year, and strokes kill nearly 6 million. Most of these deaths are in developing countries.

Coronary heart disease

Disease of the blood vessels supplying the heart muscle.
Major risk factors High blood pressure, high blood cholesterol, tobacco use, unhealthy diet, physical inactivity, diabetes, advancing age, inherited (genetic) disposition.
Other risk factors Poverty, low educational status, poor mental health (depression), inflammation and blood clotting disorders.

Rheumatic heart disease

Damage to the heart muscle and heart valves from rheumatic fever, caused by streptococcal bacteria.

Congenital heart disease

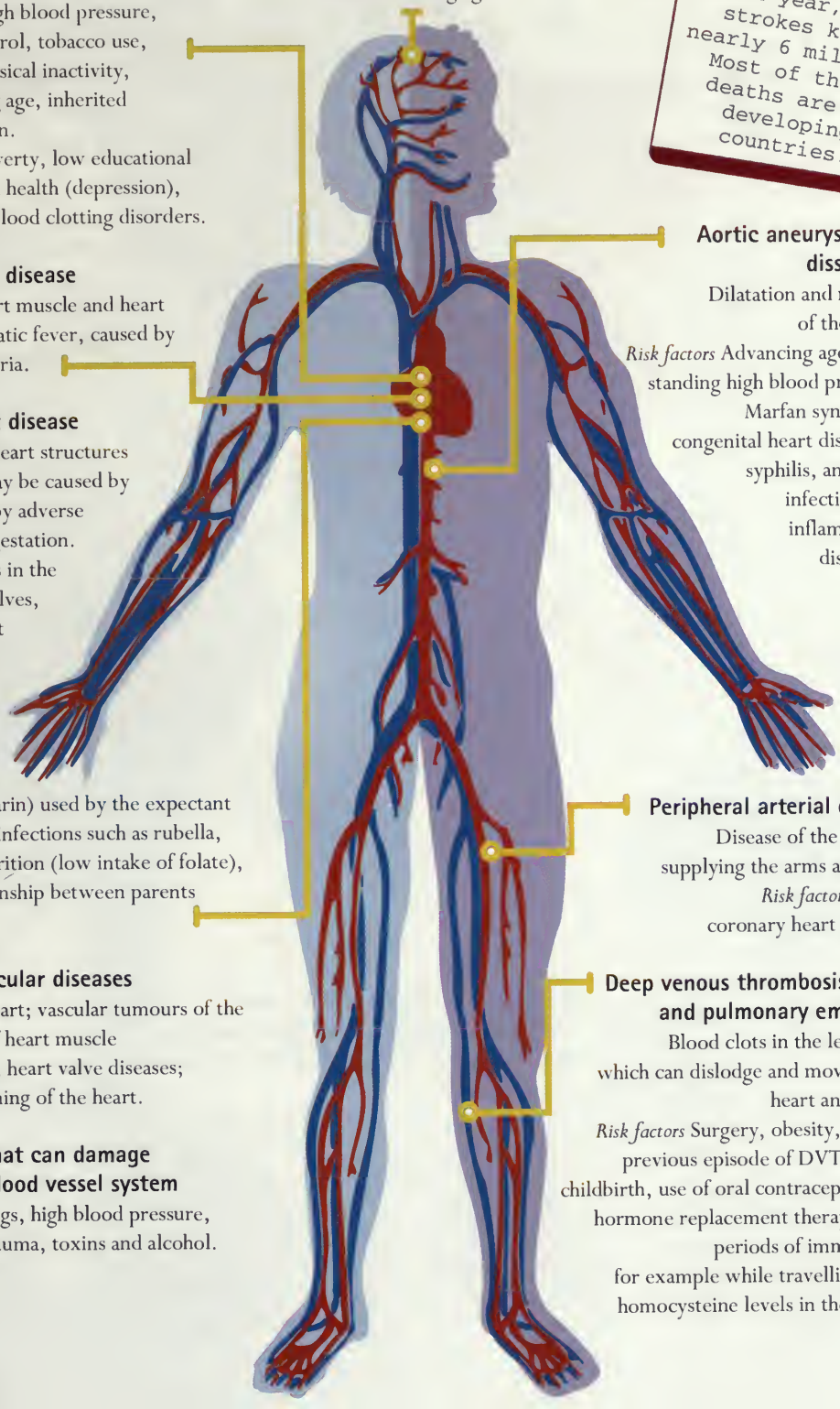
Malformations of heart structures existing at birth may be caused by genetic factors or by adverse exposures during gestation. Examples are holes in the heart, abnormal valves, and abnormal heart chambers.
Risk factors
Maternal alcohol use, medicines (for example thalidomide, warfarin) used by the expectant mother, maternal infections such as rubella, poor maternal nutrition (low intake of folate), close blood relationship between parents (consanguinity).

Other cardiovascular diseases

Tumours of the heart; vascular tumours of the brain; disorders of heart muscle (cardiomyopathy); heart valve diseases; disorders of the lining of the heart.

Other factors that can damage the heart and blood vessel system

Inflammation, drugs, high blood pressure, unhealthy diet, trauma, toxins and alcohol.



Aortic aneurysm and dissection

Dilatation and rupture of the aorta.
Risk factors Advancing age, long-standing high blood pressure, Marfan syndrome, congenital heart disorders, syphilis, and other infectious and inflammatory disorders.

Peripheral arterial disease

Disease of the arteries supplying the arms and legs.
Risk factors As for coronary heart disease.

Deep venous thrombosis (DVT) and pulmonary embolism

Blood clots in the leg veins, which can dislodge and move to the heart and lungs.
Risk factors Surgery, obesity, cancer, previous episode of DVT, recent childbirth, use of oral contraceptive and hormone replacement therapy, long periods of immobility, for example while travelling, high homocysteine levels in the blood.

2 Rheumatic fever and rheumatic heart disease

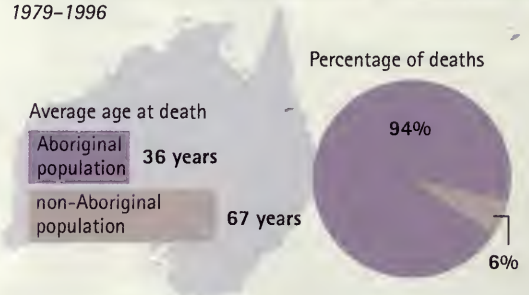
Rheumatic fever usually follows an untreated beta-haemolytic streptococcal throat infection in children. It can affect many parts of the body, and may result in rheumatic heart disease, in which the heart valves are permanently damaged, and which may progress to heart failure, atrial fibrillation, and embolic stroke.

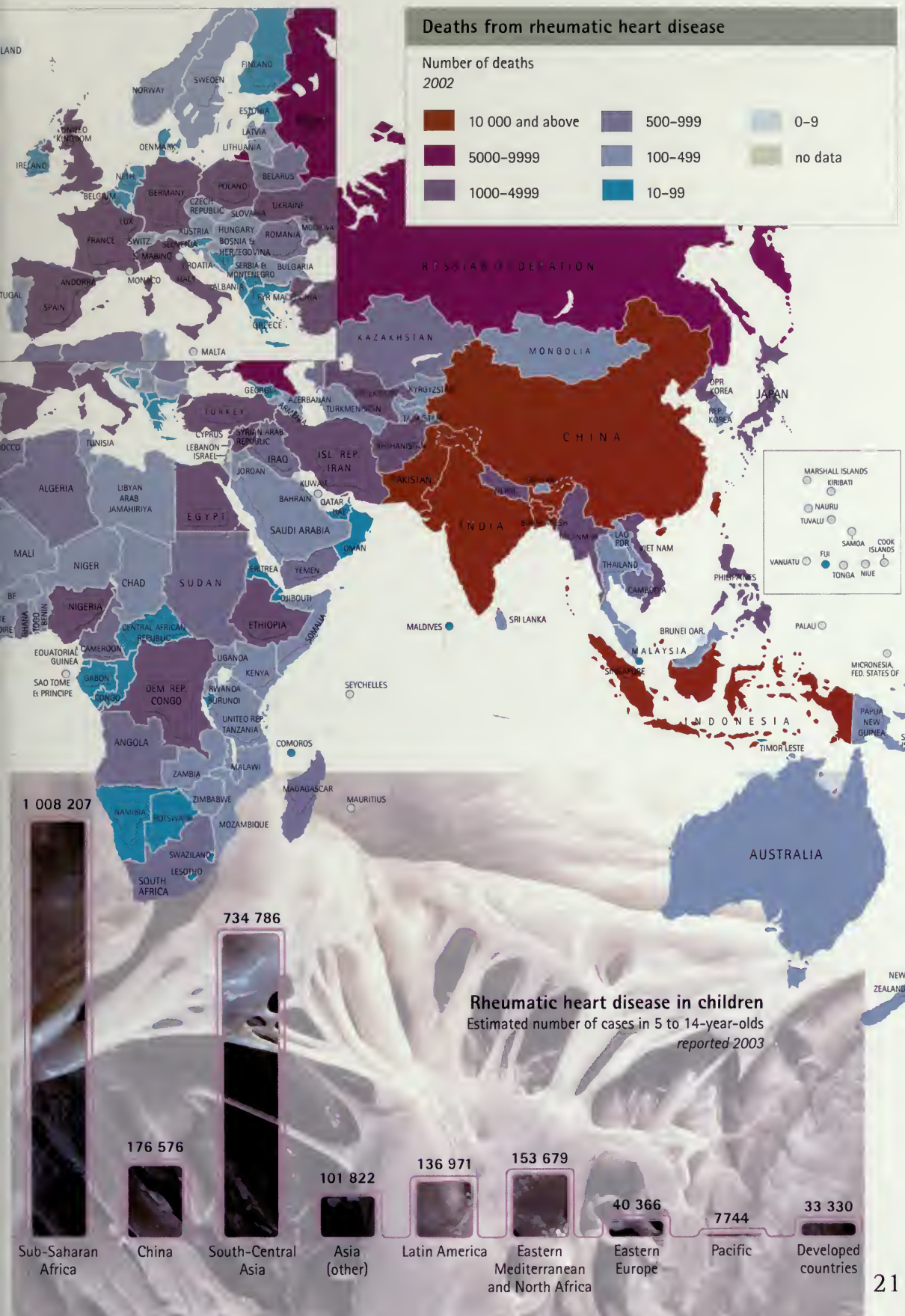
Nowadays, rheumatic fever mostly affects children in developing countries, especially where poverty is widespread. Up to 1% of all schoolchildren in Africa, Asia, the Eastern Mediterranean region and Latin America show signs of the disease.

Of 12 million people currently affected by rheumatic fever and rheumatic heart disease, two-thirds are children between 5 and 15 years of age. There are around 300 000 deaths each year, with two million people requiring repeated hospitalization and one million likely to require surgery in the next 5 to 20 years.

Early treatment of streptococcal sore throat can preclude the development of rheumatic fever. Regular long-term penicillin treatment can prevent rheumatic fever becoming rheumatic heart disease, and can halt disease progression in people whose heart valves are already damaged by the disease. In many developing countries, lack of awareness of these measures, coupled with shortages of money and resources, are important barriers to the control of the disease.

Deaths from rheumatic fever and rheumatic heart disease in the Aboriginal and non-Aboriginal populations of Australia
1979–1996




Deaths from rheumatic heart disease
Number of deaths
2002
10 000 and above
5000–9999
1000–4999
500–999
100–499
10–99
0–9
no data
Rheumatic heart disease in children
Estimated number of cases in 5 to 14-year-olds
reported 2003
1 008 207
Sub-Saharan Africa
176 576
China
734 786
South-Central Asia
101 822
Asia (other)
136 971
Latin America
153 679
Eastern Mediterranean and North Africa
40 366
Eastern Europe
7744
Pacific
33 330
Developed countries

Risk Factors

"He that eats but one dish seldom needs the doctor."

Old Scottish proverb

3 Risk factors

"The gods are just, and of our pleasant vices
Make instruments to plague us."
King Lear, V.iii.193 William Shakespeare
(1564–1616)

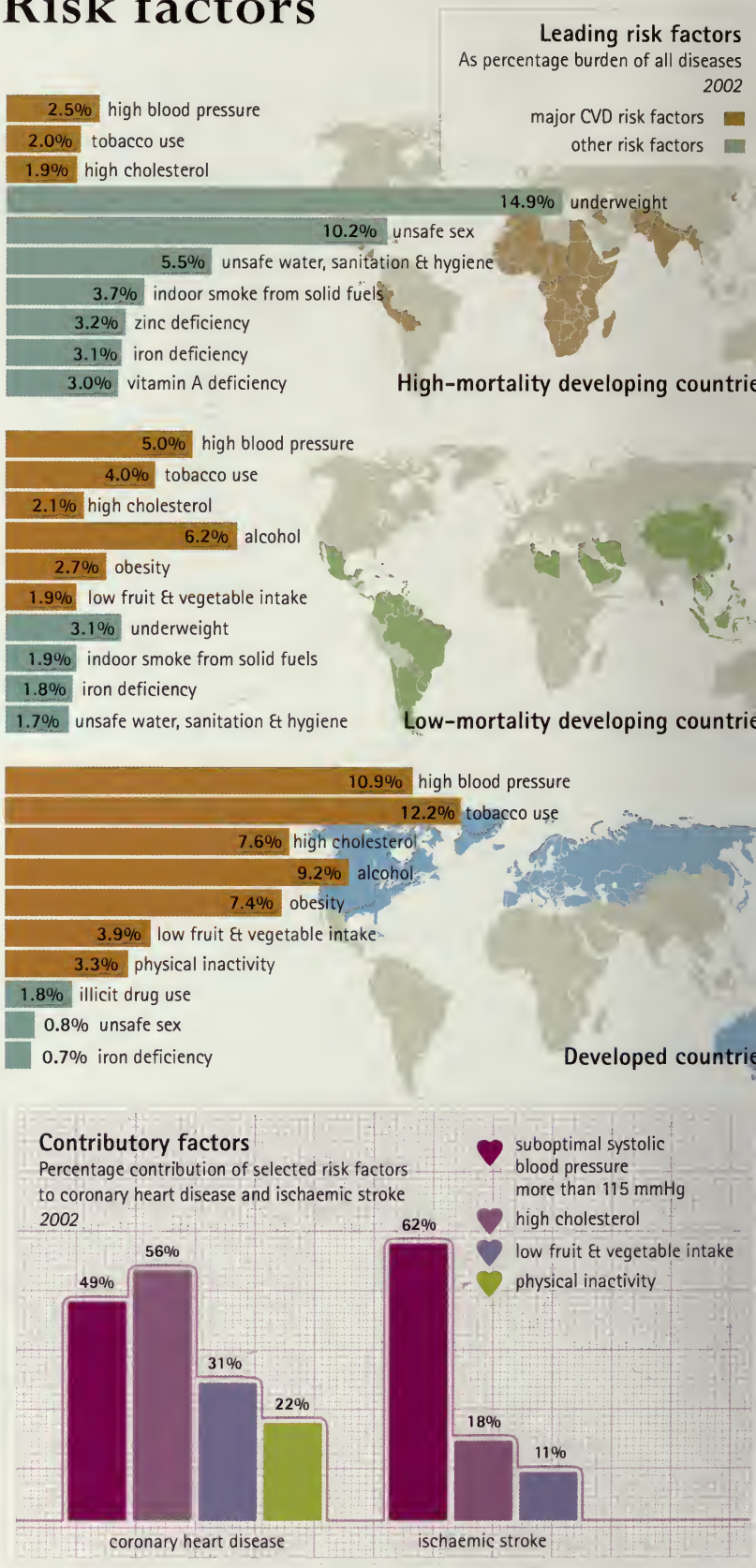
Over 300 risk factors have been associated with coronary heart disease and stroke. The major established risk factors meet three criteria: a high prevalence in many populations; a significant independent impact on the risk of coronary heart disease or stroke; and their treatment and control result in reduced risk.

Risk factors for cardiovascular disease are now significant in all populations. In the developed countries, at least one-third of all CVD is attributable to five risk factors: tobacco use, alcohol use, high blood pressure, high cholesterol and obesity.

In developing countries with low mortality, such as China, cardiovascular risk factors also figure high on the top 10 list. These populations face a double burden of risks, grappling with the problems of undernutrition and communicable diseases, while also contending with the same risks as developed nations.

Even in developing countries with high mortality, such as those in sub-Saharan Africa, high blood pressure, high cholesterol, tobacco and alcohol use, as well as low vegetable and fruit intake, already figure among the top risk factors.

Some major risks are modifiable in that they can be prevented, treated, and controlled. There are considerable health benefits at all ages, for both men and women, in stopping smoking, reducing cholesterol and blood pressure, eating a healthy diet and increasing physical activity.



Major modifiable risk factors

- **High blood pressure**
  Major risk for heart attack and the most important risk factor for stroke.
- **Abnormal blood lipids**
  High total cholesterol, LDL-cholesterol and triglyceride levels, and low levels of HDL-cholesterol increase risk of coronary heart disease and ischaemic stroke.
- **Tobacco use**
  Increases risks of cardiovascular disease, especially in people who started young, and heavy smokers. Passive smoking an additional risk.
- **Physical inactivity**
  Increases risk of heart disease and stroke by 50%.
- **Obesity**
  Major risk for coronary heart disease and diabetes.
- **Unhealthy diets**
  Low fruit and vegetable intake is estimated to cause about 31% of coronary heart disease and 11% of stroke worldwide; high saturated fat intake increases the risk of heart disease and stroke through its effect on blood lipids and thrombosis.
- **Diabetes mellitus**
  Major risk for coronary heart disease and stroke.

Approximately 75% of cardiovascular disease can be attributed to conventional risk factors.

Other modifiable risk factors

- **Low socioeconomic status (SES)**
  Consistent inverse relationship with risk of heart disease and stroke.
- **Mental ill-health**
  Depression is associated with an increased risk of coronary heart disease.
- **Psychosocial stress**
  Chronic life stress, social isolation and anxiety increase the risk of heart disease and stroke.
- **Alcohol use**
  One to two drinks per day may lead to a 30% reduction in heart disease, but heavy drinking damages the heart muscle.
- **Use of certain medication**
  Some oral contraceptives and hormone replacement therapy increase risk of heart disease.
- **Lipoprotein(a)**
  Increases risk of heart attacks especially in presence of high LDL-cholesterol.
- **Left ventricular hypertrophy (LVH)**
  A powerful marker of cardiovascular death.

Non-modifiable risk factors

- **Advancing age**
  Most powerful independent risk factor for cardiovascular disease; risk of stroke doubles every decade after age 55.
- **Heredity or family history**
  Increased risk if a first-degree blood relative has had coronary heart disease or stroke before the age of 55 years (for a male relative) or 65 years (for a female relative).
- **Gender**
  Higher rates of coronary heart disease among men compared with women (premenopausal age); risk of stroke is similar for men and women.
- **Ethnicity or race**
  Increased stroke noted for Blacks, some Hispanic Americans, Chinese, and Japanese populations. Increased cardiovascular disease deaths noted for South Asians and American Blacks in comparison with Whites.

"Novel" risk factors

- **Excess homocysteine in blood**
  High levels may be associated with an increase in cardiovascular risk.
- **Inflammation**
  Several inflammatory markers are associated with increased cardiovascular risk, e.g. elevated C-reactive protein (CRP).
- **Abnormal blood coagulation**
  Elevated blood levels of fibrinogen and other markers of blood clotting increase the risk of cardiovascular complications.

4 Risk factors start in childhood and youth

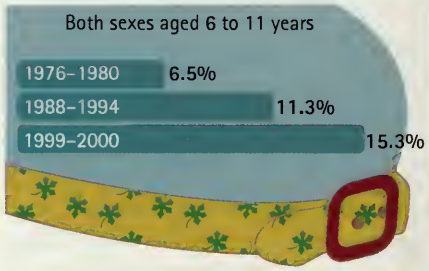
"Encased in fat in youth, encased in a coffin in middle age."
Ancient Chinese proverb

Although cardiovascular diseases typically occur in middle age or later, risk factors are determined to a great extent by behaviours learned in childhood and continued into adulthood, such as dietary habits and smoking.

Throughout the world, these risks are starting to appear earlier. Physical activity decreases markedly in adolescence, particularly in girls. Obesity has increased substantially, not only in Europe and North America, but also in traditionally slender populations such as the Chinese and Japanese. Type 2 diabetes was previously rare in children, but is increasing in adolescents in, for example, North America, Japan and Thailand.

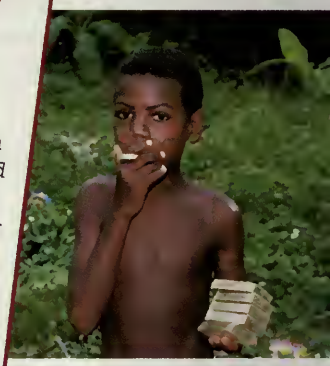
Markers of CVD can be seen in young children. Post-mortems of children who died in accidents have found fatty streaks and fibrous plaques in the coronary arteries. These early lesions of atherosclerosis were most frequently found in children whose risk factors included smoking, elevated plasma lipids, high blood pressure and obesity.

Programmes to address childhood and youth risk factors are mostly confined to developed countries, but urgent action is required worldwide. Families, schools, communities, health professionals, public health officials and policy-makers all need to promote healthy lifestyles in children and young people. Unless the spread of risk factors is stemmed, the world faces an epidemic of CVD.

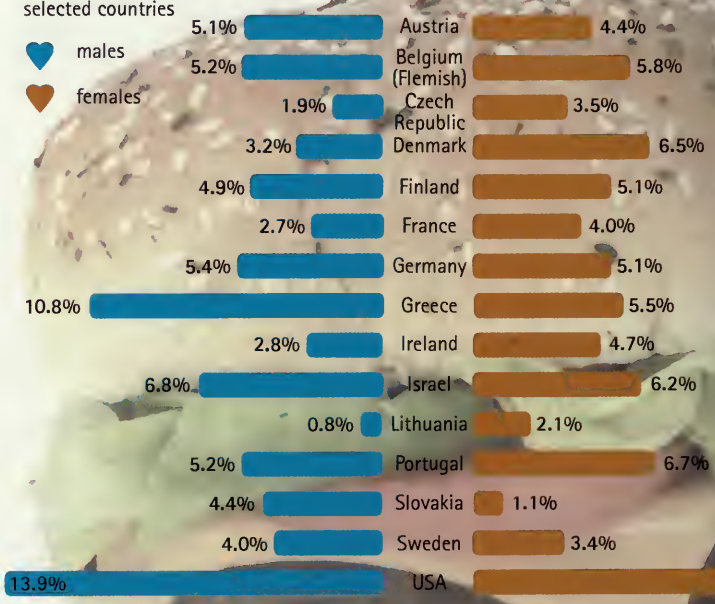


Overweight trends in the USA
Percentage of young people who are overweight
1976–2000

The risks for cardiovascular disease start in youth: worldwide, 18 million children under five years old are overweight, and 14% of 13 to 15-year-old students around the world currently smoke cigarettes.



Overweight youth
Percentage of 15-year-olds who are overweight
1997–1998
selected countries




Boys
Girls
In the USA, physical activity decreases precipitously, especially in girls, beginning around age 10 years.
Early starters
Percentage of students, primarily aged 13 to 15 years, using tobacco
1999–2003
45% and above
30%–44.9%
15%–29.9%
below 15%
no data
Subnational data (region or city)
RUSSIAN FEDERATION
USA
CHINA
INDIA
BRAZIL
INDONESIA
SUDAN

5 Risk factor: blood pressure

"There are six flavours and, of them all, salt is the chief."
Hindu proverb

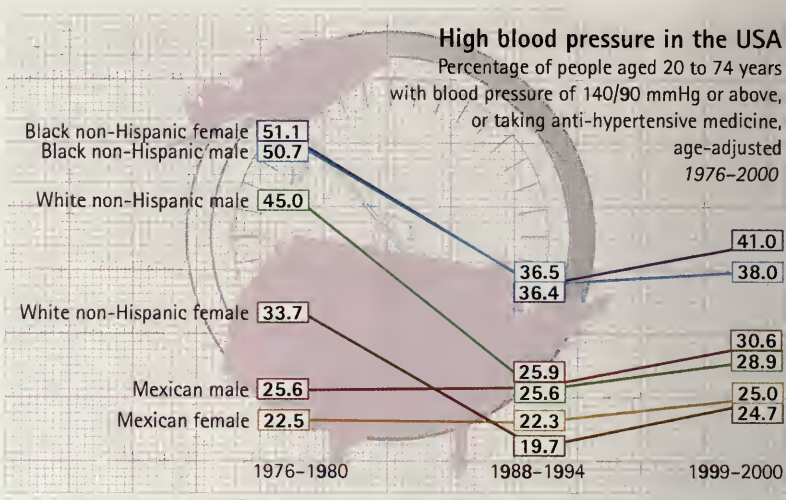
High blood pressure (hypertension) is one of the most important preventable causes of premature death worldwide. Even a blood pressure at the top end of the normal range increases risk. High blood pressure is defined as a systolic blood pressure (SBP) above 140 mmHg and/or a diastolic blood pressure (DBP) above 90 mmHg.

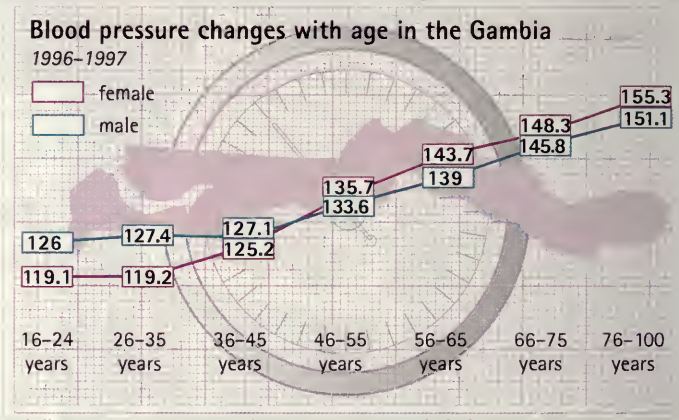
In most countries, up to 30% of adults suffer from high blood pressure and a further 50% to 60% would be in better health if they reduced their blood pressure, by increasing physical activity, maintaining an ideal body weight and eating more fruits and vegetables.

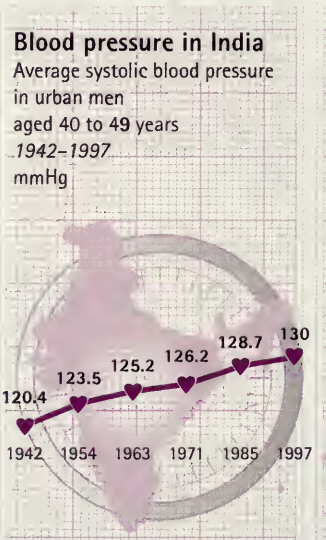
In people aged up to 50 years, both DBP and SBP are associated with cardiovascular risk; above this age, SBP is a far more important predictor. Blood pressure usually rises with age, except where salt intake is low, physical activity high, and obesity largely absent.

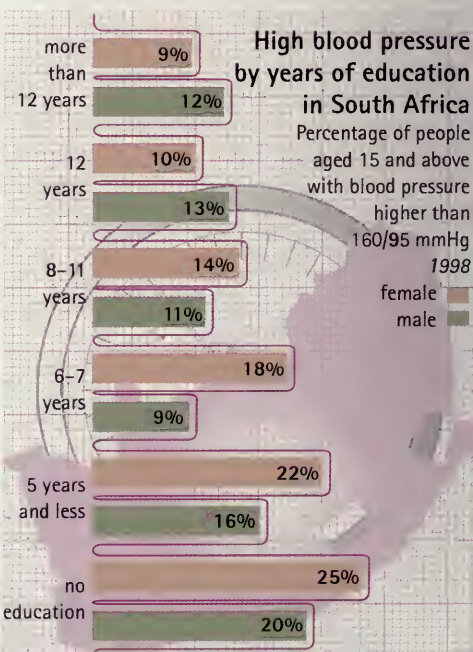
Most natural foods contain salt, but processed food may be high in salt; in addition, individuals may add salt for taste. Dietary salt increases blood pressure in most people with hypertension, and in about a quarter of those with normal blood pressure, especially with increasing age. A high intake of salt independently increases the risk of CVD in overweight persons.

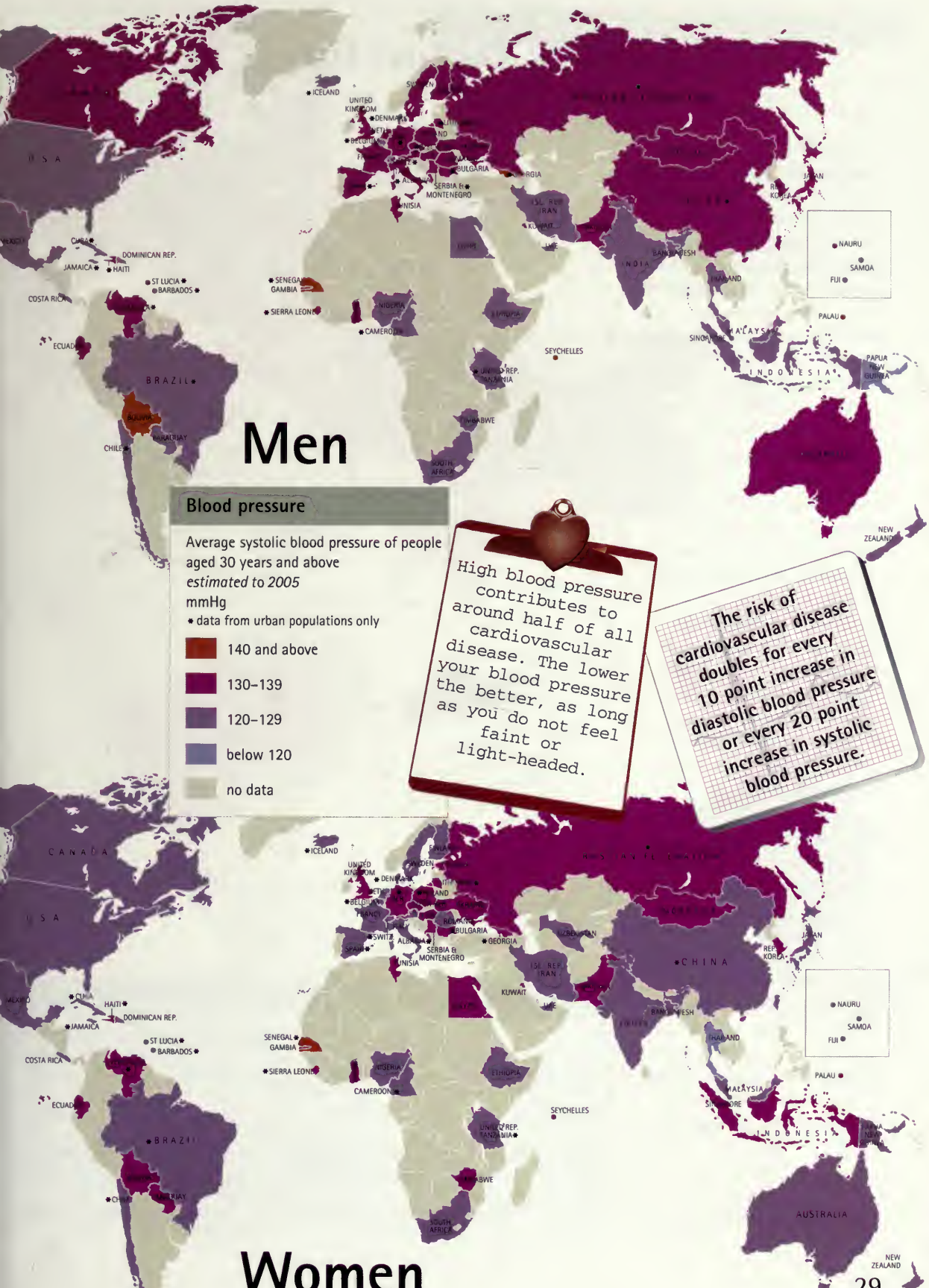
In addition to lifestyle changes, effective medication is available for control of high blood pressure.










Men
Blood pressure
Average systolic blood pressure of people aged 30 years and above
estimated to 2005
mmHg
* data from urban populations only
140 and above
130–139
120–129
below 120
no data
High blood pressure contributes to around half of all cardiovascular disease. The lower your blood pressure the better, as long as you do not feel faint or light-headed.
The risk of cardiovascular disease doubles for every 10 point increase in diastolic blood pressure or every 20 point increase in systolic blood pressure.
Women

6 Risk factor: lipids

High levels of LDL-cholesterol, and other abnormal lipids (fats), are risk factors for cardiovascular disease. Cholesterol is a soft, waxy substance found among the lipids in the bloodstream and in all the body's cells. It is needed to form cell membranes and hormones, and for other bodily functions.

The body can make cholesterol, or it can obtain it from food, especially animal products such as meats, poultry, fish, eggs, and dairy products. Certain saturated vegetable fats and oils, including coconut fat and palm oil, are cholesterol-free but cause an increase in blood cholesterol. Some foods that do not contain animal products may contain trans-fats, which also cause the body to make more cholesterol. Fruit, vegetables and cereals do not contain cholesterol.

Cholesterol is transported around the body in two kinds of lipoproteins: low-density lipoprotein, or LDL, and high-density lipoprotein, or HDL. A high level of LDL can lead to clogging of the arteries, increasing the risk of heart attack and ischaemic stroke, while HDL reduces the risk of coronary heart disease and stroke.

The female sex hormone estrogen tends to raise HDL-cholesterol levels, which may help explain why premenopausal women are relatively protected from developing coronary heart disease.

Current recommended lipid levels

	European guideline	US guideline
Total cholesterol	less than 5.0 mmol/l	less than 240 mg/dl (6.2 mmol/l)
LDL-cholesterol	less than 3.0 mmol/l	less than 160 mg/dl (3.8 mmol/l)
HDL-cholesterol	1.0 mmol/l or more in males 1.2 mmol/l or more in females	40 mg/dl (1 mmol/l) or more
Triglycerides (fasting)	less than 1.7 mmol/l	less than 200 mg/dl (2.3 mmol/l)

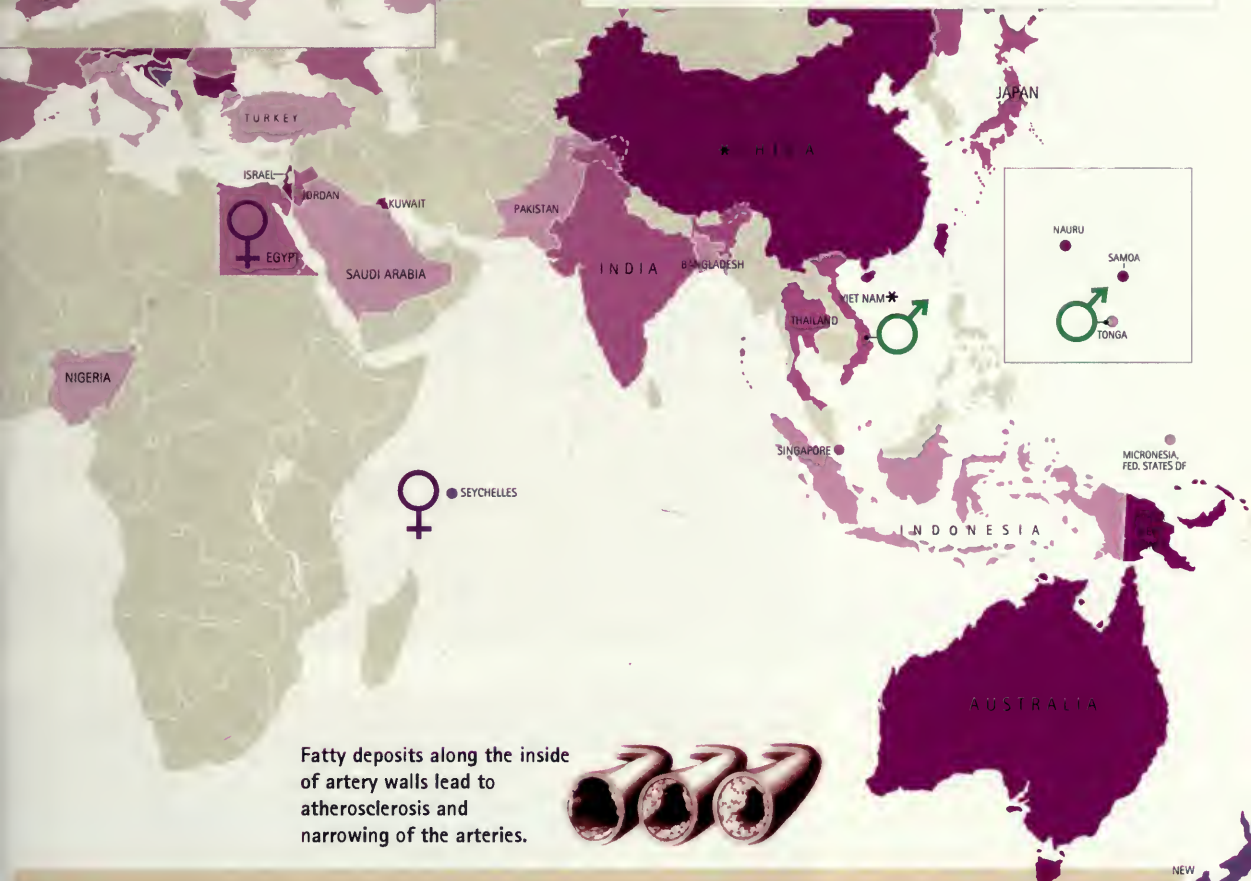
Cholesterol

Average cholesterol levels in women aged 30 and above
mmol/litre
estimated to 2005
* data from urban populations only

- 6.0 and above
- 5.5–5.99
- 5.0–5.49
- 3.0–4.99
- no data

♂ Average cholesterol levels in men more than 0.4 mmol/litre higher than in women

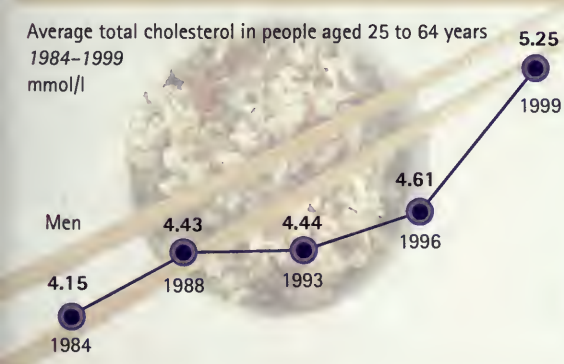
♀ Average cholesterol levels in women more than 0.4 mmol/litre higher than in men

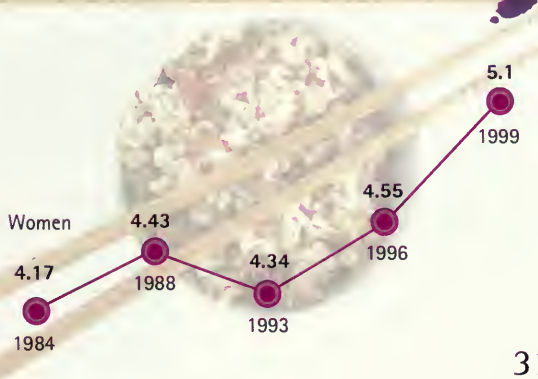


Fatty deposits along the inside of artery walls lead to atherosclerosis and narrowing of the arteries.

Trends in cholesterol levels in Beijing, China

Average total cholesterol in people aged 25 to 64 years
1984–1999
mmol/l





7 Risk factor: tobacco

"From a short pleasure can come a long repentance."
French proverb

The public may believe that the major risk from cigarettes is lung cancer, but far more smokers develop cardiovascular disease – mainly heart attacks and stroke. In 1940, a link was identified between cigarette use and coronary heart disease, and there is now a huge body of scientific literature linking tobacco with CVD. The risks are much higher in people who started smoking before the age of 16. Tobacco use, other than smoking, and passive smoking are also implicated as CVD risks.

Smoking promotes CVD through several mechanisms. It damages the endothelium lining of the blood vessels, increases cholesterol plaques (fatty deposits in the arteries), increases clotting, raises LDL-cholesterol levels and lowers HDL, and promotes coronary artery spasm. Nicotine accelerates the heart rate and raises blood pressure.

A gene has been discovered that increases smokers' risk of developing coronary heart disease by up to four times. Around a quarter of the population carries one or more copies of this gene.

Women smokers are at particular risk, with a higher risk of heart attack than male smokers. Women who smoke only three to five cigarettes a day double their risk of heart attack, while men who smoke six to nine cigarettes a day double their risk.

Cardiovascular risks of smoking

Cardiovascular risks of passive smoking

Adults

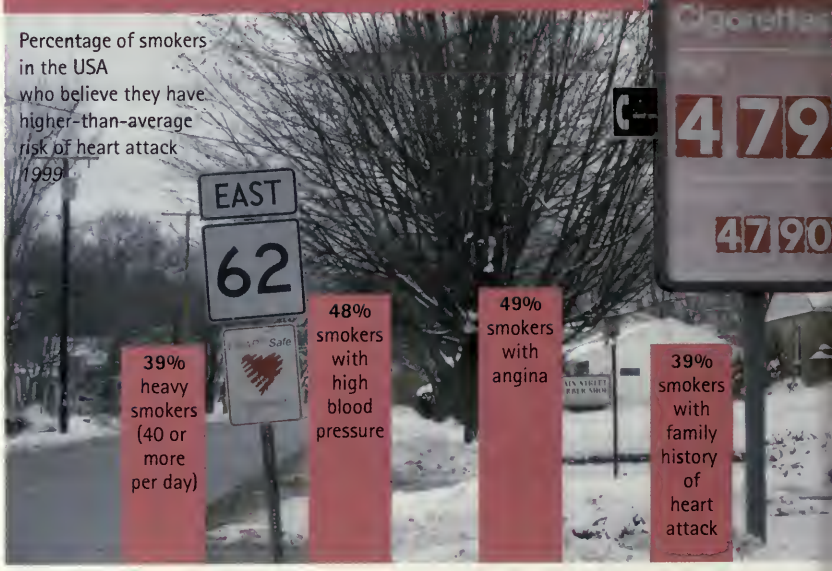
- Harms, clogs, and weakens arteries
- Heart attack, angina, stroke

Children

- Reduces amount of oxygen the blood can carry
- Damages arteries
- Early-onset atherosclerosis
- Sudden infant death syndrome (cot death)

In the USA, up to 62 000 people die each year from heart disease caused by passive smoking.

Smokers don't know the risks of heart attack



Tobacco causes a fifth of cardiovascular disease worldwide.

Men

Smoking prevalence

Percentage of people aged 18 years and above who smoke

2003 or latest available data

* data from urban populations only

- 60% and above
- 45%–59.9%
- 30%–44.9%
- 15%–29.9%
- below 15%
- no data

Quitting smoking effectively reduces cardiovascular risk to close to that of a person who has never smoked.

Women

Only 4% of both smokers and nonsmokers in China know that smoking causes heart disease.

8 Risk factor: physical inactivity

"Take a stroll after meals and you won't have to go to the medicine shop."
Ancient Chinese proverb

Industrialization, urbanization and mechanized transport have reduced physical activity, even in developing countries, so that currently more than 60% of the global population are not sufficiently active.

Physical exercise is linked to longevity, independently of genetic factors. Physical activity, even at an older age, can significantly reduce the risk of coronary heart disease, diabetes, high blood pressure, and obesity, help reduce stress, anxiety and depression, and improve lipid profile. It also reduces the risks of colon cancer, breast cancer and ischaemic stroke.

Doing more than 150 minutes of moderate physical activity or 60 minutes of vigorous physical activity a week – whether at work, in the home, or elsewhere – can reduce the risk of coronary heart disease by approximately 30%.

Despite documented evidence of the benefit of physical activity in preventing and treating cardiovascular and other chronic diseases, more than a quarter of a million individuals die each year in the United States because of a "lack of regular physical exercise".

Only 8% of the world's population currently owns a car. Between 1980 and 1998, the global fleet of cars, trucks and buses grew by 80%, with a third of the increase taking place in developing countries.

Sitting

Time spent seated each week, people aged 18 years and above
2000
selected countries

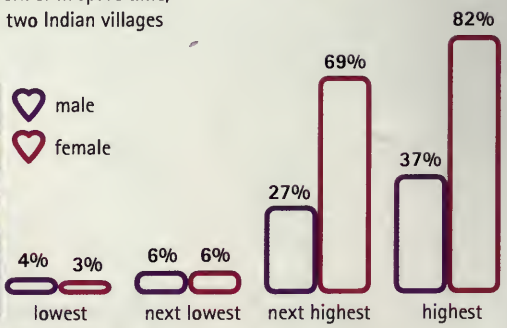
Physical activity

The following activities have similar benefits to health:

- Washing and waxing a car for 45–60 minutes
- Washing windows or floors for 45–60 minutes
- Playing volleyball for 45 minutes
- Wheeling self in wheelchair for 30–40 minutes
- Bicycling 8 km in 30 minutes
- Pushing a pushchair 2.5 km in 30 minutes
- Walking 3 km in 30 minutes
- Swimming laps for 20 minutes
- Playing basketball for 15–20 minutes

Physical inactivity by social class in India

Percentage of time spent seated, at work or in spare time, by people aged 25 years and above in two Indian villages
1993–1995



Physical activity levels

Energy expenditure per week in work, leisure and transport
MET-mins
2002–2003
1 MET is the amount of energy expended while sitting quietly at rest

- 6000 and above
- 3500–5999
- 1300–3499
- below 1300
- no data

Both the intensity and duration of exercise are important in reducing deaths from coronary heart disease.

Being physically inactive increases your risk of coronary heart disease and ischaemic stroke by around 1.5 times.

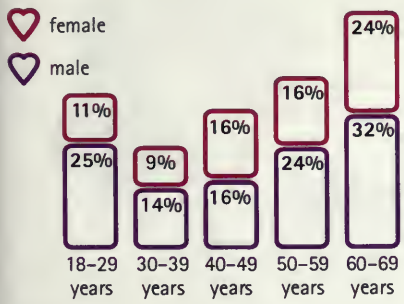
Worldwide, physical inactivity causes about 1.9 million deaths, 20% of cardiovascular disease and 22% of coronary heart disease.

In 1997, in China there were 250 bicycles to every car, while the USA had less than one bicycle to every car.

25% of the world's cars are in the USA, a country with just 5% of the world's population.

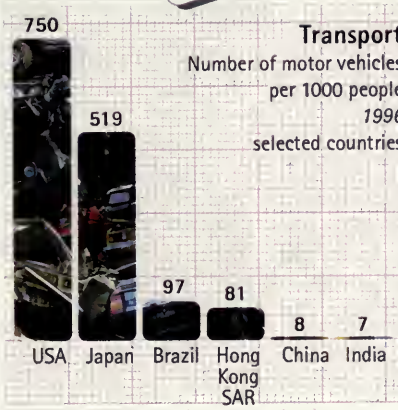
Singapore keeps moving

Percentage participation in any form of sport for at least 20 minutes, on 3 or more days a week, by age
1998



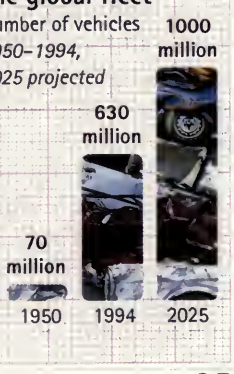
Transport

Number of motor vehicles per 1000 people
1996
selected countries



The global fleet

Number of vehicles
1950–1994, 2025 projected



9 Risk factor: obesity

"Eat less at dinner and you will live to ninety-nine."
Ancient Chinese proverb

Belt size, abdominal girth and waist-to-hip ratio are useful indicators of obesity. The Body Mass Index (BMI), a measure of weight in relation to height, is commonly used for classifying overweight and obesity.

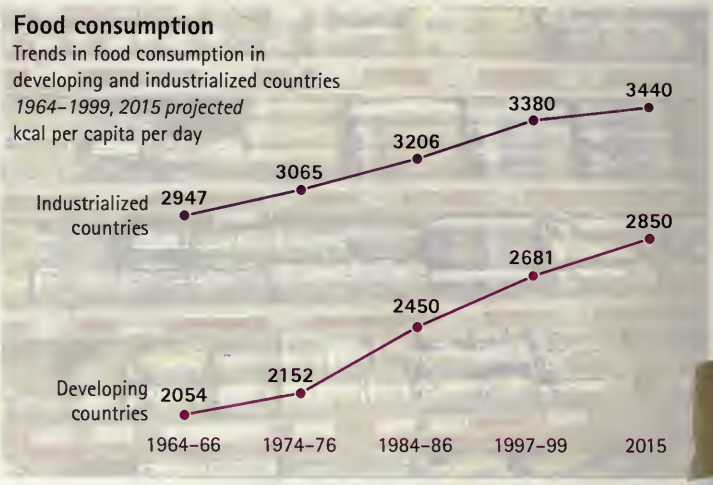
The risks of cardiovascular disease and type 2 diabetes tend to increase on a continuum with increasing BMI, but for practical purposes a person with a BMI of over 25 is considered overweight, while someone with a BMI of over 30 is obese. But one size does not fit all. In women, a BMI as low as 21 may be associated with the greatest protection from coronary heart disease death. The BMI for observed risk in different Asian populations varies from 22 to 25 kg/m^2.

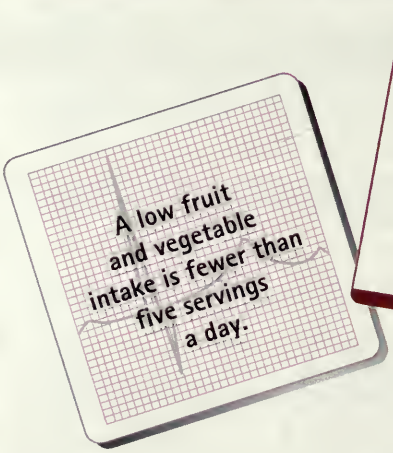
Availability of food, changes in the kind of food eaten, and decreased exercise are presenting humanity with one of its greatest challenges. Low fruit and vegetable intake accounts for about 20% of CVD worldwide. Obese smokers live 14 fewer years than nonsmokers of normal weight.

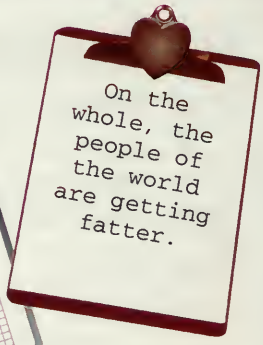
More than 60% of adults in the USA are overweight or obese. Triple-width coffins, capable of holding a 300 kg (700 lb) body, are in increasing demand. Worldwide, airlines are having to recalculate their passenger "payload" weight. There are 70 million overweight people in China. South Pacific populations used to be physically active and slim, but the region now has some of the world's highest rates of obesity.

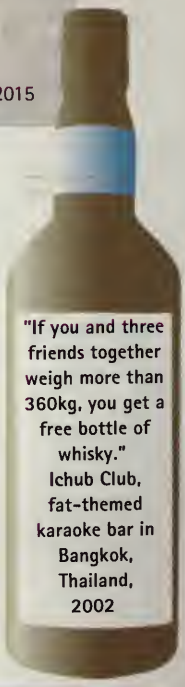
Food consumption

Trends in food consumption in developing and industrialized countries
1964–1999, 2015 projected
kcal per capita per day









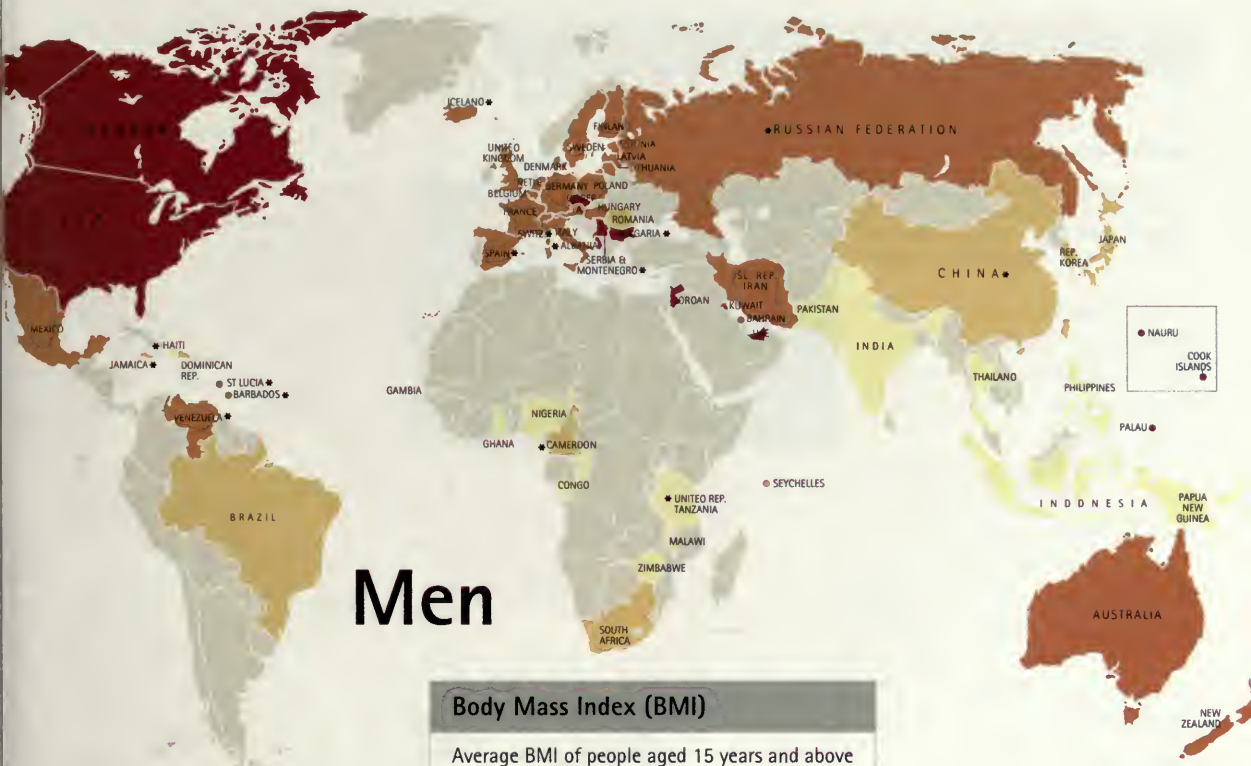
"If you and three friends together weigh more than 360kg, you get a free bottle of whisky."
Ichub Club, fat-themed karaoke bar in Bangkok, Thailand, 2002

Apple shape at higher risk of CVD than pear shape

Waist-to-hip ratio of 0.91 and above is associated with nearly threefold increased risk of coronary heart disease.

Increased CVD risk if:	Men	Women
Waist to hip ratio	more than 0.90	more than 0.85
Waist measurement	more than 101cm (40 inches)	more than 89cm (35 inches)

Cartoon characters used to promote the WeightWise campaign of the British Dietetic Association.

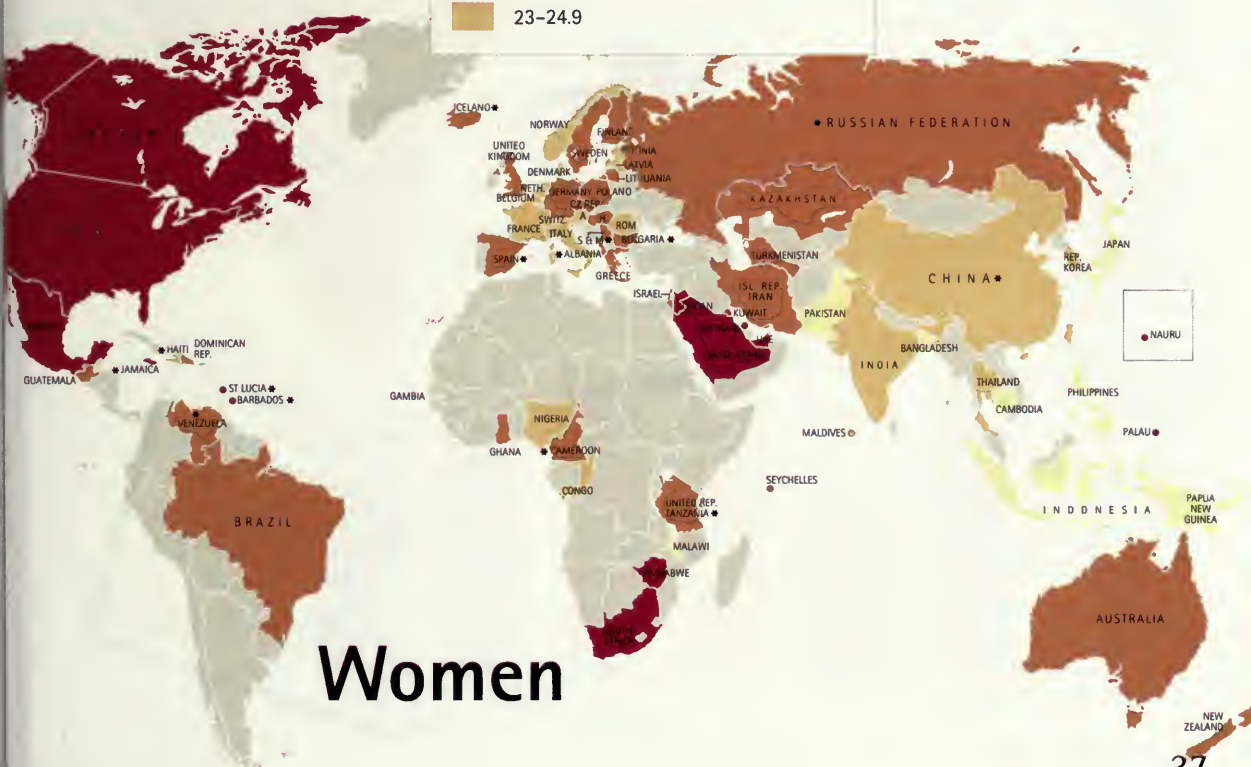


Men

Body Mass Index (BMI)

Average BMI of people aged 15 years and above
estimated to 2005
kg/m²
* data from urban populations only

- 27 and above
- 25–26.9
- 23–24.9
- 18–22.9
- no data



Women

10 Risk factor: diabetes

"The urine of diabetics is wonderfully sweet as if imbued with honey or sugar."
Thomas Willis (1621–1675), physician to King Charles II, England

Diabetes is a risk factor for coronary heart disease and stroke, and is the most common cause of amputation that is not the result of an accident.

Insulin is a hormone produced by the pancreas and used by the body to regulate glucose (sugar). Diabetes occurs when the body does not produce enough insulin, or cannot use it properly, leading to too much sugar in the blood. Symptoms include thirst, excessive urination, tiredness, and unexplained weight loss.

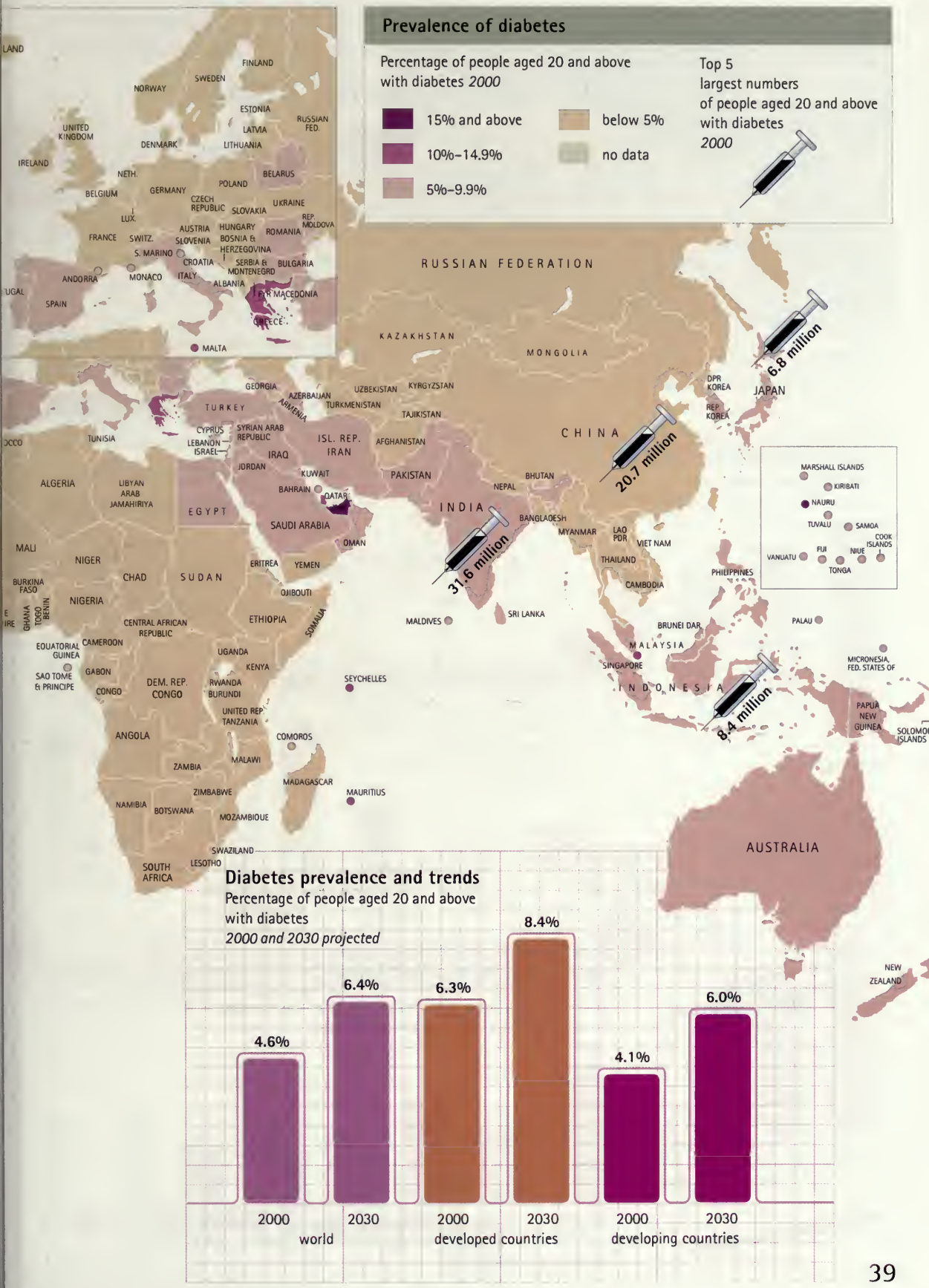
There are two main types of diabetes. Type 1 diabetes, in which the pancreas stops making insulin, accounts for 10% to 15% of cases. The majority of people with diabetes have type 2 disease, in which insulin is produced in smaller amounts than needed, or is not properly effective. This form is preventable, because it is related to physical inactivity, excess calorie intake and obesity. People with type 1 diabetes need insulin injections to lower blood sugar, but many people with type 2 do not.

At least half of all people with diabetes are unaware of their condition. Diabetes is more prevalent in developed countries, but modernization and lifestyle changes are likely to result in a future epidemic of diabetes in developing countries.

Lifestyle changes can be more effective than drugs in preventing type 2 diabetes.

Over 170 million people in the world have diabetes, and the numbers are increasing.

Lifestyle changes in childhood, in particular unhealthy diets and low exercise levels, are leading to an increasing prevalence of type 2 diabetes in children.


Prevalence of diabetes
Percentage of people aged 20 and above with diabetes 2000
15% and above
10%–14.9%
5%–9.9%
below 5%
no data
Top 5 largest numbers of people aged 20 and above with diabetes 2000
6.8 million
20.7 million
31.6 million
8.4 million
RUSSIAN FEDERATION
CHINA
INDIA
INDONESIA
JAPAN
AUSTRALIA
NEW ZEALAND
Diabetes prevalence and trends
Percentage of people aged 20 and above with diabetes
2000 and 2030 projected
4.6%
6.4%
6.3%
8.4%
4.1%
6.0%
2000
2030
world
developed countries
developing countries

11 Risk factor: socioeconomic status

"Wealth is both an enemy and a friend."
Nepalese proverb

In developing countries, coronary heart disease has historically been more common in the more educated and higher socioeconomic groups, but this is beginning to change. In industrial countries, such as Canada, the United Kingdom, and the United States, there is a widening social class difference in the opposite direction.

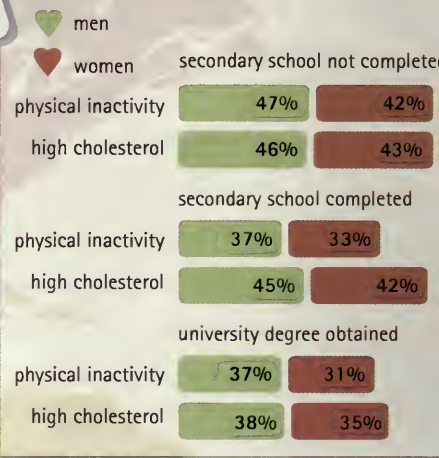
Studies in developed countries suggest that low income is associated with a higher incidence of coronary heart disease, and with higher mortality after a heart attack. The prevalence of risk factors for heart disease, such as high blood pressure, smoking and diabetes, is also higher. The use of medications is lower, especially of lipid-lowering agents and ACE inhibitors, as well as other treatments, such as cardiac catheterization.

The pathways by which socioeconomic status might affect cardiovascular disease include: lifestyle and behaviour patterns; ease of access to health care; and chronic stress.

In Canada, children from poor families are twice as likely to be obese as children from rich families.

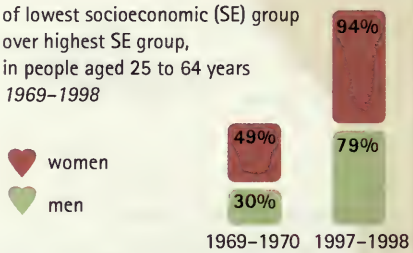
Prevalence of CVD risk factors by education in Canada

Percentage of people aged 18 to 74 years with high levels of physical inactivity and high cholesterol, by educational level, age standardized *1986–1992*



The CVD mortality gap in the USA

Percentage increased CVD mortality of lowest socioeconomic (SE) group over highest SE group, in people aged 25 to 64 years *1969–1998*



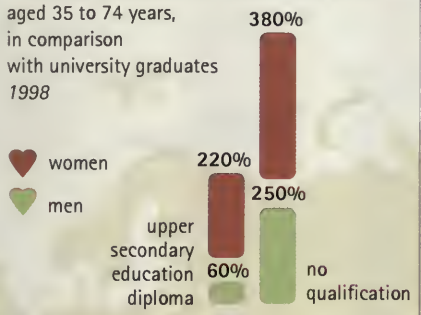
Low socioeconomic status is associated with increased risk of cardiovascular disease.

Prevalence of high blood pressure by income in Trinidad and Tobago

Percentage of women aged 24 to 85 years with blood pressure of 140/90 mmHg or above, or currently treated *2001*

Educational level and obesity in Italy

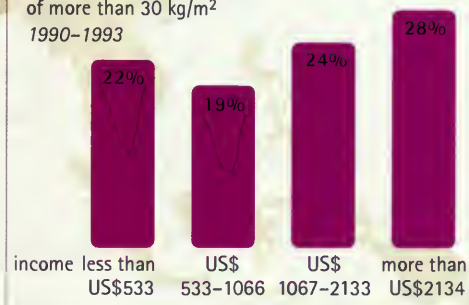
Percentage increased risk of obesity in people aged 35 to 74 years, in comparison with university graduates
1998



In China, years of education are more important than occupation, income or marital status in relation to cardiovascular risk factors, especially cigarette smoking.

Income and obesity in Saudi Arabia

Percentage of people aged 20 years and above with Body Mass Index of more than 30 kg/m²
1990–1993

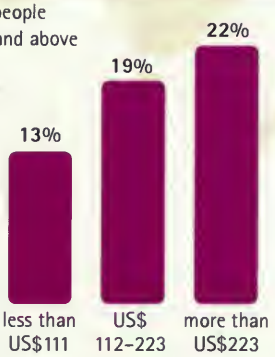


Smoking and occupation in Uganda

Percentage of women aged 15 to 54 years and men aged 15 to 59 years who currently smoke daily by category of work
2000–2001

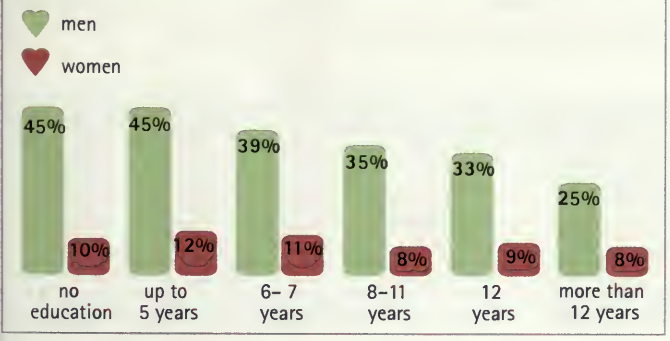
Prevalence of diabetes by income in India

Percentage of people aged 20 years and above with diabetes, by income level
2000



Smoking by years of education in South Africa

Percentage of people aged 15 years and above who currently smoke daily
1998



12 Women: a special case?

Widespread misconceptions persist about heart disease, often thought to be primarily a disease of middle-aged men. In reality, cardiovascular disease affects as many women as men, albeit at an older age. Many women still believe that they are more at risk from cancer than from heart disease.

Risk factors for CVD are similar for men and women, but tobacco use is more dangerous in women. In addition, high blood triglycerides are an important cause of atherosclerosis in young women, but not in young men. The menopause has no direct effect, but hormone replacement therapy increases the risk of CVD.

Heart disease is under-detected in women, particularly younger women. In developed countries, women are less likely to be referred to a heart specialist, to be hospitalized, to be prescribed medicine or invasive treatment, or to be referred for exercise testing or echocardiography. Women are more likely to enter the medical system with the diagnosis of a second heart attack.

After a first stroke, women are kept in hospital longer, and remain more disabled than men receiving similar care. More research is needed to improve our understanding of the differences in responses to treatment in men and women.

In the interim, however, adherence to the published guidelines for the prevention and control of heart disease and stroke seems prudent.

Heart disease and stroke kill as many women as men.

Risk factors

Modifiable risks – risk or prevalence is higher in women than men

- **Tobacco use** (higher risk)
- **High triglyceride levels** (higher risk)
- **Diabetes** (more prevalent)
- **Obesity** (more prevalent)
- **Depression** (more prevalent)

Modifiable risks – risk is similar in men and women

- **High blood pressure**
- **High total cholesterol**
- **Low HDL-cholesterol**
- **Combined hyperlipidaemia**
- **Unhealthy diet**
- **Physical inactivity**
- **Stress**

Risks for women only

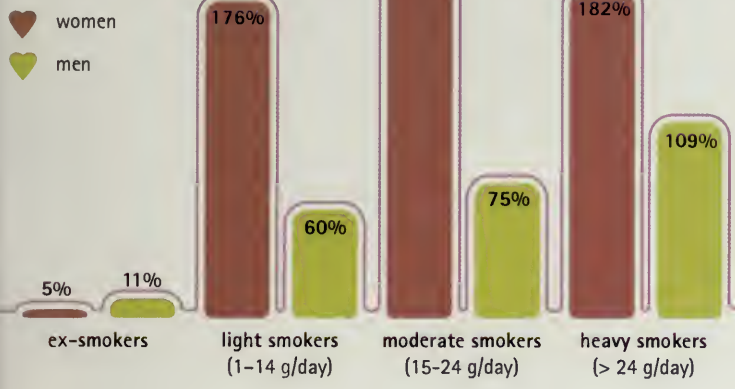
- **Oral contraceptive use**
- **Hormone replacement therapy**
- **Polycystic ovary syndrome**
- **Risk of heart attack highest early in each menstrual cycle**

Non-modifiable risks for men and women

- **Advancing age**
- **Gender**
- **Heredity**
- **Ethnicity/race**

Smoking

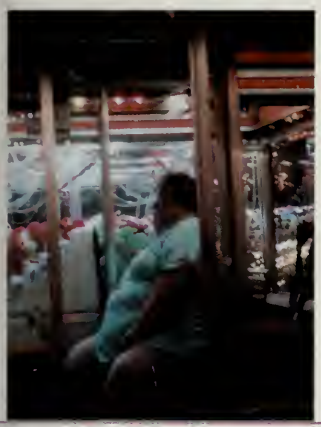
Percentage increase in risk of heart attack in people who smoke in Denmark
1976–1993

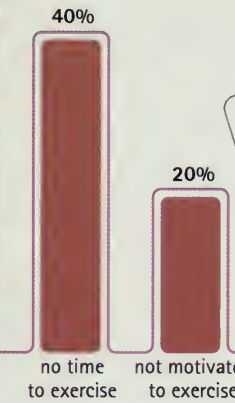


Women who smoke are at higher risk of heart attack than men who smoke.

No time to walk

Percentage of women in the United Kingdom aged 15 years and above who do not exercise more because of lack of time or motivation
2003

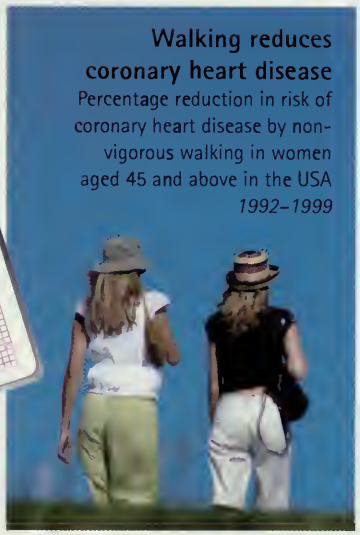




25% of women in the United Kingdom never exercise.

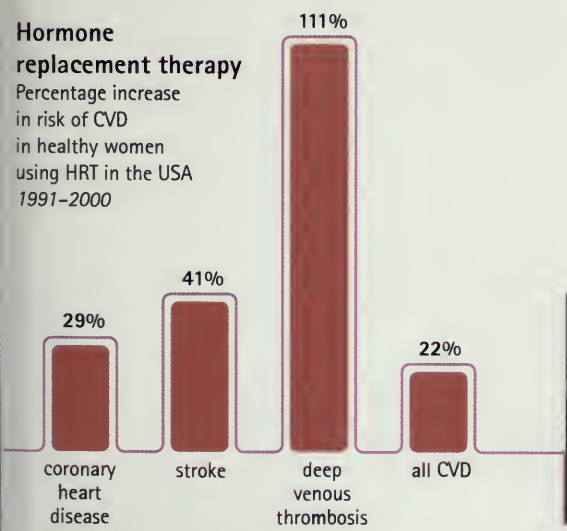
Walking reduces coronary heart disease

Percentage reduction in risk of coronary heart disease by non-vigorous walking in women aged 45 and above in the USA
1992–1999



Hormone replacement therapy

Percentage increase in risk of CVD in healthy women using HRT in the USA
1991–2000



THE BURDEN

"You don't get to choose how you're going to die, or when. You can only decide how you're going to live now."

Joan Baez, folk singer and activist, USA (1941–)

13 Global burden of coronary heart disease

"Misfortunes always come in by a door that has been left open for them."
Czechoslovakian proverb

Disability-adjusted life years (DALYs) lost can be thought of as "healthy years of life lost". They indicate the total burden of a disease, as opposed to simply the resulting deaths.

Cardiovascular disease is responsible for 10% of DALYs lost in low- and middle-income countries, and 18% in high-income countries.

A heart attack occurs when the blood vessels supplying the heart muscle become blocked, starving it of oxygen, leading to the heart muscle's failure or death. Heart attack has the same risk factors as CVD in general. Cold weather, exercise, or strong emotion can precipitate a heart attack.

Coronary heart disease is decreasing in many developed countries, but is increasing in developing and transitional countries, partly as a result of increasing longevity, urbanization, and lifestyle changes.

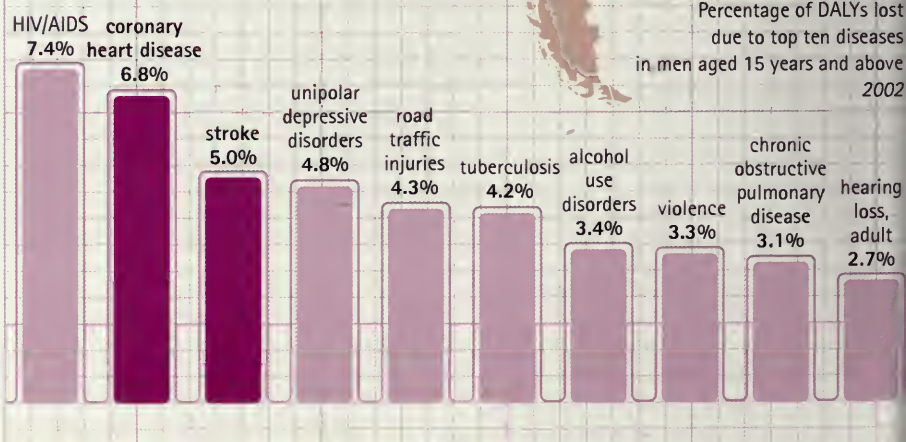
Risk of heart attack can change when people migrate. Japan has a low rate of coronary heart disease, but after moving to the USA, Japanese people have been found to have a gradually increasing risk. This eventually approaches that of people born in the USA.

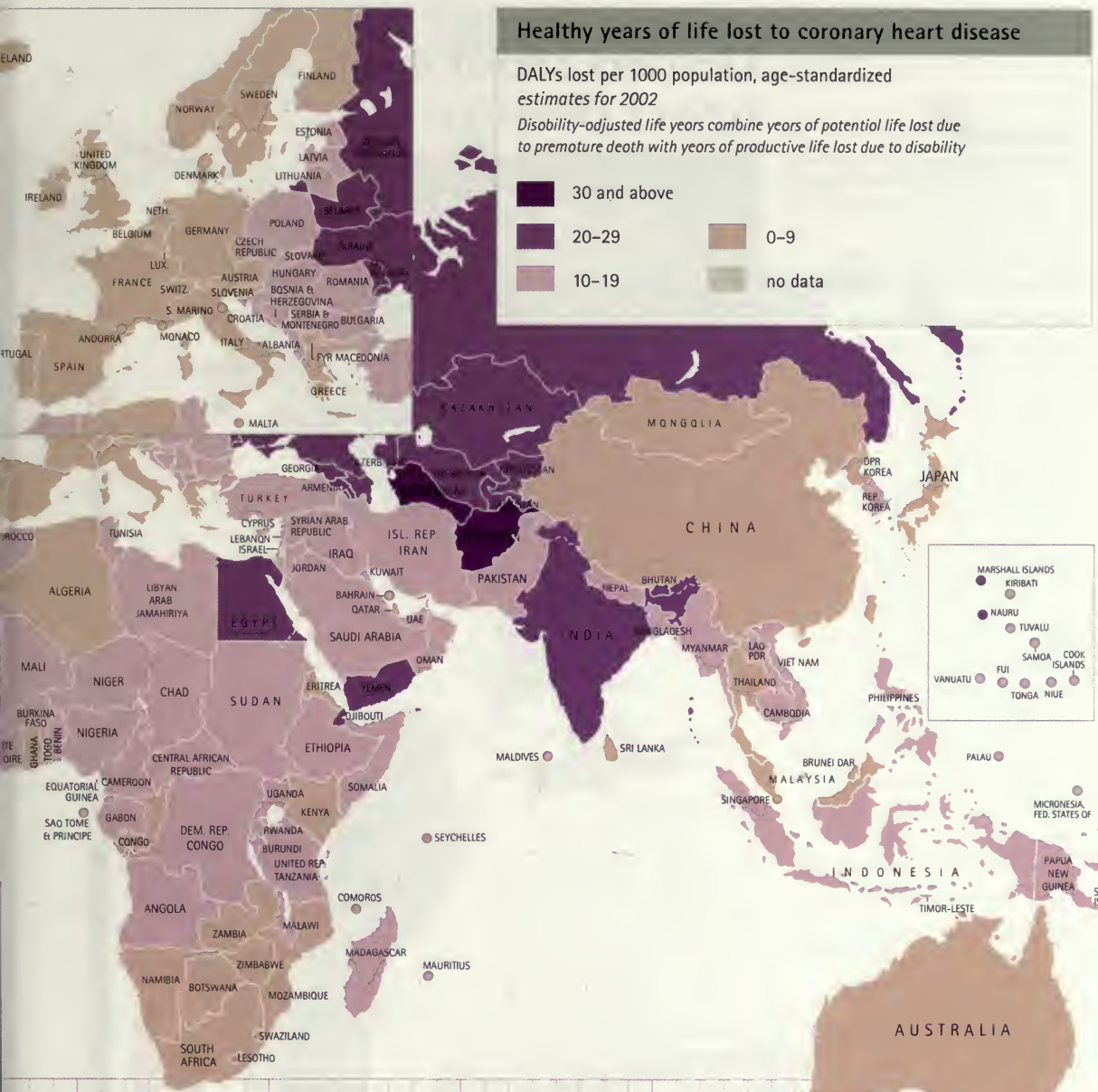
Coronary heart disease burden is projected to rise from around 47 million DALYs globally in 1990 to 82 million DALYs in 2020.

More than 60% of the global burden of coronary heart disease occurs in developing countries.

Disease burden in men

Percentage of DALYs lost due to top ten diseases in men aged 15 years and above *2002*




Healthy years of life lost to coronary heart disease
DALYs lost per 1000 population, age-standardized
estimates for 2002
Disability-adjusted life yeors combine yeors of potentiol life lost due to premoture deoth with yeors of productive life lost due to disability
30 and above
20–29
10–19
0–9
no data
FINLAND
SWEDEN
NORWAY
ESTONIA
LATVIA
LITHUANIA
DENMARK
UNITED KINGDOM
IRELAND
NETH.
BELGIUM
GERMANY
POLAND
CZECH REPUBLIC
SLOVAKIA
LUX.
FRANCE
SWITZ.
AUSTRIA
SLOVENIA
HUNGARY
ROMANIA
BOSNIA & HERZEGOVINA
S. MARINO
CROATIA
SERBIA & MONTENEGRO
BULGARIA
ANDORRA
MONACO
ITALY
ALBANIA
FYR MACEDONIA
SPAIN
GREECE
MALTA
KAZAKHSTAN
MONGOLIA
GEORGIA
ARMENIA
TURKEY
CYPRUS
LEBANON
ISRAEL
SYRIAN ARAB REPUBLIC
IRAQ
JORDAN
KUWAIT
ISL. REP. IRAN
PAKISTAN
BAHRAIN
QATAR
UAE
SAUDI ARABIA
EGYPT
TUNISIA
ALGERIA
LIBYAN ARAB JAMAHIRIYA
MALI
NIGER
CHAD
SUDAN
ERITREA
YEMEN
DJIBOUTI
OMAN
BURKINA FASO
NIGERIA
ETHIOPIA
CENTRAL AFRICAN REPUBLIC
EQUATORIAL GUINEA
CAMEROON
GABON
SAO TOME & PRINCIPE
CONGO
DEM. REP. CONGO
UGANDA
KENYA
RWANDA
BURUNDI
UNITED REP. TANZANIA
SOMALIA
SEYCHELLES
COMOROS
ANGOLA
ZAMBIA
MALAWI
ZIMBABWE
MADAGASCAR
MAURITIUS
NAMIBIA
BOTSWANA
MOZAMBIQUE
SWAZILAND
SOUTH AFRICA
LESOTHO
CHINA
DPR KOREA
REP. KOREA
JAPAN
INDIA
NEPAL
BHUTAN
BANGLADESH
MYANMAR
LAO PDR
VIET NAM
THAILAND
CAMBODIA
PHILIPPINES
MALDIVES
SRI LANKA
BRUNEI DAR.
MALAYSIA
SINGAPORE
INDONESIA
TIMOR-LESTE
PAPUA NEW GUINEA
SOLOMON ISLANDS
PALAU
MICRONESIA, FED. STATES OF
MARSHALL ISLANDS
KIRIBATI
NAURU
TUVALU
SAMOA
COOK ISLANDS
FIJI
VANUATU
TONGA
NIUE
AUSTRALIA
NEW ZEALAND
Disease burden in women
Percentage of DALYs lost due to top ten diseases in women aged 15 years and above
2002
unipolar depressive disorders 8.4%
HIV/AIDS 7.2%
coronary heart disease 5.3%
stroke 5.2%
cataracts 3.1%
hearing loss 2.8%
chronic obstructive pulmonary disease 2.7%
tuberculosis 2.6%
osteo-arthritis 2.0%
diabetes mellitus 1.9%

14 Deaths from coronary heart disease

"People live with their own idiosyncrasies and die of their own illnesses."
Vietnamese proverb

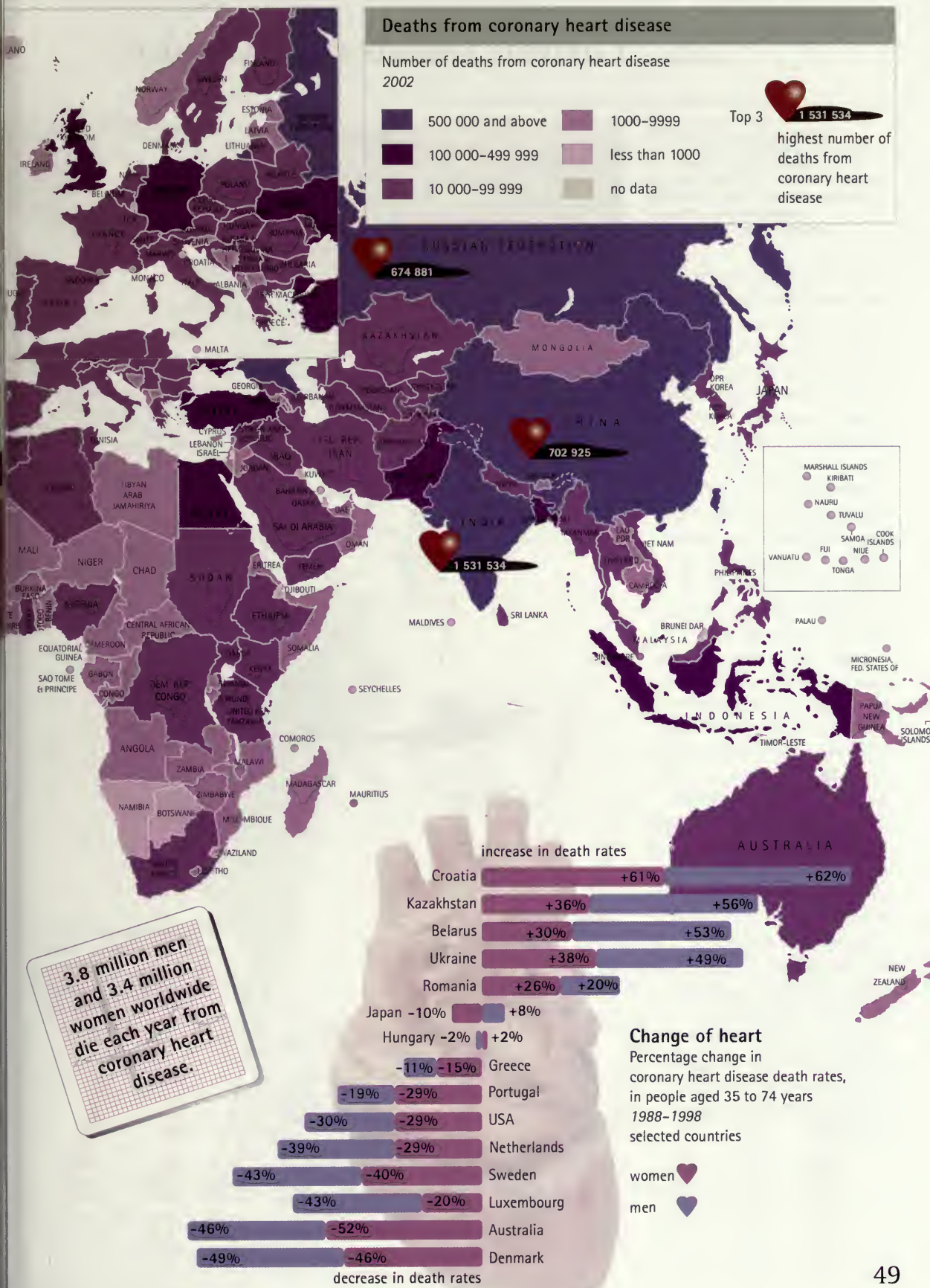
Civilization kills. Since 1990, more people have died from coronary heart disease than from any other cause. Unlike stroke, coronary heart disease is a comparative newcomer on the world stage. Variations in death rates are marked: they are lower in populations with short life expectancy.

Heart disease mortality rates are also affected by differences between countries in the major risk factors, especially blood pressure, blood cholesterol, smoking, physical activity and diet. While genetic factors play a part, 80% to 90% of people dying from coronary heart disease have one or more major risk factors that are influenced by lifestyle.

Death rates from coronary heart disease have decreased in North America and many western European countries. This decline has been due to improved prevention, diagnosis, and treatment, in particular reduced cigarette smoking among adults, and lower average levels of blood pressure and blood cholesterol. It is expected that 82% of the future increase in coronary heart disease mortality will occur in developing countries.

Of all coronary heart disease patients who die within 28 days after the onset of symptoms, about two-thirds die before reaching hospital. This highlights not only the need for early recognition of the warning signs of a heart attack, but also the need for prevention.

Despite improvements in survival rates, in the USA 1 in 4 men and 1 in 3 women still die within a year of a recognized first heart attack


Deaths from coronary heart disease
Number of deaths from coronary heart disease
2002
500 000 and above
100 000–499 999
10 000–99 999
1000–9999
less than 1000
no data
Top 3
1 531 534
highest number of deaths from coronary heart disease
674 881
702 925
1 531 534
RUSSIAN FEDERATION
KAZAKHSTAN
MONGOLIA
CHINA
INDIA
JAPAN
INDONESIA
AUSTRALIA
NEW ZEALAND
MARSHALL ISLANDS
KIRIBATI
NAURU
TUVALU
SAMOA
COOK ISLANDS
NIUE
FIJI
TONGA
VANUATU
MALTA
MALDIVES
SRI LANKA
SEYCHELLES
COMOROS
MAURITIUS
PALAU
MICRONESIA, FED. STATES OF
PAPUA NEW GUINEA
SOLOMON ISLANDS
TIMOR-LESTE
increase in death rates
Croatia +61% +62%
Kazakhstan +36% +56%
Belarus +30% +53%
Ukraine +38% +49%
Romania +26% +20%
Japan -10% +8%
Hungary -2% +2%
-11% -15% Greece
-19% -29% Portugal
-30% -29% USA
-39% -29% Netherlands
-43% -40% Sweden
-43% -20% Luxembourg
-46% -52% Australia
-49% -46% Denmark
decrease in death rates
Change of heart
Percentage change in coronary heart disease death rates, in people aged 35 to 74 years
1988–1998
selected countries
women
men
3.8 million men and 3.4 million women worldwide die each year from coronary heart disease.

15 Global burden of stroke

"I waked and sat up...when I felt a confusion and indistinctness in my head which lasted, I suppose about half a minute. Soon after I perceived that I had suffered a paralytick stroke, and that my Speech was taken from me."
Samuel Johnson, England, 1783

The increased risk of stroke from taking oral contraceptive pills is substantially reduced by using the modern, low-dose pill.

Stroke is the brain equivalent of a heart attack. Blood must flow to and through the brain for it to function. If its flow is obstructed, by a blood clot moving to the brain, or by narrowing or bursting of blood vessels, the brain loses its energy supply, causing damage to tissues leading to stroke.

Annually, 15 million people worldwide suffer a stroke. Of these, 5 million die and another 5 million are left permanently disabled, placing a burden on family and community. Stroke is uncommon in people under 40 years; when it does occur, the main cause is high blood pressure. Stroke also occurs in about 8% of children with sickle cell disease.

The major risk factors for stroke are similar to those for coronary heart disease, with high blood pressure and tobacco use the most significant modifiable risks. Atrial fibrillation, heart failure and heart attack are other important risk factors.

The incidence of stroke is declining in many developed countries, largely as a result of better control of high blood pressure, and reduced levels of smoking. However, the absolute number of strokes continues to increase because of the ageing population.


Healthy years of life lost to stroke
DALYs lost per 1000 population, age-standardized
2002
Disability-adjusted life years combine years of potential life lost due to premature death with years of productive life lost due to disability
20 and above
15–19
10–14
5–9
below 5
no data
Stroke in young people
Number of new cases of stroke per 100 000 people per year
selected populations
1986–1997
10
9
14
3
47
47
14
33
25
26
10
age 17–49 years
Israel
15–44
Italy
Florence
15–44
Italy
North
0–39
Kuwait
40–49
Kuwait
15–40
Libyan Arab Jamahiriya
Benghazi
20–54
South Africa
Blacks
11–50
Spain
Cantabria
20–44
USA
Northern Manhattan
Blacks
20–44
USA
Northern Manhattan
Hispanics
20–44
USA
Northern Manhattan
Whites

16 Deaths from stroke

Stroke carries a high risk of death. Survivors can experience loss of vision and/or speech, paralysis, and confusion. Historically called "apoplexy", "stroke" is so called because of the way it strikes people down.

Previous stroke significantly increases risk of further episodes. Certain racial, ethnic and socioeconomic groups are also at greater risk of stroke. The most important modifiable cause of stroke is high blood pressure; for every ten people who die of stroke, four could have been saved if their blood pressure had been regulated. Among those aged under 65, two-fifths of deaths from stroke are linked to smoking. Other modifiable risk factors include unhealthy diet, high salt intake, underlying heart disease, diabetes and high blood lipids.

The risk of death depends on the type of stroke. Transient ischaemic attack or TIA – where symptoms resolve in less than 24 hours – has the best outcome, followed by stroke caused by carotid stenosis (narrowing of the artery in the neck that supplies blood to the brain). Blockage of an artery is more dangerous, with rupture of a cerebral blood vessel the most dangerous of all.

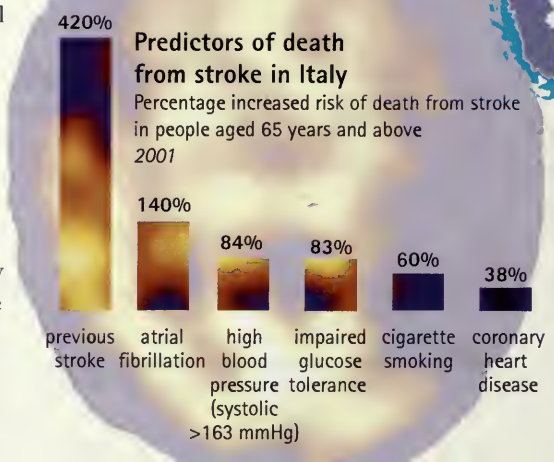
Even where advanced technology and facilities are available, 60% of those who suffer a stroke die or become dependent. Given these dismal statistics and the high cost of treatment of stroke, high priority should be accorded to preventive strategies.

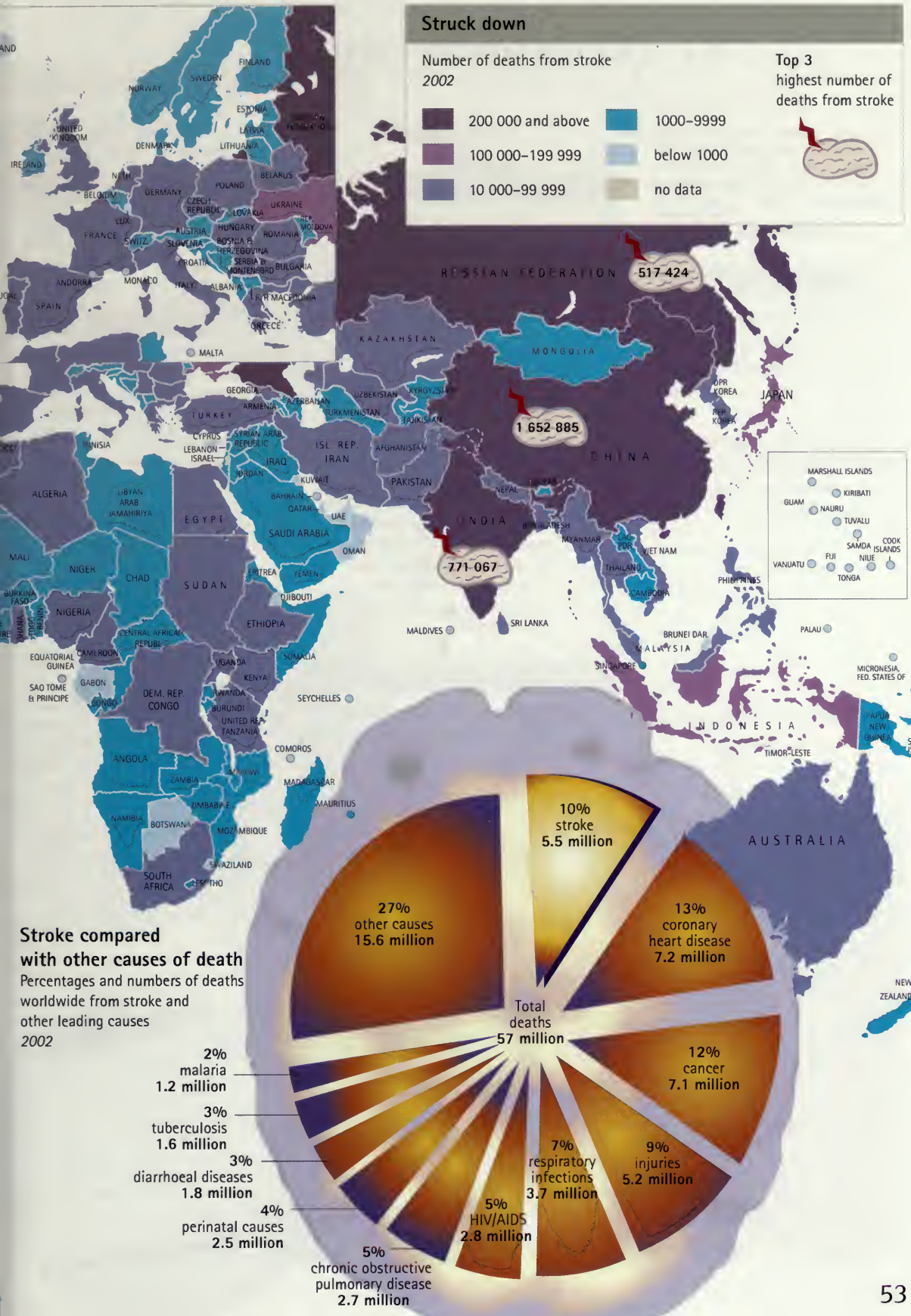
Stroke is the second leading cause of death above the age of 60 years, and the fifth leading cause in people aged 15 to 59 years old.

In the USA, someone dies of a stroke every three minutes.

Worldwide, 3 million women and 2.5 million men die from stroke every year.

Stroke is the third most common cause of death in developed countries, exceeded only by coronary heart disease and cancer.





Stroke compared with other causes of death

Percentages and numbers of deaths worldwide from stroke and other leading causes

2002

17 Economic costs

"The art of economics consists in looking not merely at the immediate but at the longer effects of any act or policy; it consists in tracing the consequences of that policy not merely for one group but for all groups."
Henry Hazlitt, USA (1894–1993)

The costs of cardiovascular disease are diverse: the cost to the individual and to the family of heath care and time off work; the cost to government of health care; and the cost to the country of lost productivity.

We attempt here to quantify some of these costs. However, the value of a human life is beyond our analysis.

Global costs of smoking

Health care costs associated with smoking-related illnesses result in a global net loss of US$200 billion per year, with one third of those losses occurring in developing countries. Estimated 1994.

Latin America and the Caribbean

Permanent disabilities resulting from diabetes cost US$50 billion in 2000, while costs associated with insulin, hospitalization, consultations and care totalled US$10.6 billion.

Global costs of diabetes

Between 4% and 5% of health budgets are spent on diabetes-related illnesses.
WHO, 2003

USA, Australia and Europe

2002 reports indicate that up to 10% of health budgets are spent on diabetes-related illnesses.

USA

"If just 10% of adults began walking regularly, Americans could save US$5.6 billion in costs related to heart disease." – President George W. Bush, 2002.

The direct costs of physical inactivity accounted for an estimated US$24 billion in health care costs in 1995.

Health problems related to obesity, such as heart disease and type 2 diabetes, cost the USA an estimated US$177 billion a year.

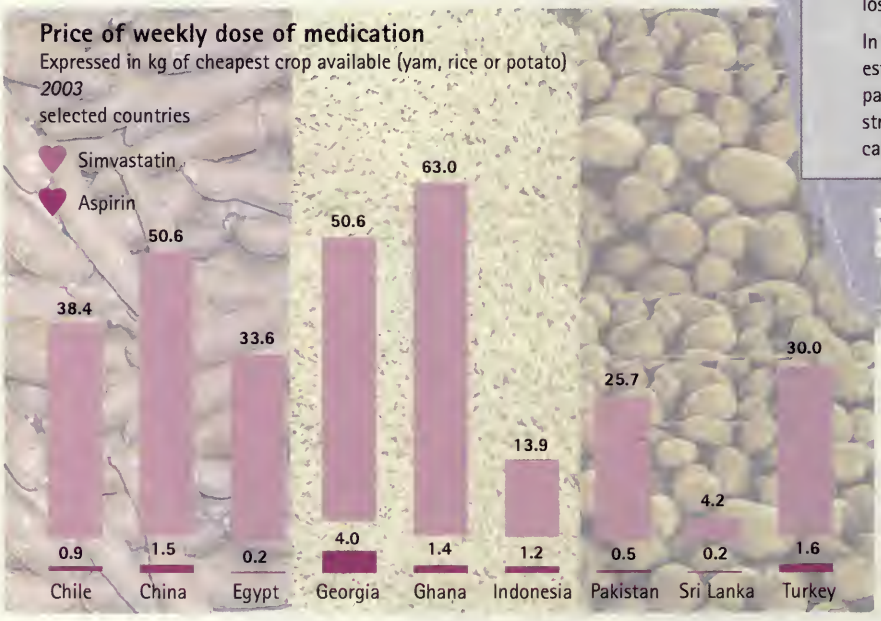
Cholesterol reducers were the top-selling medications in 2003, generating US$13.9 billion in sales.

The American Heart Association estimates that stroke will cost a total of US$53.6 billion in 2004. Direct costs for medical care and therapy will average US$33 billion and indirect costs from lost productivity will be US$20.6 billion.

In 2001, the National Stroke Association estimated that the average cost per patient for the first 90 days after a stroke was US$15 000, although 10% of cases cost more than US$35 000.

Price of weekly dose of medication

Expressed in kg of cheapest crop available (yam, rice or potato)
2003
selected countries



There is at least one intervention that can be afforded even by low-income countries.

The economics of CVD

physical exercise
stroke
diabetes
obesity
CVD
cholesterol
tobacco

United Kingdom

"The direct cost of obesity to the National Health Service is £0.5 billion [about US$0.9 billion] per year, while the indirect cost to the UK economy is at least £2 billion [about US$3.5 billion]."
– Liam Donaldson, Chief Medical Officer, 2003

More than 4% of National Health Service spending was on stroke services in 2000.

Global costs of heart disease medication

The number of people who die or are disabled by coronary heart disease and stroke could be halved with wider use of a combination of drugs that costs just US$14 a year.
WHO, 2002

Netherlands

The average total costs of care per patient for six months following a stroke were estimated at €16 000 in 2003.

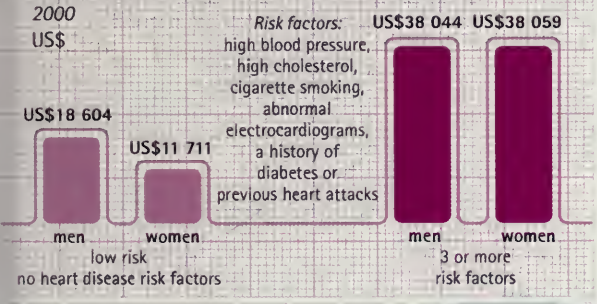
Stroke was estimated to be responsible for 3% of total health care costs in the Netherlands in 1994, and 7% of costs for the population aged 75 and over. Stroke ranked second on the list of most costly diseases for the elderly, after dementia, and these costs are expected to increase by 40% by 2015.

Singapore

Average hospital costs for stroke were reported in 2000 as US$5000 per patient. Ward charges accounted for 38%, radiology 15%, doctors' fees 10%, medications 8%, therapy 7%.

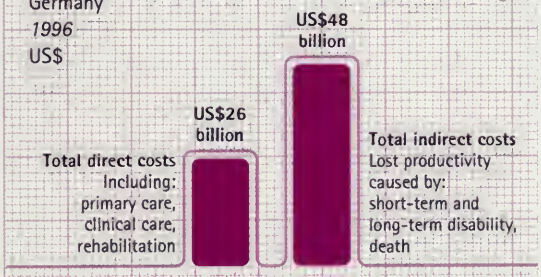
The cost of risk factors

Cumulative Medicare costs of treatment of cardiovascular disease in people aged 65 years to death, in the USA
2000
US$



Lifetime costs of coronary heart disease

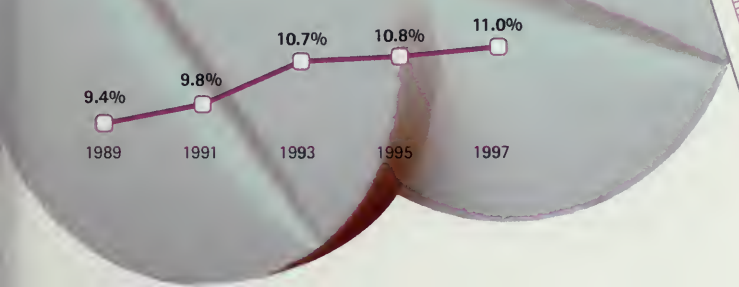
Germany
1996
US$



Average cost per case: US$82 000

Expenditure on cardiovascular medications

Percentage of total annual drug expenditure
1989–1997
OECD countries



Aspirin remains the least expensive drug for secondary prevention.

PART 4

ACTION

"Keeping your body healthy is an expression of gratitude to the whole cosmos, the trees, the clouds, everything."

Most Venerable Thich Nhat Hanh, Vietnamese Buddhist monk (1926–)

18 Research

"Science knows no country, because knowledge belongs to humanity, and is the torch that illuminates the world."
Louis Pasteur, France (1822–1892)

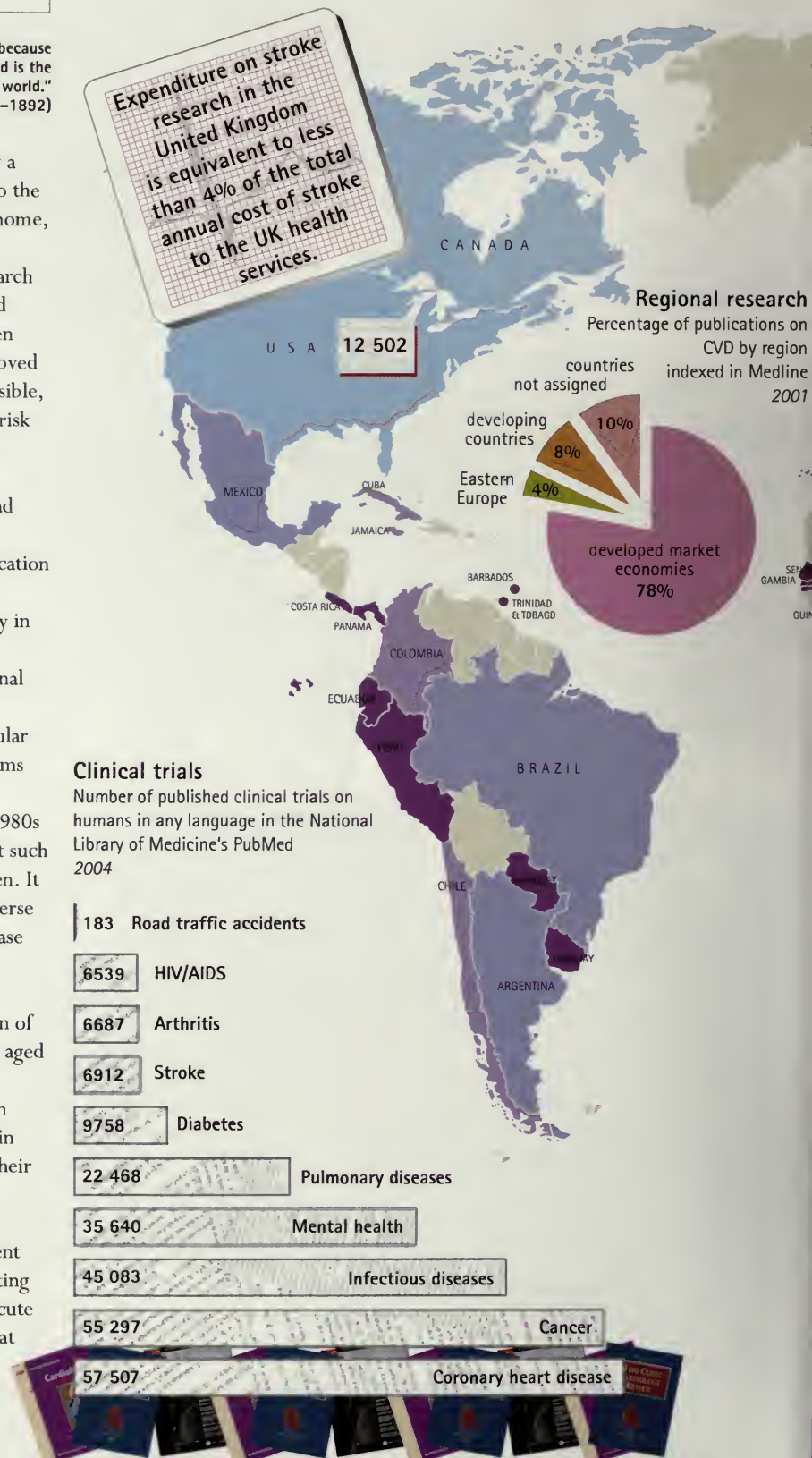
From the description of how a heart muscle cell contracts to the elucidation of the human genome, scientific advances in basic, clinical, and population research in cardiovascular disease, and their global impact, have been phenomenal. New and improved treatments have become possible, and novel markers of future risk have been identified.

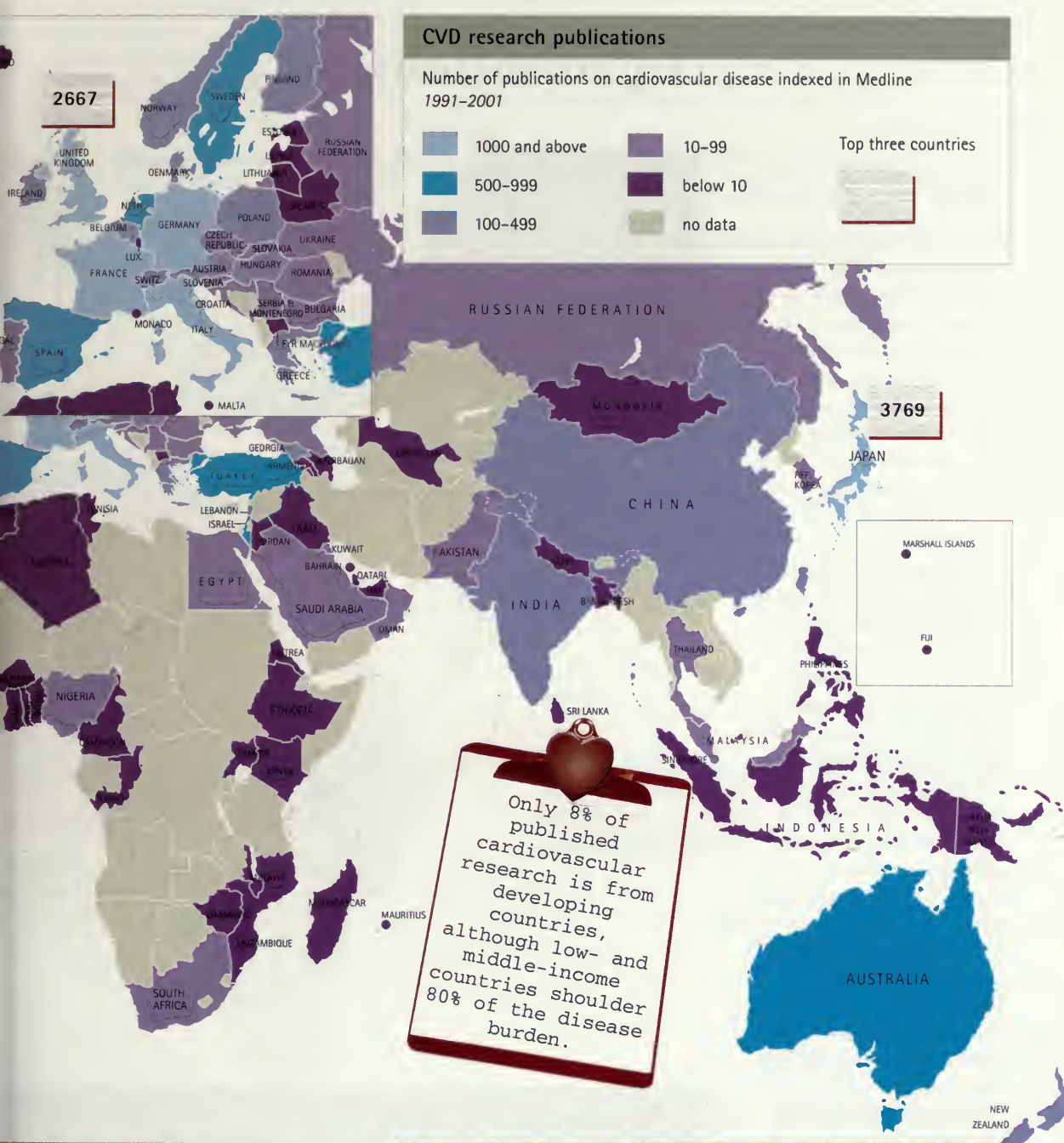
Yet several key challenges remain. There is a widespread lack of research capacity, standardized data, communication networks, and human and financial resources, especially in developing countries.

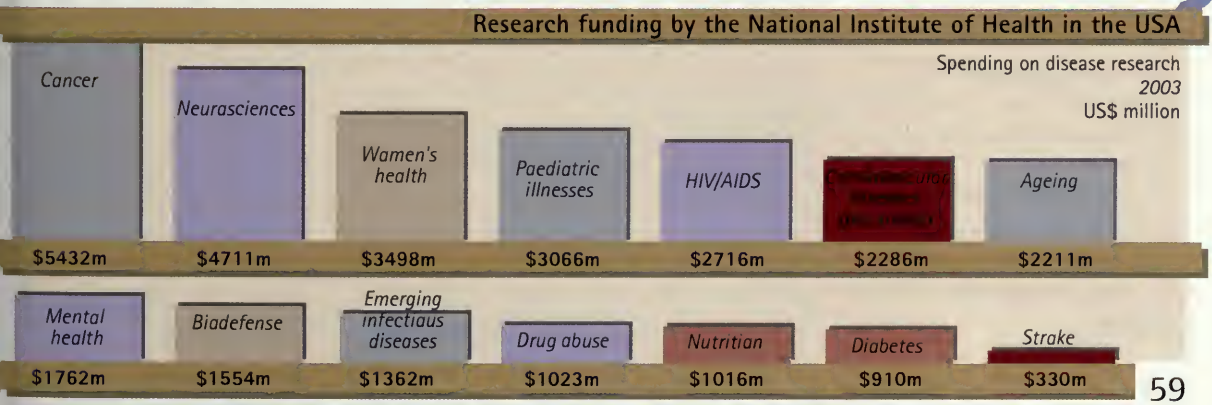
The MONICA (Multinational MONItoring of trends and determinants in CArdiovascular disease) Project involved teams from 38 populations in 21 countries from the mid-1980s to the mid-1990s, the largest such collaboration ever undertaken. It was set up to explain the diverse trends in cardiovascular disease mortality observed from the 1970s onwards. The project monitored a study population of 10 million men and women, aged 25 to 64 years.

MONICA was important in measuring levels and trends in cardiovascular diseases and their risk factors in different populations, in monitoring prevention policies in different countries, and in demonstrating the importance of the new acute and long-term treatments that were being introduced.

Expenditure on stroke research in the United Kingdom is equivalent to less than 4% of the total annual cost of stroke to the UK health services.




CVD research publications
Number of publications on cardiovascular disease indexed in Medline
1991–2001
1000 and above
500–999
100–499
10–99
below 10
no data
Top three countries
2667
3769
RUSSIAN FEDERATION
CHINA
JAPAN
INDIA
AUSTRALIA
NEW ZEALAND
INDONESIA
EGYPT
SAUDI ARABIA
NIGERIA
SOUTH AFRICA
MARSHALL ISLANDS
FIJI
Only 8% of published cardiovascular research is from developing countries, although low- and middle-income countries shoulder 80% of the disease burden.


Research funding by the National Institute of Health in the USA
Spending on disease research
2003
US$ million
Cancer $5432m
Neurasciences $4711m
Women's health $3498m
Paediatric illnesses $3066m
HIV/AIDS $2716m
Ageing $2211m
Mental health $1762m
Biodefense $1554m
Emerging infectious diseases $1362m
Drug abuse $1023m
Nutrition $1016m
Diabetes $910m
Stroke $330m

19 Organizations

"Don't agonize. Organize."
Florynce Kennedy, Lawyer, and Civil and Womens' Rights Activist (1916–2000)

The World Health Organization's Cardiovascular Disease Programme is conducted through its Geneva headquarters, and regional and national offices worldwide. The World Heart Federation helps people achieve a longer, better life through prevention and control of heart disease and stroke, focusing on low- and middle-income countries.

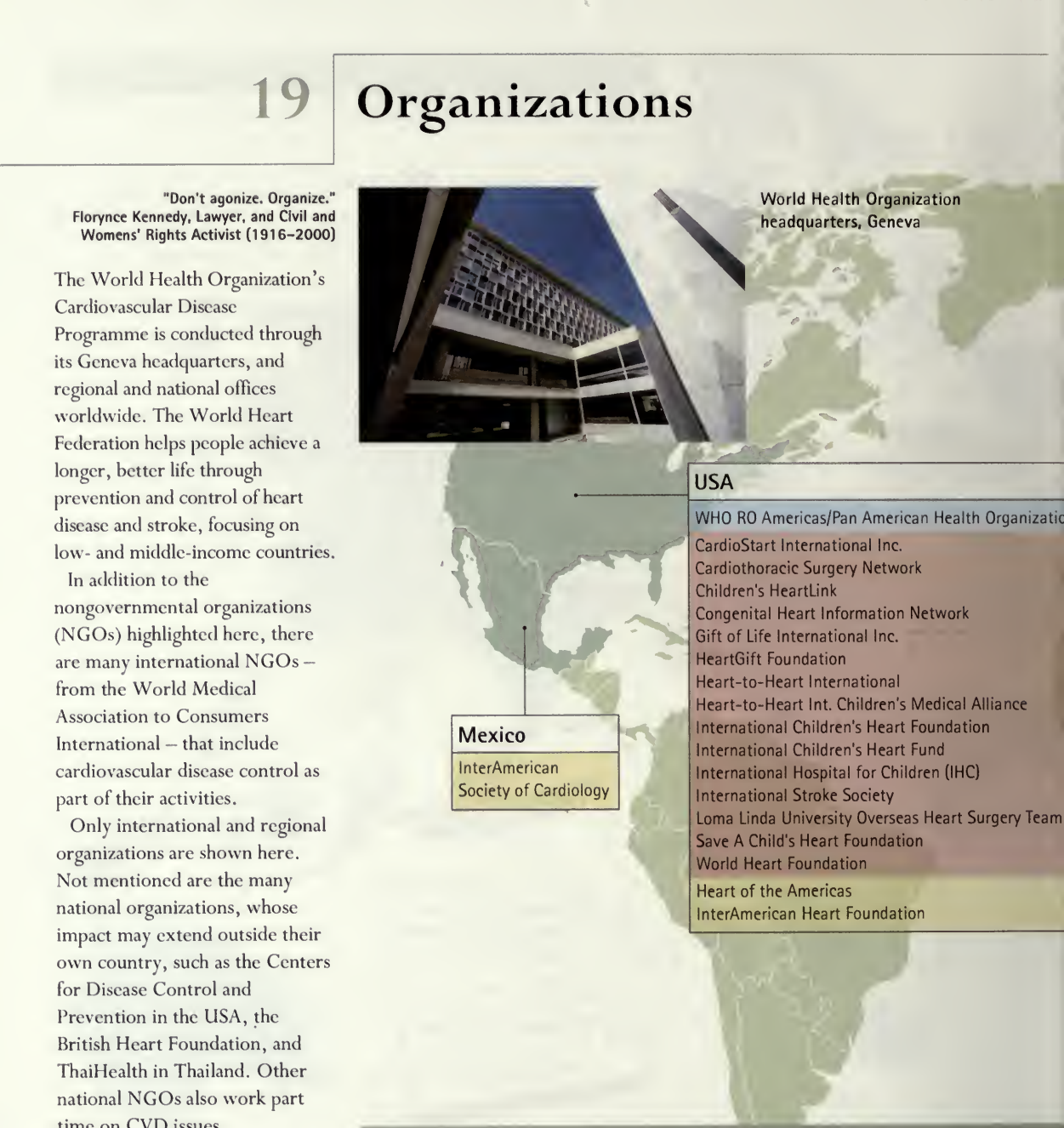
In addition to the nongovernmental organizations (NGOs) highlighted here, there are many international NGOs – from the World Medical Association to Consumers International – that include cardiovascular disease control as part of their activities.

Only international and regional organizations are shown here. Not mentioned are the many national organizations, whose impact may extend outside their own country, such as the Centers for Disease Control and Prevention in the USA, the British Heart Foundation, and ThaiHealth in Thailand. Other national NGOs also work part time on CVD issues.

There are numerous other partners in a vast arena of varied but related interests, including organizations involved with women, youth, law, economics, human rights, religion and development.

The capacity of virtually all cardiovascular disease control organizations is inadequate to meet the challenge of the CVD epidemic.

World Health Organization headquarters, Geneva



USA

WHO RO Americas/Pan American Health Organizatic
CardioStart International Inc.
Cardiothoracic Surgery Network
Children's HeartLink
Congenital Heart Information Network
Gift of Life International Inc.
HeartGift Foundation
Heart-to-Heart International
Heart-to-Heart Int. Children's Medical Alliance
International Children's Heart Foundation
International Children's Heart Fund
International Hospital for Children (IHC)
International Stroke Society
Loma Linda University Overseas Heart Surgery Team
Save A Child's Heart Foundation
World Heart Foundation

Heart of the Americas
InterAmerican Heart Foundation

Mexico

InterAmerican Society of Cardiology

World Conferences on Cardiovascular Diseases

World Congresses of Cardiology

1st	1974	Buenos Aires, Argentina
2nd	1978	Tokyo, Japan
3rd	1982	Moscow, Russian Federation
4th	1986	Washington, DC, USA
5th	1990	Manila, Philippines
6th	1994	Berlin, Germany
7th	1998	Rio de Janeiro, Brazil
8th	2002	Sydney, Australia
9th	2006	Barcelona, Spain

International Conferences on Preventive Cardiology

1st	1985	Moscow, USSR
2nd	1989	Washington, DC, USA
3rd	1993	Oslo, Norway
4th	1997	Montreal, Canada
5th	2001	Osaka, Japan
6th	2005	Iguassu, Brazil

World Stroke Congresses

1st	1989	Kyoto, Japan
2nd	1992	Washington, DC, USA
3rd	1996	Munich, Germany
4th	2000	Melbourne, Australia
5th	2004	Vancouver, Canada

International Heart Health Conferences

1st	1992	Victoria, British Columbia, Canada
2nd	1995	Barcelona, Spain
3rd	1998	Singapore
4th	2001	Osaka, Japan
5th	2004	Milan, Italy

20 Prevention: personal choices and actions

"No matter how far you have gone on the wrong road, turn back."
Turkish proverb

Good control of blood pressure, blood cholesterol and blood sugar levels, and other cardiovascular risk factors is the key to reducing risks of heart disease and stroke.

Personal behaviour and lifestyle choices can make a big difference to the risk of coronary heart disease and stroke. It is estimated that having a high-risk lifestyle may account for 82% of coronary events in women. Here, we identify personal choices that can lower individual risk for heart disease and stroke. The choices apply to young people and adults alike.

Personal choices in lifestyles and behaviour

1 Take moderate physical activity for a total of 30 minutes on most days of the week.
2 Avoid tobacco use and exposure to environmental smoke; make plans to quit if you already smoke.
3 Choose a diet rich in fruits, vegetables and potassium, and avoid saturated fats and calorie-dense meals.
4 Maintain a normal body weight; if you are overweight, lose weight by increasing physical activity and reducing calorie intake.
5 Reduce stress at home and at work.

The keys to weight loss are to take in less energy than you expend, and to exercise.

Personal actions for safeguarding cardiovascular health

1 Discuss all questions with your health care provider.
2 Have regular check-ups from your health care provider.
3 Have your blood pressure and levels of blood sugar and cholesterol checked.
4 Follow your health care provider's instructions regarding physical activity, nutrition, weight management, and any medications you have been prescribed.
5 Know the signs and symptoms of heart attack and stroke and remember that both conditions are medical emergencies.
6 Know your blood pressure and cholesterol level, and keep them at the recommended levels through lifestyle changes and by taking any prescribed medication.
7 Lower your total fat and saturated fat intake in accordance with your health care provider's instructions.

For people with diabetes, blood pressure control reduces cardio-vascular disease significantly more than close control of blood sugar.

Talk to your health care provider before taking any drugs, including aspirin, to prevent heart disease and stroke.

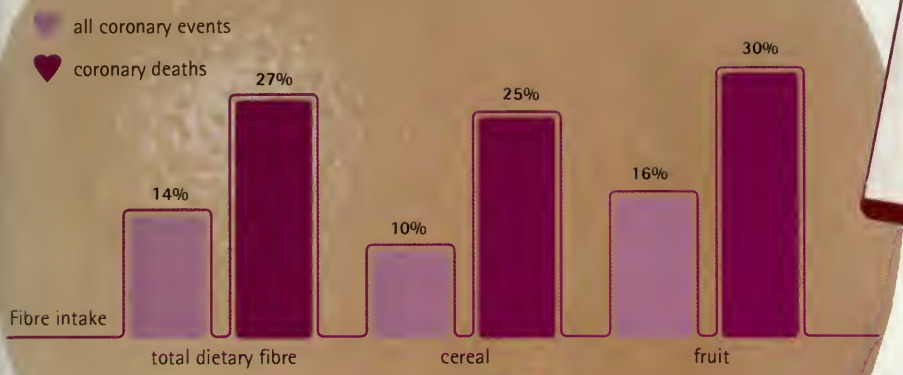
Young people

1 Actions and choices for children and adolescents with cardiovascular disease, or risk factors, should be discussed with a paediatrician or health care provider.
2 Choose a diet containing a variety of fruits, vegetables, whole grains, dairy products, fish, legumes, poultry, and lean meat.
3 There is no need to restrict fat intake in children under two years of age.
4 For children over two years and adolescents, limit foods high in saturated fats (to less than 10% of daily calorie intake), cholesterol (to less than 300 mg per day), and trans-fatty acids.
5 Increase physical activity, and avoid tobacco use or exposure to environmental tobacco smoke.

Healthy living must begin in childhood and youth.

Eat fruit and cereals

Percentage reduction in risk with each daily increment of 10 g of dietary fibre *reported 2004*



Reducing salt intake from 12 g per day to 3 g per day would reduce strokes by one-third and coronary heart disease by one-quarter.

In the USA, people eat twice as much sugar and fat as recommended.

Burning calories through physical activity is as important as watching what you eat.

In Japan, since the 1970s, the "10 000 Steps Project" has set a national daily exercise goal. To monitor steps walked, the average Japanese family today owns three pedometers.

Compared with less active people, moderately active and highly active individuals have a 20% and 27% respectively lower risk of stroke or stroke death.

People with low fitness are up to six times more likely to develop diabetes and high blood pressure.

The benefits of stopping smoking

Time since last cigarette	Effect
20 minutes	Blood pressure and pulse rate drop to normal.
1 day	Probability of heart attack begins to decrease.
3 months	Circulation improves.
1 year	Excess risk of coronary heart disease is half that of a continuing smoker.
5 to 15 years later	Risk of stroke is reduced to that of people who have never smoked.
15 years later	Risk of coronary heart disease is similar to that of people who have never smoked, and the overall risk of death almost the same, especially if the smoker quits before illness develops.

21 Prevention: population and systems approaches

"Thinking well is wise; planning well, wiser; doing well wisest and best of all."
Old Iranian proverb

Significant health gains in cardiovascular health can be made within short time spans, through public health and treatment interventions that have an impact on large segments of the population.

As shown here, there is a gap between what is known and what is done in practice, for both prevention and treatment of cardiovascular disease.

Governments are stewards of health resources, and have a fundamental responsibility to protect the health of citizens. Ministries of Health and the health profession can play various roles in reducing CVD, by making data available, educating the public, making treatments affordable and available, advising patients on healthy living practices, and advocating for policy and environmental change. These have been the essential messages of the International Heart Health Conferences and the related declarations on heart health.

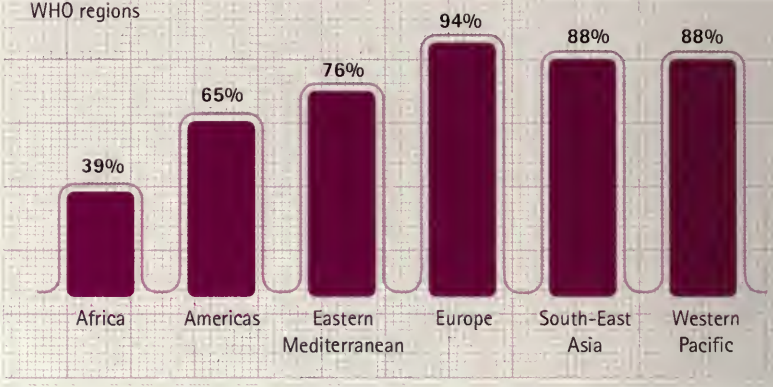
UK dieticians promote the benefits for heart health of eating oily fish, more fruit and vegetables, and less saturated fat.

Noncommunicable disease (NCD) prevention and control

Percentage of countries with integration of components of NCD prevention and control programmes in primary health care

2001

WHO regions

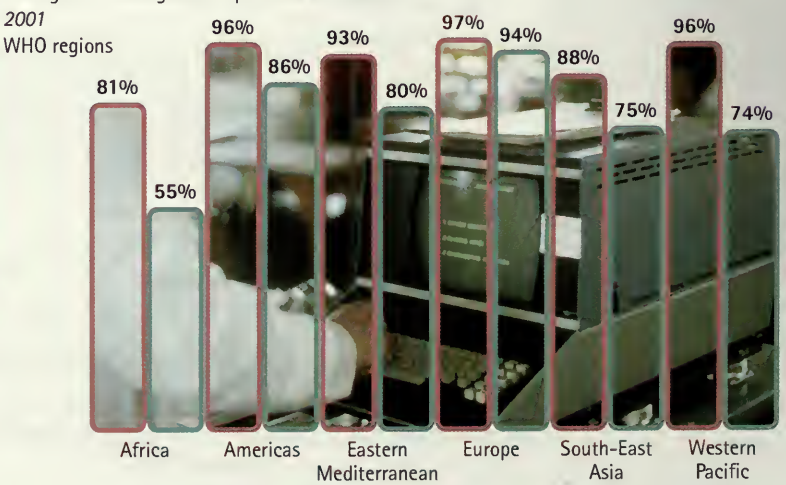


Availability of equipment

Percentage availability of basic equipment at primary health care level for diagnosis and management of high blood pressure and diabetes

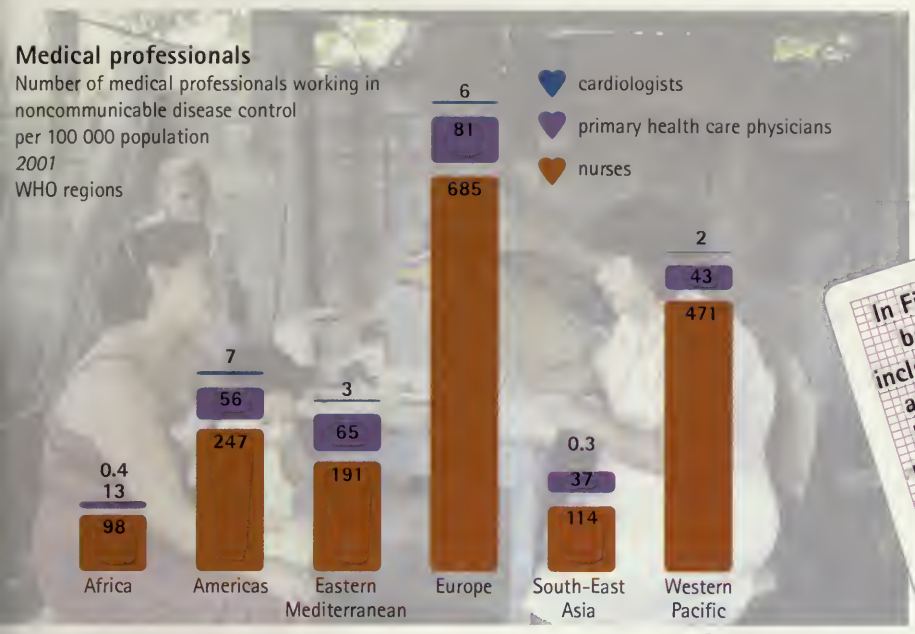
2001

WHO regions



Medical professionals

Number of medical professionals working in noncommunicable disease control per 100 000 population
2001
WHO regions

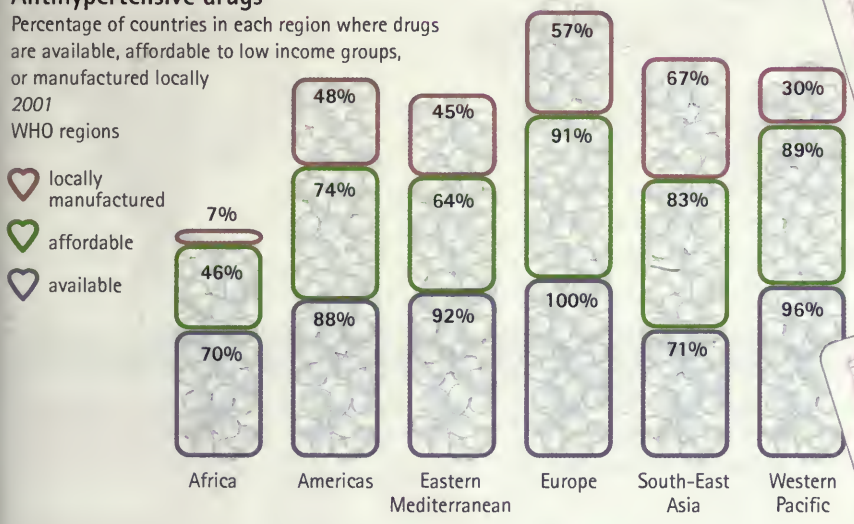


A large gap exists between knowledge and practice.

In Finland, community-based interventions, including health education and nutrition labelling, led to population-wide reductions in cholesterol, closely followed by a sharp decline in heart disease.

Antihypertensive drugs

Percentage of countries in each region where drugs are available, affordable to low income groups, or manufactured locally
2001
WHO regions

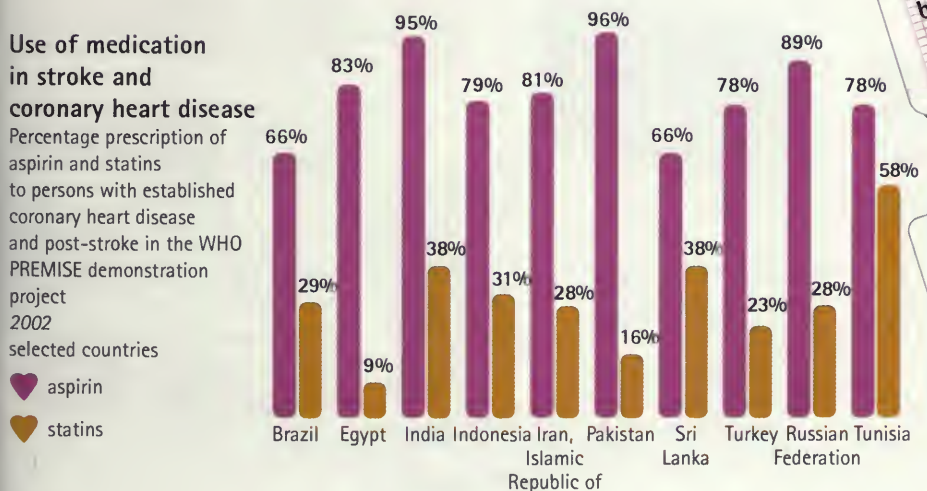


In Japan, government-led health education campaigns and increased treatment of high blood pressure have reduced blood pressure levels in the population; stroke rates have fallen by more than 70%.

In New Zealand, the introduction of recognizable logos for healthy foods led many companies to reformulate their products. The benefits included greatly reduced salt content in processed foods.

Use of medication in stroke and coronary heart disease

Percentage prescription of aspirin and statins to persons with established coronary heart disease and post-stroke in the WHO PREMISE demonstration project
2002
selected countries



In Mauritius, a change from palm oil to soya oil for cooking brought down cholesterol levels, but obesity was unaffected.

22 Health education

"Education is the most powerful weapon which you can use to change the world."
Nelson Mandela, South Africa (1918–)

For successful prevention and control of the cardiovascular disease epidemic, changes to policy, legislation and taxation are not enough. These interventions will not be effective if there is no public understanding, support and demand for them. Some areas lie beyond legislation – for example, the choice of food for families, the amount of salt added in cooking, whether or not to smoke – and here health education is essential to promote healthy choices.

Schools provide an ideal venue for health education. They can teach about risk factors, refusal skills, and the strategies of the tobacco and food industries. For example, young people can analyse how tobacco industry promotion attempts to manipulate them by equating smoking with growing up, freedom and being cool.

Increasing knowledge, and changing beliefs, attitudes and intentions, on their own are not enough to change behaviour. School programmes must also lead by example, by making healthy food available, providing exercise facilities, prohibiting tobacco use at all school facilities and events, and helping students and staff lose weight and quit smoking. Ideally, these activities should be part of a coordinated school health programme, reinforced by community-wide efforts.

The WHO Global School Health Initiative is designed to strengthen international, national and local support for effective school health programmes or "health-promoting schools". Guidelines have been developed on various factors that affect health, such as tobacco, diet and physical activity.

The WHO Global School-based Student Health Survey is aimed at adolescents aged 13 to 15 years, and covers nine risk or protective factors. Survey results will provide information on trends over time, which is useful for formulation of risk reduction policies.

World Heart Day

World Heart Federation event

participating countries and territories *2003*

Heart Health Declarations

See Milestones pp76-81 for further details

World Heart Day Themes

- 2000 Physical Activity
- 2001 A Heart for Life
- 2002 Nutrition and Physical Activity

- 2003 Women, Heart Disease and Stroke
- 2004 Children, Adolescents and Heart Disease
- 2005 Obesity

World Heart Day Activities *2001*

medical activities (e.g. blood pressure testing)	68.5% of countries
activities to engage the public in physical activity	65% of countries
scientific activities (e.g. conferences or workshops)	61% of countries
activities to advocate for a heart healthy diet	35% of countries
other activities (e.g. charity gala, dance, concert, carnival)	35% of countries

Lifelong health education is essential for improving heart health.

1995 Spain

The Catalonia Declaration: Investing in Heart Health

2001 Japan

The Osaka Declaration: Health, Economics and Political Action: Stemming the Global Tide of Cardiovascular Disease

2004 Italy

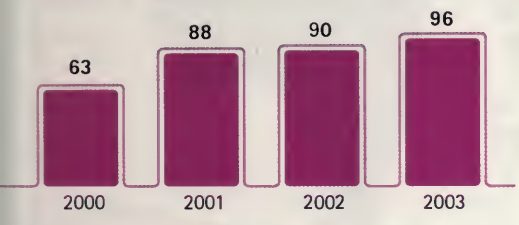
The Milan Declaration: Positioning Technology to Serve Global Heart Health

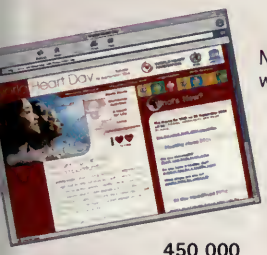
1998 Singapore

The Singapore Declaration: Forging the Will for Heart Health in the Next Millennium

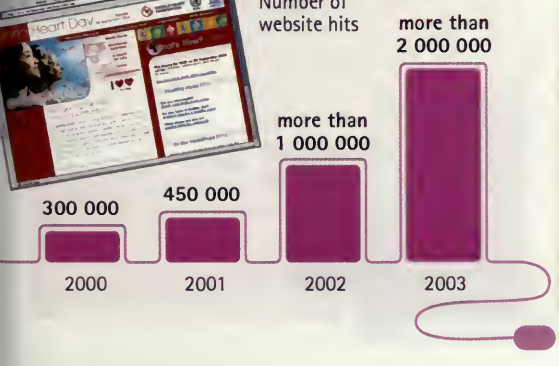
Evaluation of World Heart Days *2000–2003*

Number of participating countries and territories





Number of website hits



Giving up smoking: International Quit and Win

1994–2002, 2004 projected

Up to 25% of participants in the International Quit and Win Campaign are off tobacco after one year

23 Policies and legislation

"The welfare of the people is the ultimate law."
Salus Populi Suprema Est Lex.
Cicero (106 BCE–43 BCE)

Laws, treaties, policies and regulations have played important roles in the prevention and control of disease. Only governments can legislate for health warnings on cigarettes, introduce mandatory food standards and labelling, crack down on smuggling, set a "pro-health tax policy", or implement national transport policy. Often governments are the main providers of health care; they decide how funding is allocated, from prevention programmes to treatment, research, and training.

The first international convention that relates specifically to cardiovascular disease is the WHO Framework Convention on Tobacco Control. It was adopted without dissent by the World Health Assembly in Geneva in May 2003, and is currently in the process of ratification. Once 40 countries have ratified the Convention, it will come into effect as a legally binding treaty among those countries. The Convention includes clauses on advertising bans, smoke-free areas, health warnings, taxation, smoking cessation and smuggling.

17th century: earliest known bans on smoking enacted.

2002 USA: fast-food chain targeted in obesity lawsuit.

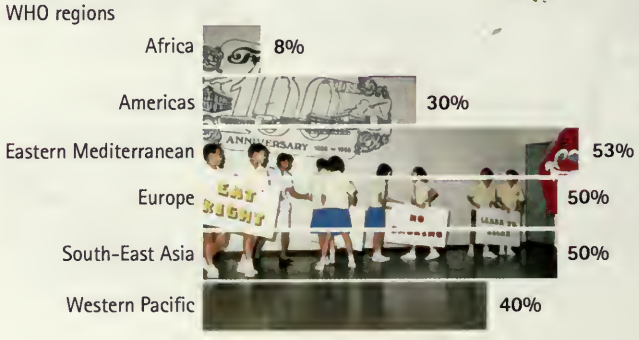
2004 USA: US House of Representatives banned lawsuits against fast-food restaurants by obese customers who say they became overweight by eating there.

2002 USA: a smoking ban in Helena, Montana, reduced heart attack hospitalizations by 40%. This trend reversed within 6 months of the ban being lifted.

Policies and legislation are vital components of efforts to reduce coronary heart disease, stroke, and their risk factors.

Cardiovascular disease plans worldwide

Percentage of countries by region with national plans for CVD prevention and control
2001



Smoke-free workplaces

Smoke-free areas in government buildings
2004 or latest available data

- smoking banned
- smoking restricted
- not regulated
- unknown

Smoking in private workplaces banned. Exceptions or limited restrictions may apply to restaurants, bars, and other venues.

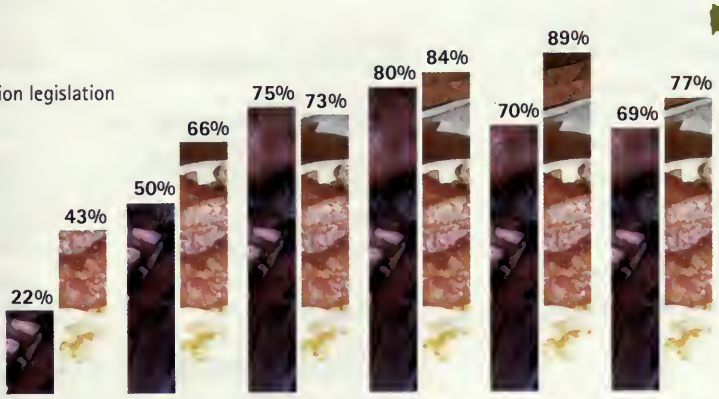
First five countries to ratify the Framework Convention on Tobacco Control.

1970 Singapore: smoking banned in buses, cinemas, theatres and other specified buildings.

Legislation

Percentage of countries by region with tobacco, and food and nutrition legislation
2001
WHO regions

- tobacco
- food and nutrition



24 Treatment

"If you do not repair your gutter, you will have your whole house to repair."
Old Spanish proverb

In 1931, Paul Dudley White noted that there was no specific treatment for coronary heart disease. He described the treatment of high blood pressure as "difficult and almost hopeless". Today, effective and relatively inexpensive medication is available to treat nearly all cardiovascular diseases, including high blood pressure.

Improvements in surgical techniques have led to safer operations. Effective devices have been developed, such as pacemakers, prosthetic valves, and patches for closing holes in the heart. Other developments have led to a wide array of interventions that often make surgery unnecessary.

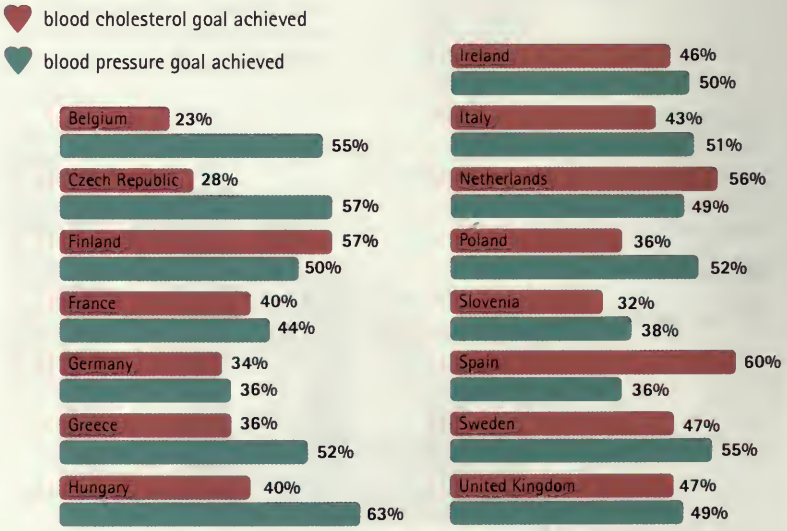
Together, these advances in treatment improve quality of life and reduce premature death and disability. They also add to the rising costs of health care. Increasingly, high-technology procedures are chosen over less expensive, but nevertheless effective, strategies.

In addition, marked disparities in the quality of treatment can be seen in groups of different race, ethnicity, sex, and socioeconomic status. In essence, many patients who could benefit from treatment remain untreated, or inadequately treated. In future, increased emphasis needs to be placed on the appropriate use of proven treatments for everyone with coronary heart disease or stroke.

Cardiac rehabilitation
Percentage of people with established coronary heart disease advised to participate in cardiac rehabilitation
2001
selected European countries

Proportion of people with high blood pressure receiving treatment: 1 in 4 in Finland, Germany, Spain and Sweden; 1 in 3 in Canada and Italy; 1 in 2 in the United States.

Patients reaching blood pressure and blood cholesterol goals during treatment
Percentage of people aged 70 years or below with established CVD who achieve blood pressure goal of less than 140/90 mmHg, or blood cholesterol goal of less than 5.0 mmol/l
2001
selected European countries



Types of treatment

Selected medication, devices and operations

Medication used in treatment of

1 High blood pressure

2 Coronary heart disease

3 Heart failure

4 Arrhythmia (heart rhythm disorders)

5 Blood clotting disorders

Devices

1 Pacemakers

2 Implantable defibrillators

3 Coronary stents

4 Prosthetic valves

5 Artificial heart

Operations

1 Coronary artery bypass

2 Balloon angioplasty

3 Valve repair and replacement

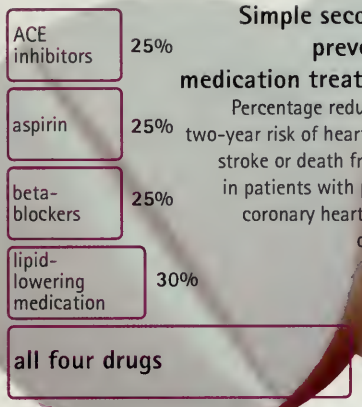
4 Heart transplantation

5 Artificial heart operations

Simple secondary prevention medication treatments

Percentage reduction in two-year risk of heart attack, stroke or death from CVD in patients with previous coronary heart disease or stroke

2002



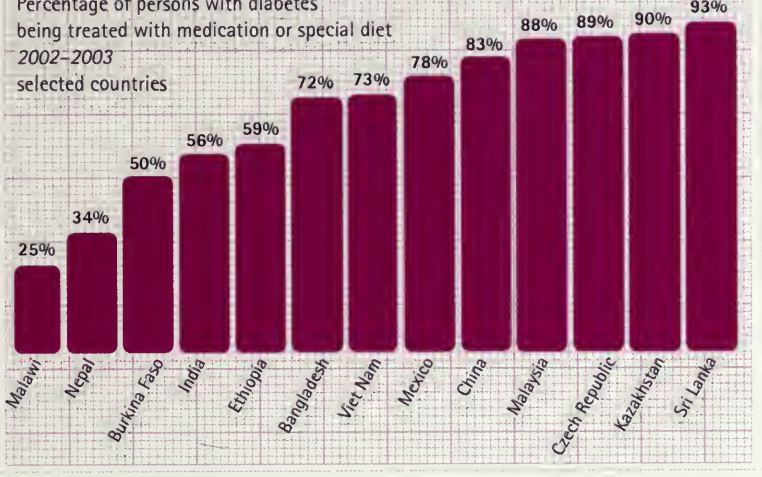
Worldwide, treatment of cardiovascular diseases and their risk factors remains inadequate for most patients.

Diabetes treatment

Percentage of persons with diabetes being treated with medication or special diet

2002–2003

selected countries

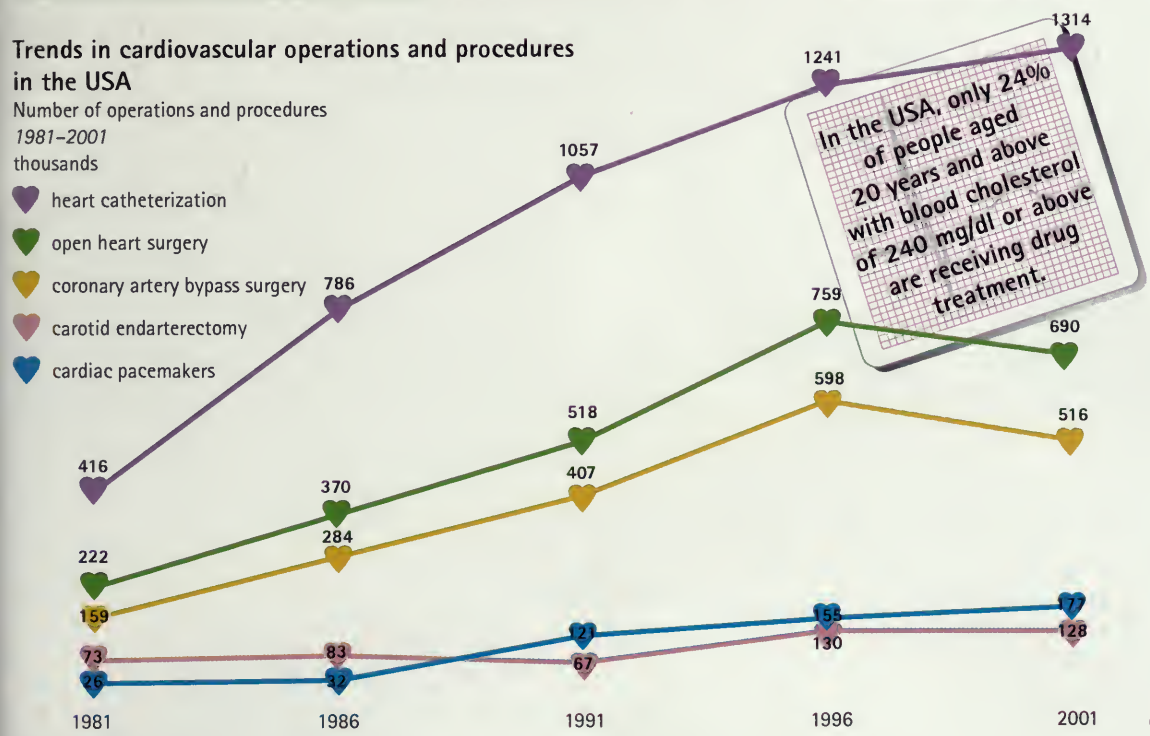


Trends in cardiovascular operations and procedures in the USA

Number of operations and procedures

1981–2001

thousands



In the USA, only 24% of people aged 20 years and above with blood cholesterol of 240 mg/dl or above are receiving drug treatment.


RSM

PART 5

THE FUTURE AND THE PAST

"Let my heart be wise,
It is the gods' best gift."

Euripides *Medea,* 431 BCE

25 The future

"I never think of the future – it comes soon enough."
Albert Einstein (1879–1955)

Unlike Einstein, we have to think of the future, and plan now, to reduce the numbers of deaths from coronary heart disease and stroke.

Predictions are by their nature speculative. Nevertheless, this much is certain: the global epidemic of cardiovascular disease is not only increasing, but also shifting from developed to developing nations.

Action can work. There are currently about 800 million people with high blood pressure worldwide. Studies now indicate that in North America, Western Europe, and the Asia-Pacific region, each 10 mmHg lowering of systolic blood pressure is associated with a decrease in risk of stroke of approximately one-third, in people aged 60 to 79 years. Globally, if diastolic blood pressure (DBP) can be reduced by 2%, and by 7% in those with DBP over 95 mmHg, a million deaths a year from coronary heart disease and stroke could be averted by 2020 in Asia alone.

No matter what advances there are in high-technology medicine, the fundamental message is that any major reduction in deaths and disability from CVD will come from prevention, not cure. This must involve robust reduction of risk factors.

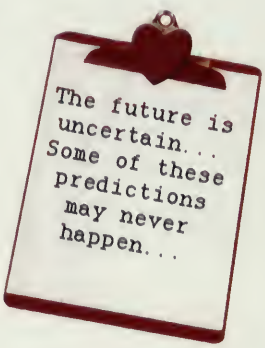
"Unless current trends are halted or reversed, over a billion people will die from cardiovascular disease in the first half of the 21st century. The large majority will be in developing countries and much of the life years will be lost in middle age. This would be an enormous tragedy, given that research in the last half of the 20th century showed that cardiovascular disease was largely preventable."

Anthony Rodgers, Clinical Trials Research Unit, University of Auckland, New Zealand, 2004

DALYs
Disability-adjusted life years combine years of potential life lost due to premature death with years of productive life lost due to disability.

DALYs	by 2010	by 2020	by 2030
CVD DALYs Annual number of DALYs	153 million	169 million	187 million
Burden of CVD Percentage of all DALYs	10.4%	11.0%	11.6%
CVD rankings globally	3rd: coronary heart disease 5th: stroke	3rd: coronary heart disease 4th: stroke	3rd: coronary heart disease 4th: stroke
CVD rankings in developing countries	4th: coronary heart disease 8th: stroke	3rd: coronary heart disease 6th: stroke	3rd: coronary heart disease 5th: stroke

DEATHS	by 2010	by 2020	by 2030
CVD deaths Annual number of deaths	18.1 million	20.5 million	24.2 million
CVD deaths Percentage of all deaths	30.8%	31.5%	32.5%
Coronary heart disease deaths Percentage of all male deaths	13.1%	14.3%	14.9%
Coronary heart disease deaths Percentage of all female deaths	13.6%	13.0%	13.1%
Stroke deaths Percentage of all male deaths	9.2%	9.8%	10.4%
Stroke deaths Percentage of all female deaths	11.5%	11.5%	11.8%
CVD deaths from cigarette smoking Annual number of deaths	1.9 million	2.6 million	



RISK FACTORS	by 2010	by 2020	by 2030
Smokers Number	1.3–1.4 billion	1.4–1.6 billion	1.4–1.8 billion
Diabetes Number of people aged 20 years and above	221 million	300 million	366 million
Miscellaneous		Serious increases in LDL-cholesterol in many developing populations.	Short-term, long-term, and lifetime absolute risk of coronary heart disease and stroke routinely calculated by health care providers for everyone.

ECONOMIC COSTS	by 2010	by 2020	by 2030
Obesity-related complications Percentage of health care spending in the USA, people aged 50 to 69 years	15%	20%	25%

ACTION	by 2010	by 2020	by 2030
Research and development	New causal factors discovered for heart disease, including bacteria and viruses.	All newborn babies discharged home with CD-ROM containing their unique genomic maps, with summaries of CVD, of which they may be at increased risk. External glucose sensor will drive insulin pumps to deliver continuous microdoses of insulin. Vaccine produced to switch off nicotine receptors.	Bio-engineered tissues available for all heart and vascular structures.
UN Conventions and Goals	WHO Framework Convention on Tobacco Control (FCTC) ratified. WHO Global Strategy on Chronic Diseases, Diet and Physical Inactivity (2004).	Convention on Food ratified (covering content, labelling, taxation, advertising). Millennium Development Goals (2015): access to affordable essential drugs in developing countries provided, in cooperation with pharmaceutical companies.	Convention on universal access to essential preventive health care, and principles of equity in quality care delivery.

TREATMENT	by 2010	by 2020	by 2030
Miscellaneous	Full personal medical records stored on smart card.	Health systems driven by primary health care to ensure universal access to quality health care services. Instantaneous computer language translation enables patients to be understood by doctors in any country.	Patients' knowledge of their own health equals that of doctors in the 1990s.
Investigation	ECGs, X-rays, ultrasound images, etc. transmitted electronically to diagnostic centres, often in another country. Wireless ECGs.	Minuscule computer, with microsensors, automatically sensing and recording health data, could be everyday wear. Biochemical inflammation and genetic markers used routinely in blood tests to screen patients for heart problems.	"Trial and error" in drug prescription abandoned in favour of personalized prescription through pharmacogenomic testing for predictable responses to drugs.
Genetics	CVD-modifying genes identified.	Genetic manipulation to prevent and treat CVD, including post-operative prevention of re-stenosis of arteries.	
Artificial body parts developed	Heart	Lungs	Brain add-ons Nerves to transplanted hearts
Transplant surgery		Xenotransplantation with pig hearts soars as rejection problem overcome.	Pig-napping of personal transgenic pigs a new crime.
High technology		Nano-surgeons, or sub-microscopic robots, will crawl through arteries, scraping away fatty deposits and repairing damaged or diseased parts. Angiogenesis, the growth of new blood vessels, may become an alternative to coronary bypass, angioplasty or clot-buster drugs.	Computerized "auto-doc" machine externally detects and treats illness by magnetic resonance therapy. Off-pump beating heart surgery predominates. Automated external defibrillators offered as routine electronic options in new homes for persons at high risk of sudden death.
Medication		Six-drug "polypill" will reduce CVD by more than 80% if taken by everyone aged 55 and older, and everyone with existing CVD.	Drugs developed to raise HDL-cholesterol (as effective as statins are today for lowering LDL-cholesterol).

Milestones in knowledge of heart and vascular disorders

Palaeolithic era *Spain* Oldest anatomical drawing in El Pindal cave of a mammoth with a dark smudge at the shoulder, which is thought to represent the heart.

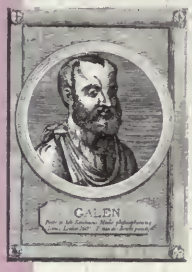
2698–2598 BCE *China* Huang Ti, the Yellow Emperor, was thousands of years ahead of his time in writing in Nei Ching (Canon of Medicine): "The blood current flows continuously in a circle without a beginning or end and never stops" and "all the blood is under control of the heart". He also recorded the association between salt intake and a "hardened pulse".

1550 BCE *Egypt* Papyrus Ebers stated that after death the heart becomes the witness of the body's behaviour during life. To avoid incriminating testimony, the Egyptians buried the heart separately from the body.

600 BCE *Greece* Alcmaeon noted empty arteries in animals after death and inferred that arteries normally contained air.

400 BCE *Greece* Hippocrates, the Father of Medicine (460–370 BCE), challenged the belief that illness was caused by the gods; he believed illness was caused by an imbalance of the four bodily humours: yellow bile, black bile, blood, and phlegm. He was also the first to recognize stroke.

310–250 BCE *Egypt* Erasistratus described the heart, veins, arteries and valves, but claimed that arteries contained "pneuma" (air or spirit or soul), which was replaced each time a person breathed; when an artery was cut, blood rushed in as the pneuma escaped.



131–201 CE Graeco-Roman physician Claudius Galen, with knowledge gained from animals killed by Roman gladiators, described the heart and the movement of blood in the arteries, but claimed that the liver was the centre of the circulation and that the blood passed from the right to the left side of the heart.

980–1037 *Persia* Avicenna (Ibn Sina) stated that the heart is located centrally to all organs of the body, and that the left side of the heart was created as a store of spirit and soul.

1210–1288 *Syria* Ibn al-Nafis described the pulmonary and coronary circulation in *The Perfect Man*.

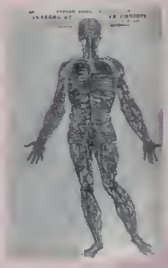
1452–1519 *Italy* Leonardo da Vinci incorrectly drew the liver as the centre of circulation. But he stated "vessels in the elderly through the thickening of the tunics, restrict the transit of the blood." This is one of the earliest descriptions of arteriosclerosis.

1509–1553 *Spain* Michael Servetus described the pulmonary circulation in his book *Christianismi Restitutio*.

1510–1559 *Padua, Italy* Matteo Realdo Colombo described the heart valves.

1525–1603 *Rome, Italy* Andrea Cesalpino noted that the circulation system is a closed system, and was the first in modern times to coin the term "blood circulation".

1553–1619 *Padua, Italy* Hieronymus Fabricius demonstrated valves in veins, which help to "prevent dilatation of veins".



1555 *Padua, Italy* Andreas Vesalius (1514–1564) stated that the heart, and not the liver, was the centre of the circulation.

1559 *Italy* Riva di Trento discovered that there are two coronary arteries, each supplying blood to half of the heart.

1628 *England* William Harvey (1578–1657), a physician, published his thesis that the heart pumped blood around the body, in *De Motu Cordis*.

mid-1600s *Switzerland* Jacob Wepfer found that patients who died with "apoplexy" had bleeding in the brain. He also discovered that a blockage in one of the brain's blood vessels could cause apoplexy.

1706 *France* Anatomy professor Raymond de Vieussens first described the structure of the heart's chambers and vessels.

1712–1780 *England* John Fothergill both forecast the role of psychosocial factors and advised

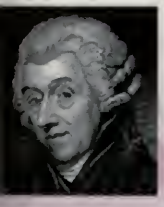
that a restricted diet "might greatly retard the progress" of coronary heart disease.

1677–1761 *England* Stephen Hales, an English clergyman and scientist, first measured blood pressure by inserting a brass tube into the artery of a horse. This was a scientific experiment, published in 1733, demonstrating that the heart exerts pressure in order to pump blood. The horse died.

1745–1827 *Italy* Alessandro Volta discovered that electric energy was produced by heart muscle contractions.

1749–1832 *England* Edward Jenner, better know for smallpox vaccine, made the essential link between angina pectoris and disease of the coronary arteries.

1752–1832 *Italy* Antonio Scarpa described arterial aneurysm.



1772 *England* William Heberden (1710–1801) described angina pectoris: "they who are afflicted with it, are seized while they are walking (especially if it be uphill, and soon after eating) with a painful and most disagreeable sensation in the breast, which seems as if it would extinguish life if it were to increase or to continue; but the moment they stand still, all this uneasiness vanishes". He was also the first to write about hyperlipidaemia as a risk factor when he noticed that the serum of an obese patient who suddenly died was "thick like cream".

1775 *Scotland* John Hunter (1728–1793), a surgical pathologist, wrote "in a sudden and violent transport of anger, he fell down and expired immediately", illustrating the importance of emotion, stress and anger in precipitating coronary death. Hunter himself suffered from angina pectoris and died suddenly after a violent argument with a hospital colleague.

1785 *England* William Withering described the use of digitalis in coronary heart disease in his monograph *An Account of the Foxglove*. Foxglove had been used for centuries by American Indians.

1791 *Italy* Luigi Galvani discovered that electrical stimulation of a frog's heart led to contraction of the cardiac muscle.

1799 *England* Caleb Hillier found something hard and gritty in the coronary arteries during an autopsy and "well remembered looking up to the ceiling, which was old and crumbling, conceiving that some plaster had fallen down". He discovered, however, that the vessels had hardened, and stated that "a principle cause of the syncope anginosa is to be looked for in disordered coronary arteries".

1815 *England* London surgeon Joseph Hodgson claimed inflammation was the underlying cause of atherosclerosis and it was not a natural degenerative part of the ageing process.

1815 *France* M.E. Chevreul named the fatty substance extracted from gallstones "cholesterol" from the Greek "khole" (bile) and "stereos" (solid).

1819 *France* Rene Theophile Laennec (1781–1826), invented the stethoscope. He rolled paper into a cylinder while examining a young woman with cardiac symptoms as he was reluctant to apply his ear to the chest.

1838 *France* Louis René Lecanu showed that cholesterol was present in human blood.

1841 *Austria* Carl Von Rokitansky championed the thrombogenic theory, proposing that deposits observed in the inner layer of the arterial wall derived primarily from fibrin and other blood elements rather than being the result of a purulent process. This theory came under attack from Rudolf Virchow.

1843 J. Vogel showed that cholesterol was present in atherosclerotic plaques.

1844 *Denmark* First pathology report of plaque rupture in a coronary artery in Bertel Thorvaldsen, the celebrated neoclassical Danish artist and sculptor, who died of sudden cardiac death in the Royal Theatre in Copenhagen.

1850 Ventricular fibrillation first described.

1850s Ophthalmoscope invented, allowing direct visualization of arteries at the back of the eye.

1852 *England* Fatty material in the coronary arteries described by Sir Richard Quain, which he attributed to nutrition. He linked the fatty heart to "languid and feeble circulation, a sense of uneasiness and oppression in the chest, embarrassment and distress in breathing, coma, syncope, angina pectoris, sudden death..."

1856–1967

1856 *Germany* Rudolf Virchow, a Pole, believed that disease occurred at cellular level, and also described cerebral emboli causing stroke. Virchow also emphasized the societal causes of disease as "disturbances of human culture".

1867 *England* Lauder Brunton, pharmacologist, discovered that amyl nitrite relieved angina.

1872 *France* Gabriel Lippmann invented the capillary electrometer, the precursor of the electrocardiograph.

1893 *Holland* Willem Einthoven (1860–1927) introduced the term electrocardiogram or ECG/EKG; distinguished five deflections – PQRST (1895); constructed the first electrocardiograph in 1901, which weighed 270 kg, occupied two rooms and required five people to operate it; transmitted the first ECG from hospital to his laboratory 1.5 km away via telephone cable (in 1905); published the first normal and abnormal ECGs (1906) and won the Nobel Prize (1924).

1895 *Germany* Physicist Wilhem Konrad Roentgen (1845–1923) discovered X-rays, which are still used to visualize the heart.

1896 *Italy* Scipione Riva-Rocci invented the sphygmomanometer to measure blood pressure.

1897 The introduction of modern aspirin. In one of life's little ironies, Bayer's first aspirin advertisements said that the drug did "not affect the heart".

1906 *Germany* M. Cremer, first oesophageal ECG by a professional sword swallower. First fetal ECG from the abdominal surface of a pregnant woman.

1907 *England* First case report of atrial fibrillation by Arthur Cushny, professor of pharmacology at University College, London.

1912 James B. Herrick described heart disease resulting from hardening of the arteries.

1912 First human cardiac catheterization (no X-ray visualization) by Frizt Bleichroeder, E. Unger and W. Loeb.

1915 *USA* Establishment of organization in New York City, which became the American Heart Association.

1920 *USA* First ECG of acute myocardial infarction by Harold Pardee.

1923 *USA* First operative widening of scarred cardiac valve by E. Cutler and S.A. Levine.

1925 *United Kingdom* Widening of narrowed mitral valve by Souter, who stretched the valve ring with his fingers.

1928 *United Kingdom* Sir Alexander Fleming discovered penicillin, which is used to treat rheumatic fever.

1928 "Apoplexy" divided into categories based on the cause of the blood vessel problem, and replaced by the term "cerebral vascular accident (CVA)".

1929 *Germany* First documented right heart catheterization in human by Werner Forssmann using radiographic techniques.

1931 *USA* First description of the use of exercise to provoke attacks of angina pectoris by Charles Wolferth and Francis Wood.

1931 *USA* First artificial cardiac pacemaker, which stimulated the heart by transthoracic needle, developed by Dr Albert Hyman.

1937 *USA* First prototype heart-lung machine built by physician John Heysham Gibbon, and tested on animals. He performed the first human open heart operation in 1953 using the machine.

1938 *USA* First human heart surgery, first surgical correction of a congenital heart defect: closure of patent ductus arteriosus performed by surgeon Robert E. Gross.

1944 *China* First repair of patent ductus arteriosus in China.

1944 *USA* First operation on "blue baby" (Fallot's tetralogy) at Johns Hopkins.

1944 *USA/Sweden* First repair of coarctation of aorta by Crafoord and Grosse.

1947 *USA* First defibrillation of human heart during cardiac surgery, by Claude Beck in Cleveland.

1948 *USA* "Blind finger" closed heart surgery for mitral stenosis reintroduced by Dr Dwight Harken and Dr Charles Bailey.

1948 *USA* California physician Lawrence Craven noticed that 400 of his male patients who took aspirin for two years had no heart attacks. By 1956, he had chronicled the health of 8000 patients taking aspirin and found no heart attacks in the group.

1948 *USA* Start of the Framingham Heart Study where, for the first time, a large cohort of healthy men and women were studied prospectively.

1949 *USA* Portable Holter Monitor invented by Norman Jeff Holter to record ambulatory ECG.

1950 The International Society of Cardiology established, later joined with International Cardiology Federation and renamed World Heart Federation.

1950 *Canada* First pacemaker invented by John Hopps.

1952 *USA* First prosthetic valve implanted in aorta by surgeon Charles Hufnagel.

1952 *USA* First successful human open heart surgery under hypothermia by Walton Lillehei and John Lewis, who implanted the first synthetic valve in a five-year-old girl who had been born with an atrioseptal defect (hole in her heart).

1952 *USA* External cardiac pacemaker designed by Paul Zoll.

1953 *USA* First demonstrated coronary artery disease among young US soldiers killed in action in Korea (later observed in the casualties of the Viet Nam War too) by William F. Enos, Robert H. Holmes and James Beyer.

1954 *United Kingdom* First carotid endarterectomy by Eastcott, Pickering and Rob.

1954 *India* Called on WHO to address the coming epidemic of cardiovascular disease in developing countries.

1955 *United Kingdom* First reported mitral valve replacement by Judson Chesterman.

1950s Minimization of bias for the reliable assessment of cardiovascular treatments by introduction of randomization into clinical trials (at instigation of Sir Austin Bradford Hill).

1956 *USA* First report of the successful ending of ventricular fibrillation in humans by externally applied countershock published by Dr Paul Zoll.

1957 First battery-powered external pacemaker.

1958 *USA* Seymour Furman inserted a pacemaker in a patient who lived for 96 days.

1958 *Sweden* Internal long-term cardiac pacing by Åke Senning.

1958 Start of development of a selective coronary angiography procedure by Mason Sones.

1959 WHO established Cardiovascular Diseases programme.

1960s High blood pressure identified as a treatable risk factor for stroke.

1960 *USA* First Coronary Care Unit in Bethany, Kansas.

1960 *Framingham, USA* Cigarette smoking found to increase the risk of heart disease.

1960 *USA* First replacement of heart valve with Starr-Edwards mechanical valve, developed by Albert Starr (*left*) and Lowell Edwards.

1961 *USA* Framingham Heart Study investigators coined the term "risk factors" for the development of coronary heart disease. High cholesterol level, blood pressure, and electrocardiogram abnormalities found to increase the risk of coronary heart disease.

1961 *USA* First use of external cardiac massage to restart a heart by J.R. Jude.

1961 *USA* First direct current defibrillation with external paddles by Bernard Lown and Barough Berkowitz.

1960s First human implant of totally implantable pacemaker.

1964 *USA* First transluminal angioplasty performed on a narrowed artery in the leg by Charles T. Dotter.

1965 *USA* Michael DeBakey and Adrian Kantrowitz implanted mechanical devices to help a diseased heart.

1967 *South Africa* First whole heart transplant from one person to another by Dr Christiaan Barnard.

1967 *USA* Saphenous vein coronary bypass graft by Dr Rene Favaloro.

1967 *Framingham, USA* Physical inactivity and obesity found to increase the risk of heart disease.

1969–2004

1969 *USA* First use of artificial heart in human by Denton Cooley.

1972 *USA* The Stanford Three Community Study started (later becoming The Stanford Five-City Project); this showed a 23% reduction in coronary heart disease risk caused by community-based interventions that change lifestyle-related risk factors such as physical activity, dietary habits and tobacco use.

1972 *Finland* North Karelia Project began, aimed at preventing cardiovascular disease among residents. Cardiovascular mortality rates for men, aged between 35 and 64 years, decreased by 57% from 1970 to 1992.

1974 *Framingham, USA* Diabetes linked to cardiovascular disease.

1970s Aspirin recognized as preventing heart attacks and stroke.

1970s Development of computerized tomography (CT) to aid early diagnosis of stroke.

1977 *Switzerland* First coronary PTCA (percutaneous transluminal coronary angioplasty); Andreas Gruentzig inserted a balloon-tipped catheter into a coronary artery and inflated the balloon, and thus successfully opened a blockage and restored blood flow.

1977 *Italy* The Martignacco Project community prevention trial resulted in reduction of coronary heart disease through community-based interventions that change lifestyle-related risk factors such as physical activity, dietary habits and tobacco use.

1977 *Framingham, USA* Effects described of triglycerides and LDL- and HDL- cholesterol on heart disease.

1978 *Framingham, USA* Psychosocial factors found to affect heart disease.

1978 *Australia* North Coast Healthy Lifestyle Programme showed significant reduction in smoking.

1978 *Switzerland* Swiss National Research Programme community prevention trial resulted in reduction of smoking, blood pressure and obesity.

1978 Atrial fibrillation (irregular heart beat) found to increase the risk of stroke.

1979 *South Africa* Coronary Risk Factor Study community prevention trial resulted in reduction of smoking, blood pressure and composite coronary heart disease risks.

1979 *Germany* First use by Peter Rentrop of intracoronary streptokinase, a clot-dissolving drug to stop a heart attack in progress.

1981 *Framingham, USA* Filter cigarettes found to carry as much risk for coronary heart disease as unfiltered cigarettes.

1981 *USA* Report on relationship between diet and heart disease.

1982 *USA* First permanent artificial heart, designed by Robert Jarvik, and implanted by Willem DeVries, in a 61-year-old man.

1983 *USA* List of 246 coronary risk factors published by Hopkins and Williams (list now much longer).

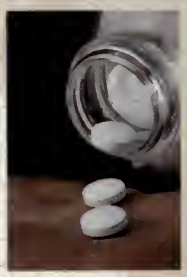
1980s Minimization of random error for the reliable assessment of cardiovascular treatments by introduction of large-scale "mega-trials" (at instigation of Sir Richard Peto).

1986 *France* First coronary stent implanted by Jacques Puel and Ulrich Sigwart.

1987 *Japan* M. Okada used a laser to burn channels in the heart muscle to help revascularize the heart in patients with coronary heart disease.

1987 *Framingham, USA* High blood cholesterol levels found to correlate directly with risk of death in young men.

1988 *Framingham, USA* High levels of HDL-cholesterol found to reduce risk of death.



1988 ISIS-2 trial shows emergency treatment for heart attacks with aspirin and fibrinolytic "clot-busting" drugs saves lives.

1988 *Framingham, USA* Isolated systolic hypertension found to increase risk of heart disease.

1988 *Framingham, USA* Cigarette smoking found to increase risk of stroke.

1990 Randomized trials showed that lowering blood pressure lowers the risk of stroke.

1990 *United Kingdom* Meta-analysis of trials by Clinical Trial Service Unit (CTSU) in Oxford showed

that lowering blood pressure lowers the risk of coronary disease.

1991 *China* Tianjin CVD Intervention Programme community prevention trial led to the creation of non-smoking environments and increased sales of low-sodium seasonings.

1992 *Canada* The Victoria Declaration on Heart Health affirmed that CVD is largely preventable, that there is the scientific knowledge to eliminate most CVD, and that the public health infrastructure and capacity to address prevention were lacking.

1990s *USA* Hostility (including traits such as anger, cynicism, and mistrust), a major component of type A behaviour, shown to be associated with an increased risk of heart attack and other cardiac complications in healthy persons and patients with coronary heart disease.

1992 *China* First heart-lung transplant in China.

mid-1990s *Scandinavia*, *United Kingdom*, *USA* Remarkable improvement in survival of coronary heart disease patients treated with statins.

1995 *Spain* The Catalonia Declaration: Investing in Heart Health, and its follow-up convention in 1997, emphasized the importance of investments in heart health and provided examples of many successful CVD prevention programmes worldwide.

1998 *USA* Hypertension gene in men identified.

1998 New advances: gene therapy grows new blood vessels to the heart; strong confirmation that "superaspirin" IIb/IIIa receptor blocker drugs prevent blood clots; the importance of inflammation in cardiovascular disease recognized; study on the deadly effects of smoking fewer than 10 cigarettes per day.

1998 *Singapore* The Singapore Declaration: Forging the Will for Heart Health in the Next Millennium.

2000 *Canada* The Victoria Declaration on Women, Heart Disease and Stroke addressed the importance of science and policy in action and the need to tackle gender disparities in health. It called upon all stakeholders to join forces and take appropriate action to control the cardiovascular disease epidemic.

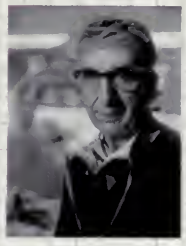
2000 First World Heart Day, which has become a global annual event.

2000 The entire human genome is mapped.

2000 WHO 53rd World Health Assembly endorsed Global strategy for noncommunicable disease (NCD) prevention and control, which outlines major objectives for monitoring, preventing and managing NCDs with special emphasis on major NCDs with common risk factors and determinants – cardiovascular disease, cancer, diabetes and chronic respiratory disease.

2001 *Japan* The Osaka Declaration: Health, Economics and Political Action: Stemming the Global Tide of Cardiovascular Disease emphasized the global nature of the CVD burden and highlighted the need to address economic and political factors in order to tackle CVD.

2002 *United Kingdom* The Heart Protection Study showed that statins could benefit people with diabetes and those with cholesterol levels previously considered low.



2002 *USA* NASA's Commercial Invention of the Year Award given for the DeBakey Ventricular Assist Device, based on space shuttle technology, and developed by Michael DeBakey *(above)* and NASA engineer David Saucier. The pump, used to treat heart failure, was one-tenth the size of previous heart-assist devices, and was first used in a patient in 2000.

2003 *Switzerland* WHO Framework Convention on Tobacco Control adopted at the 56th World Health Assembly.

2003 *Switzerland* The World Health Report: "Shaping the Future" highlighted CVD as the first of three growing threats that make up the "neglected global epidemics". The report called for action at the national and global levels to prevent and control CVD.

2004 *Switzerland* WHO Global Strategy on Diet, Physical Activity and Health endorsed by World Health Assembly.

2004 *Italy* Milan Declaration on Heart Health: Positioning Technology to serve Global Heart Health.

PART 6

WORLD TABLES

"Live as if you were to die tomorrow. Learn as if you were to live forever."

Mahatma Gandhi (1869–1948)

World Data Table

Country	1 Population Thousands 2002	2 Heart disease		3 Stroke		4 Rheumatic heart disease
		Disability DALYS lost per 1000 population 2002	Mortality Number of deaths 2002	Disability DALYS lost per 1000 population 2003 or latest available data	Mortality Number of deaths 2002	Number of deaths 2002
Afghanistan	22 930	36	33 157	13	11 532	1 938
Albania	3 141	13	3 989	13	4 169	42
Algeria	31 266	7	14 948	8	16 223	756
Andorra	69	3	67	3	52	3
Angola	13 184	13	7 130	15	7 640	615
Antigua and Barbuda	73	6	52	13	92	0
Argentina	37 981	6	34 292	6	22 668	234
Armenia	3 072	20	8 515	10	4 212	151
Australia	19 544	5	25 474	3	11 730	243
Austria	8 111	6	15 418	4	7 559	185
Azerbaijan	8 297	28	22 302	9	6 540	184
Bahamas	310	5	154	6	155	1
Bahrain	709	8	283	3	84	6
Bangladesh	143 809	18	130 006	9	64 515	10 253
Barbados	269	6	286	7	270	2
Belarus	9 940	28	59 719	14	22 892	550
Belgium	10 296	5	14 985	4	9 234	68
Belize	251	8	153	7	111	1
Benin	6 558	10	3 017	12	3 279	236
Bhutan	2 190	20	2 672	10	1 370	195
Bolivia	8 645	6	3 948	7	3 138	70
Bosnia and Herzegovina	4 126	10	5 590	13	6 508	21
Botswana	1 770	8	697	8	670	15
Brazil	176 257	9	139 601	11	129 172	3 055
Brunei Darussalam	350	5	92	6	90	7
Bulgaria	7 965	14	26 243	13	20 882	232
Burkina Faso	12 624	11	5 877	13	6 604	466
Burundi	6 602	10	3 084	12	3 492	82
Cambodia	13 810	13	7 635	11	5 963	614
Cameroon	15 729	10	9 443	12	10 198	621
Canada	31 271	5	43 246	3	15 621	422
Cape Verde	454	6	202	9	266	4
Central African Rep.	3 819	10	2 513	12	2 727	51
Chad	8 348	10	4 385	12	4 747	300
Chile	15 613	4	9 075	5	8 142	315
China	1 294 867	4	702 925	12	1 652 885	97 245
Colombia	43 526	8	31 289	6	17 745	380
Comoros	747	8	282	10	310	23
Congo	3 633	9	1 577	10	1 718	39
Congo, Dem. Rep.	51 201	11	24 217	13	26 439	1 930
Cook Islands	18	10	11	12	11	0
Costa Rica	4 094	6	2 937	3	1 194	45
Côte d'Ivoire	16 365	11	9 257	12	9 530	233
Croatia	4 439	10	11 653	11	8 653	152
Cuba	11 271	8	16 275	5	7 684	196
Cyprus	796	7	1 358	3	795	1
Czech Republic	10 246	11	25 899	7	15 663	286
Denmark	5 351	5	10 013	4	4 871	17

5 Smoking prevalence Percentage of people 18 years and above who smoke *2003 or latest available data*		6 Diabetes Percentage of people aged 20 years and above with diabetes *2000*	7 Research Number of publications on cardiovascular disease *1991–2001*	8 Policies and legislation Legal status of smoking in government buildings *2004 or latest available data*	Country
men	women				
–	–	4.7%	–	unknown	Afghanistan
46.2%	22.8%	4.5%	–	not regulated	Albania
40.2%	11.5%	2.6%	1	unknown	Algeria
49.6%	35.9%	8.8%	–	banned	Andorra
–	–	0.9%	–	not regulated	Angola
–	–	7.3%	–	unknown	Antigua and Barbuda
32.0%	18.9%	6.1%	110	not regulated	Argentina
67.4%	4.1%	4.7%	1	not regulated	Armenia
30.7%	23.1%	6.8%	710	restricted	Australia
37.4%	26.3%	3.8%	320	restricted	Austria
32.0%	1.7%	6.8%	1	banned	Azerbaijan
–	–	6.2%	–	unknown	Bahamas
29.5%	16.0%	9.1%	4	unknown	Bahrain
63.0%	34.5%	4.6%	3	restricted	Bangladesh
19.8%	3.0%	5.8%	1	banned	Barbados
63.6%	22.0%	9.9%	3	restricted	Belarus
33.2%	22.9%	4.0%	345	restricted	Belgium
–	–	4.2%	–	restricted	Belize
–	5.4%	3.3%	1	unknown	Benin
–	–	3.5%	–	unknown	Bhutan
36.7%	19.2%	4.9%	–	restricted	Bolivia
54.6%	31.5%	3.8%	–	banned	Bosnia and Herzegovina
–	–	3.6%	–	restricted	Botswana
29.4%	18.4%	4.3%	307	banned	Brazil
–	–	9.4%	–	banned	Brunei Darussalam
47.3%	28.2%	7.7%	18	banned	Bulgaria
25.6%	13.2%	2.7%	2	not regulated	Burkina Faso
–	–	1.0%	–	not regulated	Burundi
–	6.5%	1.9%	–	restricted	Cambodia
20.7%	2.4%	1.0%	4	restricted	Cameroon
30.0%	26.6%	8.8%	1 237	restricted	Canada
–	–	3.4%	–	restricted	Cape Verde
–	–	1.0%	–	not regulated	Central African Rep.
19.7%	3.1%	2.8%	–	not regulated	Chad
44.1%	36.6%	5.2%	53	restricted	Chile
58.9%	3.6%	2.4%	472	restricted	China
–	–	3.6%	11	unknown	Colombia
30.5%	18.4%	1.4%	–	unknown	Comoros
20.8%	3.9%	1.1%	2	restricted	Congo
–	–	1.4%	–	unknown	Congo, Dem. Rep.
–	–	6.3%	–	not regulated	Cook Islands
24.3%	10.0%	3.3%	2	restricted	Costa Rica
21.0%	4.0%	3.6%	–	restricted	Côte d'Ivoire
41.4%	27.4%	4.4%	41	banned	Croatia
48.8%	28.5%	6.0%	15	restricted	Cuba
–	–	9.2%	–	restricted	Cyprus
42.6%	26.2%	4.3%	78	banned	Czech Republic
40.3%	36.9%	3.8%	308	restricted	Denmark

World Data Table

Country	1 Population Thousands 2002	2 Heart disease		3 Stroke		4 Rheumatic heart disease
		Disability DALYS lost per 1000 population 2002	Mortality Number of deaths 2002	Disability DALYS lost per 1000 population 2003 or latest available data	Mortality Number of deaths 2002	Number of death 2002
Djibouti	693	21	727	7	248	27
Dominica	78	3	30	4	30	0
Dominican Republic	8 616	11	7 271	9	4 833	54
Ecuador	12 810	5	5 826	5	4 374	117
Egypt	70 507	21	103 829	8	35 054	3 398
El Salvador	6 415	10	5 328	4	1 684	39
Equatorial Guinea	481	11	313	12	333	18
Eritrea	3 991	9	1 326	10	1 474	42
Estonia	1 338	16	6 235	9	2 964	65
Ethiopia	68 961	10	32 477	11	35 329	2 482
Fiji	831	18	783	17	685	21
Finland	5 197	7	12 488	4	4 875	77
France	59 850	3	46 132	3	37 750	1 136
Gabon	1 306	11	1 001	11	951	57
Gambia	1 388	10	789	11	837	48
Georgia	5 177	23	26 035	17	15 680	59
Germany	82 414	6	172 717	4	79 326	2 241
Ghana	20 471	9	10 471	11	11 337	705
Greece	10 970	7	16 825	6	22 694	10
Grenada	80	9	85	13	91	1
Guatemala	12 036	4	2 796	4	2 232	14
Guinea	8 359	11	4 137	12	4 415	289
Guinea-Bissau	1 449	11	783	13	844	52
Guyana	764	12	791	18	880	8
Haiti	8 218	5	2 469	16	6 764	62
Honduras	6 781	10	4 544	8	2 786	79
Hungary	9 923	13	29 502	8	17 148	354
Iceland	287	5	416	3	189	3
India	1 049 549	20	1 531 534	10	771 067	103 913
Indonesia	217 131	14	220 372	8	123 684	11 660
Iran, Isl. Rep.	68 070	17	81 983	8	31 768	1 138
Iraq	24 510	19	22 036	8	8 291	695
Ireland	3 911	8	6 527	4	2 650	51
Israel	6 304	4	5 705	3	2 233	170
Italy	57 482	4	92 928	4	69 075	1 790
Jamaica	2 627	5	1 877	11	3 559	59
Japan	127 478	3	90 196	5	134 952	2 585
Jordan	5 329	13	3 788	6	1 428	127
Kazakhstan	15 469	28	51 948	17	26 874	919
Kenya	31 540	9	13 661	10	14 843	360
Kiribati	87	1	7	18	81	0
Korea, Dem. People's Rep. of	22 541	13	26 953	8	14 337	1 317
Korea, Republic of	47 430	3	15 811	9	46 151	202
Kuwait	2 443	10	940	3	213	7
Kyrgyzstan	5 067	22	10 850	22	8 366	351
Lao People's Dem. Rep.	5 529	19	5 539	12	3 620	484
Latvia	2 329	17	9 928	12	7 278	109
Lebanon	3 596	17	5 471	7	2 072	119

5 Smoking prevalence Percentage of people 18 years and above who smoke *2003 or latest available data*		6 Diabetes Percentage of people aged 20 years and above with diabetes *2000*	7 Research Number of publications on cardiovascular disease *1991–2001*	8 Policies and legislation Legal status of smoking in government buildings *2004 or latest available data*	Country
men	women				
–	–	2.5%	–	unknown	Djibouti
–	–	6.2%	–	unknown	Dominica
22.1%	16.2%	5.2%	–	restricted	Dominican Republic
31.9%	7.4%	4.8%	3	banned	Ecuador
47.9%	1.8%	7.2%	20	restricted	Egypt
–	–	3.0%	–	unknown	El Salvador
–	–	3.8%	–	unknown	Equatorial Guinea
–	–	2.8%	4	not regulated	Eritrea
57.1%	28.8%	4.4%	7	banned	Estonia
9.7%	0.8%	2.8%	4	not regulated	Ethiopia
47.3%	14.0%	8.3%	1	not regulated	Fiji
31.6%	22.3%	3.9%	331	banned	Finland
42.6%	33.9%	3.9%	1 407	restricted	France
–	–	1.2%	–	not regulated	Gabon
43.4%	6.2%	3.3%	4	restricted	Gambia
61.4%	6.3%	5.3%	159	not regulated	Georgia
39.0%	30.9%	4.1%	2 276	restricted	Germany
14.2%	1.9%	3.3%	1	restricted	Ghana
53.5%	33.6%	10.3%	245	restricted	Greece
–	–	7.3%	–	unknown	Grenada
24.5%	3.7%	2.7%	–	restricted	Guatemala
–	–	0.9%	3	banned	Guinea
–	–	3.1%	–	not regulated	Guinea-Bissau
–	–	4.2%	–	unknown	Guyana
25.2%	5.4%	4.1%	–	unknown	Haiti
–	–	2.7%	–	unknown	Honduras
47.2%	27.7%	4.4%	103	banned	Hungary
26.5%	27.1%	3.2%	9	banned	Iceland
34.6%	3.4%	5.5%	294	banned	India
59.8%	5.3%	6.7%	4	restricted	Indonesia
33.4%	3.5%	6.0%	–	banned	Iran, Isl. Rep.
–	–	6.1%	1	unknown	Iraq
33.8%	26.5%	3.2%	142	restricted	Ireland
35.8%	19.7%	6.7%	634	banned	Israel
37.9%	29.7%	9.2%	1 976	banned	Italy
56.1%	21.2%	5.4%	23	not regulated	Jamaica
52.5%	12.4%	6.7%	3 769	restricted	Japan
66.8%	5.3%	8.1%	6	banned	Jordan
57.5%	6.4%	4.4%	–	restricted	Kazakhstan
66.3%	27.3%	1.4%	3	not regulated	Kenya
–	–	8.6%	–	not regulated	Kiribati
–	–	2.5%	–	unknown	Korea, Dem. People's Rep. of
69.5%	5.1%	5.6%	19	restricted	Korea, Republic of
35.7%	2.7%	9.8%	17	restricted	Kuwait
64.1%	41.4%	3.6%	–	not regulated	Kyrgyzstan
68.9%	16.1%	1.8%	–	restricted	Lao People's Dem. Rep.
64.5%	29.2%	4.5%	1	restricted	Latvia
60.7%	46.9%	7.0%	65	restricted	Lebanon

World Data Table

Country	1 Population Thousands 2002	2 Heart disease		3 Stroke		4 Rheumatic heart diseas Number of deat 2002
		Disability DALYS lost per 1000 population 2002	Mortality Number of deaths 2002	Disability DALYS lost per 1000 population 2003 or latest available data	Mortality Number of deaths 2002	
Lesotho	1 800	9	1 200	11	1 299	24
Liberia	3 239	12	1 442	14	1 559	130
Libyan Arab Jamahiriya	5 445	15	5 309	6	1 762	130
Lithuania	3 465	16	14 662	7	5 089	186
Luxembourg	447	4	455	5	390	0
Macedonia, Former Yugos. Rep. of	2 046	9	2 544	13	3 772	41
Madagascar	16 916	10	8 327	11	9 020	609
Malawi	11 871	10	6 773	11	7 249	106
Malaysia	23 965	8	13 445	7	10 169	464
Maldives	309	17	282	10	152	16
Mali	12 623	11	5 406	13	5 946	478
Malta	393	9	865	4	338	6
Marshall Islands	52	20	57	20	54	2
Mauritania	2 807	11	1 640	13	1 756	111
Mauritius	1 210	18	2 034	11	1 235	5
Mexico	101 965	6	51 454	4	26 478	1 093
Micronesia, Federated States of	108	12	64	14	69	2
Moldova, Republic of	4 270	23	18 559	15	7 848	264
Monaco	34	3	27	3	22	1
Mongolia	2 559	8	1 153	25	2 515	145
Morocco	30 072	14	29 934	5	10 607	808
Mozambique	18 537	8	7 969	10	8 896	246
Myanmar	48 852	17	58 478	11	33 406	3 746
Namibia	1 961	8	996	10	1 108	25
Nauru	13	22	17	10	7	0
Nepal	24 609	18	23 314	10	11 961	1 648
Netherlands	16 067	5	19 045	4	12 459	16
New Zealand	3 846	7	6 141	4	2 699	139
Nicaragua	5 335	8	2 680	7	1 768	70
Niger	11 544	11	4 423	13	4 831	439
Nigeria	120 911	11	64 778	12	69 932	4 795
Niue	2	10	1	12	1	0
Norway	4 514	5	8 886	3	4 817	103
Oman	2 768	17	1 765	4	375	12
Pakistan	149 911	18	154 338	9	78 512	11 604
Palau	20	14	17	14	16	0
Panama	3 064	5	1 628	5	1 489	30
Papua New Guinea	5 586	18	3 994	10	1 960	351
Paraguay	5 740	7	2 606	10	2 881	36
Peru	26 767	4	10 615	4	8 084	157
Philippines	78 580	10	45 378	7	24 368	2 812
Poland	38 622	10	77 151	7	43 032	1 277
Portugal	10 049	5	10 927	9	20 069	189
Qatar	601	9	238	4	75	4
Romania	22 387	13	60 718	13	52 272	566
Russian Federation	144 082	27	674 881	19	517 424	8 126
Rwanda	8 272	10	3 493	12	3 811	101
Saint Kitts and Nevis	42	10	46	19	84	0

5 **moking prevalence** Percentage of people 18 ears and above who smoke 003 or latest available data		6 **Diabetes** Percentage of people aged 20 years and above with diabetes *2000*	7 **Research** Number of publications on cardiovascular disease *1991–2001*	8 **Policies and legislation** Legal status of smoking in government buildings *2004 or latest available data*	**Country**
men	women				
–	–	3.1%	–	unknown	Lesotho
–	–	3.1%	–	unknown	Liberia
–	–	3.1%	–	banned	Libyan Arab Jamahiriya
46.4%	15.9%	4.2%	5	restricted	Lithuania
41.4%	30.2%	3.6%	3	restricted	Luxembourg
–	–	3.8%	5	banned	Macedonia, Former Yugos. Rep. of
–	–	1.4%	2	not regulated	Madagascar
31.0%	7.4%	1.1%	1	not regulated	Malawi
52.4%	3.0%	7.6%	16	banned	Malaysia
–	–	5.0%	–	banned	Maldives
26.9%	4.7%	2.9%	–	restricted	Mali
–	–	13.9%	5	not regulated	Malta
–	–	8.6%	9	banned	Marshall Islands
25.0%	4.3%	2.8%	–	not regulated	Mauritania
54.7%	3.1%	14.6%	2	restricted	Mauritius
36.5%	14.3%	3.9%	201	restricted	Mexico
–	–	8.6%	–	not regulated	Micronesia, Federated States of
–	–	5.9%	–	restricted	Moldova, Republic of
–	–	8.8%	7	unknown	Monaco
46.2%	7.3%	2.5%	1	restricted	Mongolia
32.6%	0.6%	2.6%	7	restricted	Morocco
–	–	1.6%	1	unknown	Mozambique
55.5%	12.2%	2.0%	–	unknown	Myanmar
33.8%	16.1%	3.1%	–	not regulated	Namibia
56.8%	64.7%	27.8%	–	banned	Nauru
61.5%	34.6%	3.9%	3	banned	Nepal
38.3%	32.8%	3.5%	917	restricted	Netherlands
28.1%	28.7%	6.7%	131	restricted	New Zealand
–	–	2.9%	–	restricted	Nicaragua
–	–	2.5%	–	unknown	Niger
16.3%	3.6%	3.4%	18	banned	Nigeria
36.8%	14.0%	6.3%	–	restricted	Niue
40.3%	39.0%	3.9%	185	restricted	Norway
23.6%	2.9%	9.9%	19	unknown	Oman
30.3%	3.8%	7.7%	12	banned	Pakistan
50.9%	22.6%	8.6%	–	banned	Palau
35.1%	17.7%	3.5%	1	unknown	Panama
48.9%	–	6.5%	3	banned	Papua New Guinea
45.8%	15.6%	3.7%	1	restricted	Paraguay
–	–	5.2%	3	restricted	Peru
59.6%	13.8%	7.1%	2	restricted	Philippines
51.5%	27.9%	4.1%	187	banned	Poland
44.2%	19.7%	8.6%	51	restricted	Portugal
–	–	10.1%	7	unknown	Qatar
33.3%	10.8%	6.6%	16	unknown	Romania
58.1%	15.8%	4.2%	13	banned	Russian Federation
–	–	0.9%	–	not regulated	Rwanda
–	–	7.3%	–	unknown	Saint Kitts and Nevis

World Data Table

Country	1 Population Thousands 2002	2 Heart disease		3 Stroke		4 Rheumati heart disea Number of dea 2002
		Disability DALYS lost per 1000 population 2002	Mortality Number of deaths 2002	Disability DALYS lost per 1000 population 2003 or latest available data	Mortality Number of deaths 2002	
Saint Lucia	148	6	71	11	120	4
Saint Vincent and Grenadines	119	9	103	10	88	2
Samoa	176	14	117	14	128	3
San Marino	27	5	40	3	26	1
Sao Tome and Principe	157	7	81	10	107	2
Saudi Arabia	23 520	17	16 438	4	3 818	126
Senegal	9 855	10	3 838	12	4 154	355
Serbia and Montenegro	10 535	12	23 610	12	21 756	238
Seychelles	80	7	54	2	15	1
Sierra Leone	4 764	13	2 813	15	3 035	216
Singapore	4 183	7	3 946	3	1 716	39
Slovakia	5 398	12	14 609	5	4 445	131
Slovenia	1 986	6	2 803	6	2 003	87
Solomon Islands	463	12	213	13	220	6
Somalia	9 480	19	6 818	13	4 426	333
South Africa	44 759	9	27 013	11	30 306	792
Spain	40 977	4	45 018	3	34 880	1 738
Sri Lanka	18 910	8	16 297	7	13 348	175
Sudan	32 878	15	28 458	10	16 532	800
Suriname	432	13	397	12	362	4
Swaziland	1 069	8	529	8	499	13
Sweden	8 867	5	20 122	3	9 984	143
Switzerland	7 171	4	10 746	2	4 508	112
Syrian Arab Republic	17 381	13	11 168	11	7 675	1 715
Tajikistan	6 195	23	11 447	7	3 048	419
Tanzania, United Republic of	36 276	10	14 720	12	16 115	439
Thailand	62 193	6	28 425	5	24 810	456
Timor-Leste	739	18	635	10	315	49
Togo	4 801	10	2 474	12	2 675	175
Tonga	103	10	70	12	79	2
Trinidad and Tobago	1 298	15	2 156	10	1 253	23
Tunisia	9 728	15	12 956	6	4 798	298
Turkey	70 318	16	102 552	13	62 782	1 584
Turkmenistan	4 794	34	11 671	7	2 182	221
Tuvalu	10	18	11	20	11	0
Uganda	25 004	10	10 163	11	11 043	288
Ukraine	48 902	28	335 610	13	126 117	3 085
United Arab Emirates	2 937	17	2 235	4	363	16
United Kingdom	59 068	7	120 530	4	59 322	1 712
United States of America	291 038	8	514 450	4	163 768	3 479
Uruguay	3 391	6	3 980	7	3 773	32
Uzbekistan	25 705	24	55 693	12	23 436	1 558
Vanuatu	207	13	120	13	122	3
Venezuela	25 226	10	17 967	5	8 720	208
Viet Nam	80 278	10	66 179	8	58 308	4 210
Yemen	19 315	22	16 217	9	6 464	743
Zambia	10 698	8	4 153	9	4 604	135
Zimbabwe	12 835	8	5 752	10	6 264	158

5 **Smoking prevalence** Percentage of people 18 years and above who smoke *2003 or latest available data*		6 **Diabetes** Percentage of people aged 20 years and above with diabetes *2000*	7 **Research** Number of publications on cardiovascular disease *1991–2001*	8 **Policies and legislation** Legal status of smoking in government buildings *2004 or latest available data*	**Country**
men	women				
34.6%	5.0%	6.2%	–	restricted	Saint Lucia
34.6%	5.6%	7.3%	–	unknown	Saint Vincent and Grenadines
67.4%	28.8%	6.1%	–	banned	Samoa
–	–	9.2%	–	unknown	San Marino
–	–	0.9%	–	not regulated	Sao Tome and Principe
29.1%	1.2%	9.3%	51	banned	Saudi Arabia
21.2%	1.5%	3.4%	3	not regulated	Senegal
55.5%	51.8%	4.2%	21	not regulated	Serbia & Montenegro
32.5%	15.0%	14.6%	–	unknown	Seychelles
–	–	3.3%	–	unknown	Sierra Leone
23.7%	3.2%	11.4%	76	restricted	Singapore
42.3%	28.0%	3.9%	25	banned	Slovakia
32.7%	20.8%	4.3%	34	restricted	Slovenia
–	–	6.4%	–	restricted	Solomon Islands
–	–	2.7%	–	unknown	Somalia
43.4%	13.9%	3.4%	77	restricted	South Africa
43.9%	31.2%	8.7%	689	restricted	Spain
38.7%	3.1%	5.4%	6	banned	Sri Lanka
27.7%	2.7%	2.9%	–	restricted	Sudan
–	–	3.8%	–	not regulated	Suriname
19.6%	4.9%	2.9%	–	not regulated	Swaziland
21.3%	24.9%	4.3%	654	banned	Sweden
37.6%	28.3%	3.9%	440	restricted	Switzerland
44.0%	16.7%	8.2%	–	banned	Syrian Arab Republic
–	–	3.1%	–	not regulated	Tajikistan
48.9%	7.2%	1.3%	–	not regulated	Tanzania, United Republic of
32.2%	2.7%	3.8%	59	restricted	Thailand
–	–	–	–	unknown	Timor-Leste
–	–	3.1%	2	not regulated	Togo
62.1%	14.2%	6.3%	–	banned	Tonga
–	–	7.3%	5	not regulated	Trinidad and Tobago
52.9%	2.5%	2.9%	8	restricted	Tunisia
51.1%	18.5%	7.3%	578	banned	Turkey
–	–	3.2%	–	banned	Turkmenistan
–	–	6.3%	–	banned	Tuvalu
33.4%	7.1%	1.1%	2	restricted	Uganda
55.5%	14.7%	4.4%	19	restricted	Ukraine
27.6%	4.0%	20.5%	8	restricted	United Arab Emirates
34.6%	34.4%	3.9%	2 667	not regulated	United Kingdom
27.8%	22.3%	8.8%	12 502	restricted	United States of America
39.4%	30.8%	6.8%	2	restricted	Uruguay
28.7%	1.4%	3.2%	1	not regulated	Uzbekistan
47.9%	4.8%	6.9%	–	restricted	Vanuatu
51.9%	20.5%	4.3%	–	unknown	Venezuela
53.2%	3.0%	1.8%	–	banned	Viet Nam
60.0%	29.0%	4.4%	–	unknown	Yemen
21.4%	8.8%	1.6%	–	restricted	Zambia
32.2%	4.6%	2.0%	2	unknown	Zimbabwe

Glossary of terms used in this publication

ACE inhibitors: angiotensin-converting-enzyme inhibitors. Drugs used to treat high blood pressure, and to aid healing after a heart attack.

Angina (angina pectoris): pain or discomfort in the chest that occurs when part of the heart does not receive enough blood. Typically, it is precipitated by effort and relieved by rest.

Angioplasty: a non-invasive surgical procedure used to open up blockages in blood vessels, particularly the coronary arteries that feed the heart. Often performed with either a balloon or a wire mesh (stent).

Anticoagulant: medication that delays the clotting (coagulation) of blood.

Arrhythmia: a change in the regular beat or rhythm of the heart. The heart may seem to skip a beat, or beat irregularly, or beat very fast or very slowly.

Arteriosclerosis: a general term for the hardening of the arteries.

Asymptomatic: without symptoms. This term may apply either to healthy persons or to persons with preclinical (prior to clinical diagnosis) disease in whom symptoms are not yet apparent.

Atherosclerosis: one form of arteriosclerosis, where the hardening and narrowing of the arteries is caused by the slow build-up of fatty deposits on the inside lining.

Atrial fibrillation: a common heart rhythm disorder in which the two small upper chambers of the heart (the atria) quiver instead of beating effectively. This quivering makes the heart less efficient, allows blood to pool and form clots, and predisposes to stroke.

Blood pressure: the force of the blood pushing against the walls of arteries. Blood pressure is given as two numbers: systolic pressure (the pressure while the heart is contracting) and diastolic pressure (the pressure when the heart is resting between contractions).

Body mass index (BMI): a measure of weight in relation to height. It is calculated as weight (in kilograms) divided by the square of height (in metres). A BMI of less than 25 is considered normal, 25–30 is overweight, and greater than 30 defines obesity.

Cardiovascular disease (CVD): any disease of the heart or blood vessels, including stroke and high blood pressure.

Carotid stenosis: narrowing of the carotid arteries, the main arteries in the neck that supply blood to the brain.

Cerebrovascular disease: also called a stroke or the brain equivalent of a heart attack. A condition in which a blood vessel in the brain bursts or is clogged by a blood clot, leading to inadequate blood supply to the brain and death of brain cells.

Cholesterol: a waxy substance that circulates in the bloodstream.

Cholesterol plaques: deposits of fat, cholesterol, cellular waste products, calcium and other substances that build up on the inner lining of an artery.

Congestive heart failure: a condition in which the heart cannot pump enough blood to meet the needs of the body's other organs.

Coronary artery bypass surgery (CABG): A type of heart surgery that re-routes blood around clogged arteries – or "bypasses" them – to improve the supply of blood and oxygen to the heart.

Coronary heart disease: heart disease in which the coronary arteries are narrowed and the supply of blood and oxygen to the heart therefore decreased. Also called coronary artery disease or ischaemic heart disease. It includes heart attack and angina.

Developing country, high mortality: a developing country with high child mortality and high or very high adult mortality.

Developing country, low mortality: a developing country with low child mortality and low adult mortality.

Diabetes mellitus: a chronic disease due to either insulin deficiency or resistance to insulin action or both, and associated with hyperglycaemia (elevated blood glucose levels).

Direct costs: costs associated with an illness that can be attributed to a medical service, procedure, medication, etc., such as X-ray examination, pharmaceutical drugs (for example, insulin), surgery, or a clinic visit.

Disability adjusted life years (DALYs): a measure of overall burden of a disease by combining the years of potential life lost due to premature death and the years of productive life lost due to the disability. One DALY is one lost year of healthy life.

Epidemic: the occurrence in a community or region of cases of an illness, specific health-related behaviour, or other health-related events clearly in excess of what would normally be expected.

Health: a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity.

HDL (high-density lipoprotein) cholesterol: the so-called "good cholesterol". HDL helps remove cholesterol from the blood vessels. High levels of blood HDL protect against heart disease.

Heart attack (myocardial infarction): death of part of the heart muscle as a result of a coronary artery becoming completely blocked, usually by a blood clot (thrombus), resulting in lack of blood flow to the heart muscle and therefore loss of needed oxygen.

Heart failure: see Congestive heart failure.

High blood pressure: a systolic blood pressure of 140 mmHg or greater or a diastolic pressure of 90 mmHg or greater.

Homocysteine: an amino acid produced by the body. Elevated levels of homocysteine in the blood can damage blood vessels and disrupt normal blood clotting, and possibly increase the risk of heart attack, stroke, and peripheral vascular disease.

Indirect costs: costs associated with an illness that occur because an individual or family members cannot work at their usual jobs, because of premature death, sickness, or disability.

Ischaemic heart disease: see Coronary heart disease.

LDL (low-density lipoprotein) cholesterol: the so-called "bad cholesterol". High levels of LDL put people at risk of heart attack.

Lipid: fat or fat-like substance, such as cholesterol, present in blood and body tissues.

MET: metabolic equivalent; a measure of energy expenditure. One MET/min is the amount of energy expended while sitting quietly at rest for one minute.

Obesity: a condition characterized by excessive body fat. Usually defined as a body mass index greater than 30.

Peripheral vascular disease: disease of certain blood vessels outside the heart or disease of the lymph vessels, for example the arteries supplying the limbs, which leads to inadequate blood supply and claudication (intermittent pain on exercise such as walking).

Physical activity: bodily movement that substantially increases energy expenditure.

Premature death: death that occurs at an age earlier than the average life expectancy for the population.

Primary prevention: a strategy that helps to prevent the onset of a disease or condition in people who are at risk but do not already have the disease or condition. Examples are promotion of exercise in the general population, smoking prevention in young people, and also the treatment and control of high blood pressure as a strategy for primary prevention of stroke.

Rheumatic heart disease: damage to the heart valves and other heart structures from inflammation and scarring caused by rheumatic fever. Rheumatic fever begins with a sore throat due to streptococcal infection.

Secondary prevention: a strategy that helps to prevent recurrent disease or complications in people who already have the disease. For example, the use of a daily dose of aspirin by heart attack survivors is an effective strategy for preventing a second heart attack.

Sedentary: denotes a person who is relatively inactive and has a lifestyle characterized by a lot of sitting.

Stent: a device used to support tissues while healing takes place. A stent can keep "tube-shaped" structures, such as blood vessels, open after a surgical procedure. An intraluminal coronary artery stent is a small, self-expanding, stainless steel mesh tube, which is placed within a coronary artery to keep the vessel open.

Stroke: the brain equivalent of a heart attack. A condition in which a blood vessel in the brain bursts (haemorrhagic stroke) or is clogged (embolic or ischaemic stroke) by a blood clot. This leads to inadequate blood supply to the brain and death of the brain cells, and usually results in temporary or permanent neurological deficits.

Transient ischaemic attack (TIA): small stroke-like event, which resolves in a day or less. It is often a warning sign of an impending stroke.

Triglyceride: the chemical form in which most fat exists in food and in the body.

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PART 3 THE BURDEN

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PART 4 ACTION

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PART 5 THE FUTURE AND THE PAST

25 Future

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Useful contacts

World Health Organization

http://www.who.int

Cardiovascular disease:
http://www5.who.int/cardiovascular-diseases/
Diabetes:
http://www.who.int/health_topics/diabetes_mellitus/en/
Diet:
http://www.who.int/health_topics/diet/en/
Nutrition:
http://www.who.int/health_topics/nutrition/en/
Obesity:
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Public Health Surveillance:
http://www.who.int/health_topics/public_health_surveillance/en/
Tobacco Free Initiative:
http://www.who.int/tobacco/en/

Centers for Disease Control and Prevention, USA

http://www.cdc.gov/

Cardiovascular Health Program:
http://www.cdc.gov/cvh/
Nutrition and Physical Activity Program:
http://www.cdc.gov/nccdphp/dnpa/
Tobacco Program:
http://www.cdc.gov/tobacco/
Diabetes Program:
http://www.cdc.gov/diabetes/
Laboratory Sciences Program:
http://www.cdc.gov/nceh/dls/programs.htm
Office of Global Health:
http://www.cdc.gov/ogh/
Behavioral Risk Factor Surveillance System:
http://www.cdc.gov/brfss
National Center for Health Statistics:
http://www.cdc.gov/nchs

International and Regional Organisations

Asian Society for Cardiovascular Surgery:
http://www.ascvs.org/
Association for European Paediatric Cardiology/Association
Européenne pour la Cardiologie Pédiatrique:
http://www.aepc.org/home.htm
Brain Aneurysm Foundation:
http://www.bafound.org
Cairdes: http://www.cairdes.com
CardioStart International Inc:
http://www.cardiostart.com/
Cardiothoracic Surgery Network:
http://www.ctsnet.org/
Chain of Hope: http://www.chainofhope.org
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http://www.childrensheartlink.org/
Children's Hearts: http://www.childrenshearts.org.uk
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http://www.cptg.ch/fr/start.htm
Congenital Heart Information Network:
http://www.tchin.org/
Congress of Neurological Surgeons:
http://www.neurosurgeon.org
Consortium for Southeastern Hypertension Control (COSEHC):
http://www.coschc.org/
East Meets West: http://www.eastmeetswest.org
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http://emnhh.homestead.com/files/index.htm
The Endocrine Society: http://www.endo-society.org/
European Association for Cardiothoracic Surgery:
http://www.eacts.org/
European Heart Institute:
http://www.european-academy.at
European Heart Network:
http://www.ehnheart.org/index2.asp
EMASH European Medical Association on Smoking and Health:
http://emash.globalink.org/
ENSH European Network for Smoke-free Hospitals:
http://ensh.free.fr/
ENSP European Network for Smoking Prevention:
http://www.ensp.org
European Network of Young People and Tobacco:
http://www.ktl.fi/enypat/
European Network of Quitlines:
http://www.quitlines-conference.com/
European Society for Noninvasive Cardiovascular Dynamics:
http://www2.mf.uni-lj.si/~esnicvd/
European Society of Cardiology:
http://www.escardio.org/
European Society of Hypertension:
http://www.eshonline.org/
European Stroke Initiative:
http://www.eusi-stroke.com/index.shtml
European Union of Non-smokers:
http://www.globalink.org/tobacco/docs/eu-docs/uene.htm
Framework Convention Alliance (FCA):
http://www.fctc.org/
G8 Telematics Heart Health Project:
http://www.med.mun.ca/g8hearthealth/
Gift of Life International Inc.:
http://www.giftoflifeinternational.org/
Global Connection International:
http://www.gciworld.org
Global Cardiovascular Infobase (in English and Spanish):
http://www.cvdinfobase.ca/
Global Healing: http://www.globalhealing.org
Global Health Information Network:
http://www.healthnet.org/
Global Partnerships for Tobacco Control:
http://www.essentialaction.org/tobacco/
Globalink, UICC International Union against Cancer:
http://www.globalink.org/
Healing the Children:
http://www.healingchildren.org
Heart Care International:
http://www.heartcareintl.org
HeartGift Foundation:
http://www.heartgift.org/index.html
The Heart of a Child Foundation – Little Hearts on the Mend:
http://www.littleheartsonthemend.org
Heart-to-Heart International:
http://www.hearttoheart.org/

Heart-to-Heart International Children's Medical Alliance:
http://www.heart-2-heart.org/
Initiative for Cardiovascular Health Research in Developing Countries:
http://www.globalforumhealth.org/pages/index.asp?
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InterAmerican Heart Foundation:
http://www.interamericanheart.org
InterAmerican Society of Cardiology (in Spanish and English):
http://www.soinca.org
Inter-American Socicty of Hypertension:
http://org.umc.edu/iash/homepage.htm:
http://www.musc.edu/iash/generale.htm
International Academy of Cardiology:
http://www.cardiologyonline.com/
International Agency on Tobacco and Health (IATH):
Email: admin@iath.org
International Atherosclerosis Society:
http://www.athero.org/
International Children's Heart Foundation:
http://www.ichf.org/
International Children's Heart Fund:
http://www.ichfund.org/
International Diabetes Federation:
http://www.idf.org/
International Diabetes Institute, Australia:
http://www.diabetes.com.au/home.htm
International Federation of Sports Medicine:
http://www.fims.org/
International Hospital for Children (IHC):
http://www.healachild.org
International Network of Women against Tobacco (INWAT):
http://www.inwat.org/
International Network towards Smoke-Free Hospitals (INTSH):
http://intsh.globalink.org/
International Non Governmental Coalition against Tobacco (INGCAT):
http://www.ingcat.org/
International Obesity Task Force:
http://www.iotf.org/
International Pediatric Hypertension Association:
http://www.pediatrichypertension.org/
International Society for Adult Congenital Cardiac Disease:
http://www.isaccd.org/
International Society for Aging and Physical Activity:
http://www.isapa.org/
International Society for Cardiovascular Surgery:
http://www.vascsurg.org/doc/1576.html##.htm
International Society for Heart Research:
http://www.ishrworld.org/
International Society for Heart & Lung Transplantation:
http://www.ishlt.org/
International Society for Minimally Invasive Cardiac Surgery:
http://www.ismics.org/
International Society for the Prevention of Tobacco Induced Diseases
(PTID): http://www.ptid.org
International Society of Cardiovascular Ultrasound:
http://www.iscu.org/
International Society of Hypertension:
http://www.hypertension2004.com.br/
International Society of Nephrology:
http://www.isn-online.org/
International Society on Hypertension in Blacks (ISHIB):
http://www.ishib.org/main/ishib_open.htm
International Stroke Society:
http://www.internationalstroke.org/index.php
International Task Force for the Prevention of Coronary Heart Disease:
http://www.chd-taskforce.de/
International Tobacco Evidence Network (ITEN):
http://www.tobaccoevidence.net/
The Internet Stroke Center:
http://www.strokecenter.org/pat/organizations.htm
Legacy Foundation, tobacco document site:
http://legacy.library.ucsf.edu/cgi/b/bib/bib-idx?g=tob
Mediterranean Stroke Society:
http://www.hsanmartino.liguria.it/cictus/mcd.htm
OTAF L'Observatoire du Tabac en Afrique Francophone:
http://otaf.globalink.org/
Physicians for Peace: http://www.physiciansforpeace.org
ProCOR: Conference on Cardiovascular Health:
http://www.procor.org/
Project Hope: http://www.projecthope.org
Project Kids Worldwide:
http://www.projectkidsworldwide.org
Project Open Hearts: http://www.poh.org
Repace's site, especially on passive smoking (Jim Repace):
http://www.repace.com/
Save A Child's Heart Foundation:
http://www.saveachildsheart.com
Society for Research on Nicotine and Tobacco (SRNT):
http://www.srnt.org/
Smokescreen Action Network:
http://www.smokescreen.org
Southeast Asian Tobacco Control Alliance:
http://www.tobaccofreeasia.net/
Stroke Awareness for Everyone:
http://www.strokesafe.org/
Stroke Clubs International:
Email: strokeclub@aol.com
Stroke Net:
http://www.strokenet.info/resources/stroke/internationalsites.htm
Surgeons of Hope Foundation:
http://www.surgconsofhope.org
Tobacco.org: http://www.tobacco.org
Tobacco Control journal:
http://www.tobaccocontrol.com
Tobacco Control Resource Center/Tobacco Products Liability Project
(TCRC/TPLP): http://tobacco.neu.edu/
TCRC Tobacco Control Resource Centre, BMA, UK:
http://www.tobacco-control.org/
Tobacco Control Supersite:
http://www.health.usyd.edu.au/tobacco/
Tobacco Documents Online (TDO, Smokescreen:
http://www.tobaccodocuments.org
Tobaccopedia:
http://TobaccoPedia.org
Treatobacco Database & Educational Resource for Treatment of
Tobacco Dependence:
http://www.treatobacco.net/
World Federation of Neurology:
http://www.wfneurology.org/
World Heart Federation:
http://www.worldheart.org/
World Heart Foundation:
http://www.world-heart.org/
World Hypertension League:
http://www.mco.edu/org/whl/
World Kidney Foundation:
http://www.worldkidneyfund.org/
World Medical Association:
http://www.wma.net/

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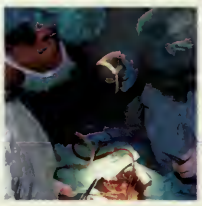
"Heart disease and stroke rob too many people of precious years of quality life. This one-of-a-kind atlas serves as a key resource for those on the frontlines of health." Dr Julie Gerberding, Director, Centers for Disease Control and Prevention, Atlanta, Georgia, USA

"We applaud the authors for producing such a comprehensive document in such a user-friendly format." World Heart Federation

Heart disease can no longer be seen as the problem of overworked, overweight middle-aged men; in today's world, we are all – women and children too – at risk. One in three deaths worldwide – 17 million deaths each year – is due to cardiovascular disease.

These full-colour maps and graphics illustrate the wide range of issues relating to this global epidemic, including:



Risk factors:
high blood pressure, tobacco, inactivity, obesity, lipids, diabetes

Women, childhood and youth

The global burden of cardiovascular disease

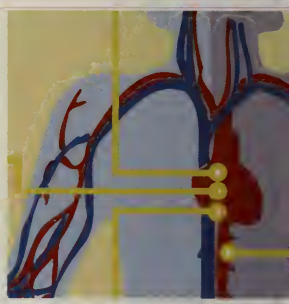
Research

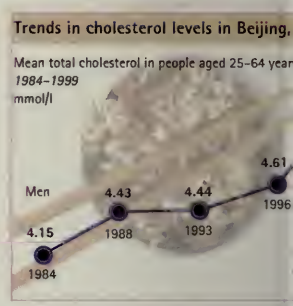
Prevention

Policies and legislation

Treatment

The future





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