EPIDEMIOLOGY AND PREVENTION OF CARDIOVASCULAR DISEASES IN ELDERLY PEOPLE

Report of a WHO Study Group
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1. **Introduction**

A WHO Study Group on Epidemiology and Prevention of Cardiovascular Diseases in the Elderly met in Geneva from 11 to 18 October 1993. Opening the meeting on behalf of the Director-General of WHO, Dr E. N. Chigan, Director, Division of Noncommunicable Diseases, pointed out that cardiovascular diseases were the leading cause of death in the adult population, and that the prevalence of the major cardiovascular diseases — hypertension, coronary heart disease (CHD) and stroke — increased markedly with age. In developed countries, 80% of all deaths from cardiovascular causes occurred in people over the age of 65 years.

Increasing longevity in developing countries would produce a corresponding increase in the prevalence of cardiovascular diseases, and of associated disability, in the coming years unless preventive measures succeeded in compensating for demographic trends. The health problems of elderly people, which often included cardiovascular diseases, would assume greater importance medically, socially and economically.

This Study Group had been convened to review the cardiovascular disease situation in elderly populations worldwide. Starting from the present knowledge of demographic changes, the epidemiological transition in developing countries, and cardiovascular disease epidemiology and prevention, the Study Group was asked to consider health policy options relevant to the prevention of cardiovascular diseases in elderly people and to discuss their relative cost-effectiveness. It was also requested to outline needs for research aimed at improving the health of elderly people.

2. **Global demographic trends in elderly populations**

This century has seen remarkable increases in the growth of the old population throughout the world. This growth has occurred in developing as well as developed countries.¹ In addition, the old population is itself becoming older: the number of people over 80 years of age — often referred to as the “oldest old” — is growing rapidly in many countries. Current projections indicate that the size of the world’s elderly population will increase considerably in the early part of the next century, with major effects on social structures, economies and health care systems throughout the world.

¹ For the purposes of this report, the developed countries are taken as all the countries of Europe, the countries of the former USSR, Australia, Canada, Japan, New Zealand and the United States of America. All other countries are classified as developing.
This section summarizes some key aspects of available data on the demographic characteristics of the old population in various parts of the world: the current and projected size of the elderly population, in absolute terms and in relation to the total population, sex differences, marital status and living arrangements. It also describes changes in life expectancy over the past four decades.

The data presented here are of variable quality, reflecting differences in the adequacy and frequency of censuses, the completeness of vital registrations, and the reliability of demographic projections. Population projections to 2025 are based on the current adult population and are therefore reasonably reliable (1-5).

Vital registration systems vary across the globe. Cause-of-death data are reported for only about one-third of deaths worldwide (6). In terms of WHO regions, coverage is almost complete for the European Region (94%) and reasonably high for the Americas (80%), while virtually no cause-of-death data are reported to WHO from Africa or South-East Asia.

2.1 Aging of the population

It is first necessary to define what is meant by “the elderly population”. In this report “the elderly population” will be taken to mean people aged 65 and older. Although this definition is somewhat arbitrary, it is in line with criteria used in many countries to define eligibility for retirement programmes and participation in other social programmes. National governments, statisticians and others should give consideration to raising the age used to define the elderly population.

2.1.1 Historical trends

Population aging in developed countries has resulted from a decline in both mortality and fertility. In some developed countries where these patterns commenced early this century, 15% or more of the population are already aged 65 or older, and 3-4% are aged 80 or older (3, 4). European countries have the highest proportion of elderly people in the world (Table 1): about 14% of people in western Europe are aged 65 years and over. Sweden is the “oldest” country in the world, with 18% of its population aged 65 and older.

Certain cities in developed countries have “aged” proportionally more than other parts of the same country, as a result of a stable older population and reduced migration of younger people into the city. For example, in 1982 the proportion of the population aged 65 and older in Paris was 17.1% compared with 13.2% for France as a whole.

Although the percentage of elderly people in the population in developing countries is substantially smaller than in the developed countries, the absolute numbers of old people worldwide are considerable (Table 2). For example, in China, where people aged 65 and
# Table 1

**Projected proportion of the population aged 65 years and over, 1990–2025**

<table>
<thead>
<tr>
<th>Region</th>
<th>Year</th>
<th>65 years</th>
<th>75 years</th>
<th>80 years</th>
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<td>1990</td>
<td>12.6</td>
<td>5.3</td>
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<td>8.5</td>
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<td>9.3</td>
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<tr>
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<td>4.6</td>
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<td>2025</td>
<td>9.4</td>
<td>3.6</td>
<td>1.8</td>
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<tr>
<td>Eastern Mediterranean/North Africa</td>
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<td>2010</td>
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<td>0.8</td>
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<td>2025</td>
<td>3.4</td>
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</table>

* Data exclude countries of the former USSR.

Source: (3)

Older people make up 5.5%, of the total population, they number 60 million, and in India, where only 3.4% are 65 and older, there are still 30 million of them. In 1988 there were an estimated 159 million persons aged 65 and older in developing countries compared with 140 million in developed countries, and over 60% of the monthly global net increase in older persons was in developing countries.

Between 1950 and the early 1970s, the numbers of people aged 65 years and older grew at about the same rate in developed and developing countries, the annual growth rate increasing from about 2% to about 3% during this period. However, in countries where the total fertility rate remains high, such as those of sub-Saharan Africa, the overall proportion of elderly people in the population has decreased. This trend is likely to be reversed as the younger groups age, and as general mortality rates continue to fall (7–6). Regional differences in the projected proportions of elderly people in the population are shown in Table 1.
<table>
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<th>Region</th>
<th>1990</th>
<th>2000</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total population</td>
<td>≥ 65 years</td>
<td>≥ 80 years</td>
</tr>
<tr>
<td>World</td>
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<td>327.6</td>
<td>52.9</td>
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<tr>
<td>Developed countries</td>
<td>1211.1</td>
<td>145.5</td>
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<tr>
<td>Developing countries</td>
<td>4084.2</td>
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<td>Latin America</td>
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<td>Europe</td>
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<tr>
<td>Former USSR</td>
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<tr>
<td>Oceania</td>
<td>26.7</td>
<td>2.4</td>
<td>0.5</td>
</tr>
</tbody>
</table>

a Includes all republics of the former USSR.
Source: UN Population Division assessment (1992)
2.1.2 Projected trends

There will be differences in annual growth rates in the elderly population in different parts of the world. From 1990 to 2025, the percentage of the population aged 65 and older is expected to increase to just over 20% in Europe and North America, to double from 5% to 10% in Asia, Latin America and the Caribbean, but to increase only modestly in the Eastern Mediterranean area, northern Africa and sub-Saharan Africa (Table 1).

This overall growth in the total number of old people between 1990 and 2025 will be much greater in developing than in developed countries, with the over-65 population doubling in many developing countries (Fig.1). Projections indicate that by the year 2020 there will be 470 million people aged 65 and older in developing countries, more than double the number in developed countries (Table 2). Three of the four countries projected to have the largest number of old people in the year 2025 are located in the Western Pacific and South-East Asian Regions: China, India and Indonesia (7). In contrast, developed countries will have substantially smaller increases in the number of persons aged 65 and older between 1990 and 2025, ranging from 33% in Sweden to 141% in Canada, with all European countries having increases of less than 100%.

The growth of the older population in developed countries is a well known phenomenon. The growth projected for older populations in developing countries is far greater and has considerable implications for health and social policy.

2.1.3 Very elderly people

It has been observed that not only is the total population getting older, but the old population itself is getting older. People over 80 years of age form the fastest-growing subgroup of the population in many countries. This age group makes up between one-quarter and one-third of the elderly population in North America and most countries in Europe. These percentages will increase early in the next century, but will then return to current levels around 2025 as people of the post-Second-World-War generation reach their late 60s and 70s. Developing countries are likely to experience a modest increase in the proportion of the population in the “oldest old” age range (Table 1) but, as with the growth of the elderly population in general, these proportions do not reflect the actual numbers of very old people, which will increase substantially.

2.2 Sex differences, marital status and living arrangements

In most developed countries, there are about 65 men for every 100 women in the age group 65 and older. There is generally a higher proportion of men in developing countries, and in a few countries, including Bangladesh, Egypt and India, there are more old men than old women. In the future, the sex ratio is projected to increase in most developed countries, as a result of a narrowing gap between male and
Figure 1
Projected percentage increase in the elderly population, 1990–2025

Indonesia

Colombia

Kenya

Singapore

Thailand

Costa Rica

Malaysia

Liberia

Republic of Korea

Mexico

Peru

Zimbabwe

Turkey

Brazil

Philippines

Morocco

Guatemala

Tunisia

India

Egypt

Sri Lanka

China

Bangladesh

Malawi

Pakistan

Canada

Australia

Cuba

Japan

Jamaica

Poland

Israel

USA

New Zealand

Argentina

Luxembourg

Former Czechoslovakia

Germany

Greece

France

Hungary

Italy

Bulgaria

Belgium

Austria

Denmark

United Kingdom

Norway

Uruguay

Sweden

Developing country

Developed country

female mortality rates. However, the sex ratio will probably fall in many developing countries, where female life expectancy is projected to increase faster than male life expectancy.

In both developed and developing countries, many more women than men are widowed. In most countries, more than 50% of women aged 65 years and older are widowed and, in some countries, more than 75% of women aged 75 and older are widowed. In contrast, there are no countries in which more than 40% of men aged 75 and older are widowed.

Marital status has the greatest impact on living arrangements in the elderly population, although a number of other factors play important roles. In developed countries, the proportion of persons aged 65 and older who live alone ranges from 10% in Japan to 40% in Sweden; in many countries it is around 30%. Large increases in the numbers of people living alone in developed countries over the past three decades have been due mainly to increases in the number of women living alone. Women are also more likely than men to be in long-term care institutions. The use of long-term care facilities varies widely, with the mix of medical facilities and non-medically oriented residential facilities also varying from country to country. The proportion of old people living alone is smaller in most developing countries, where there is a tradition of multigeneration households, and both married and widowed older persons commonly live with their children and grandchildren. This pattern is being disturbed as younger family members migrate to join the urban workforce, and it is likely that in future more elderly people in developing countries will live alone.

2.3 Trends in life expectancy and total mortality

Growth in the size of the elderly population results from changes in the size of birth cohorts and increases in life expectancy at birth. This century has seen remarkable improvements in life expectancy in most countries, although there are still tremendous disparities between developed and developing countries. Life expectancy at birth in most developed countries is 70-75 years for men and 76-81 years for women; it is currently highest in Japan, at 76 years for men and 82 years for women. Life expectancy is lower in eastern European countries than in other parts of the developed world. In developing countries, on average, life expectancy is 11 years less than in developed countries, but there is great variation. In Asia and Africa, life expectancy at birth ranges from less than 50 years to more than 70 years.

Most of the increase in life expectancy in the first half of this century resulted from reduced mortality among young age groups. In the past few decades, there have also been substantial reductions in mortality among older persons in many countries, resulting in large increases in life expectancy at age 65. In most developed countries, life expectancy at age 65 is increasing more rapidly than life expectancy at birth because of the
decline in cardiovascular diseases in middle-aged and older persons (see section 3). For example, in Japan since 1945 life expectancy at the age of 65 has increased by 36% for men and 39% for women, while the percentage increases in life expectancy at birth have been less than 23% and 25%, respectively. Life expectancy for men varies from 11.9 years to 16.9 years at the age of 65 years, and from 5.3 years to 9.2 years at the age of 80 years (Table 3). In some regions, life expectancy at the age of 65 years shows much less variation between countries than does life expectancy at birth. None the less, considerable differences in life expectancy at the age of 65 can be seen between countries that are similar by region and stage of development (Tables 4 and 5). For example, a 65-year-old woman in France can expect to live five years longer on average than a 65-year-old woman in the former Czechoslovakia. The life expectancy of elderly women is greater than that of men in all developed countries, reflecting more favourable trends in mortality for women as compared with men over the last half-century at least (Tables 4 and 5). There was an increase in mortality among older men during the 1950s and 1960s in many developed countries, with a much more recent decline in mortality rates. The reductions in mortality that have taken place in the older population have occurred among both the “young old” and the “old old”, although they have tended to be smaller in the latter group. These trends have been strongly influenced by decreasing trends in cardiovascular disease mortality, which will be described in detail in section 3.

3. **Cardiovascular disease in elderly people**

3.1 **The global burden of cardiovascular disease**

Approximately 50 million deaths occur throughout the world each year, with almost 80% of these (39 million) occurring in developing countries. It has been estimated that approximately one-quarter of all deaths in developing countries and almost half of all deaths in developed countries are attributable to cardiovascular disease (CVD). Worldwide there are more deaths from coronary heart disease (CHD) (5.2 million) than from stroke (4.6 million), although the relative importance of CHD and stroke varies considerably between countries. For example, twice as many deaths from stroke occur in developing countries as in developed countries, with one million occurring in China alone (8).

In developed countries, cardiovascular diseases account for approximately 10% of direct health care costs, and more than half of these diseases occur in people aged 65 years and older (9,10). These costs generally represent between 0.5% and 1% of the country’s gross national product. There are a range of other costs associated with cardiovascular diseases, which are more difficult to assess, primarily because elderly people tend to suffer from multiple diseases, and partly also because
<table>
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<td><strong>Life expectancy (years) for men and women at ages 65 and 80 years</strong></td>
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<table>
<thead>
<tr>
<th>Country or area (year)</th>
<th>Males</th>
<th>Females</th>
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<tbody>
<tr>
<td></td>
<td>At 65 years</td>
<td>At 80 years</td>
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<tr>
<td><strong>American Region</strong></td>
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<tr>
<td>Argentina (1990)</td>
<td>13.9</td>
<td>6.1</td>
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<td>Canada (1991)</td>
<td>15.7</td>
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<td>Chile (1989)</td>
<td>14.0</td>
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Source: WHO database
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Trends in life expectancy for women at age 65, 1950–54 to 1985–89  

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– : Data not available  
Source: WHO database
some costs are “hidden” – borne by family members and other agencies. The social and psychological costs of cardiovascular diseases for elderly patients and their carers have been infrequently evaluated.

In developing countries, there is little information on the economic consequences of ill-health in old age. Studies examining the effects of illness or death of younger adults have described a range of coping mechanisms among surviving family members, e.g. increasing workload or selling land to make up for lost income (8). The extra burden on the household as a result of cardiovascular mortality and morbidity in an elderly person has not yet been adequately documented.

3.2 Routine mortality statistics

Only about one-third of the world’s population is covered by an adequate routine death-certification reporting system, and there is great variation in coverage between regions (11). Furthermore, even when cause-of-death data are routinely available, precise diagnoses are difficult in older people, because they are more likely to have several diseases and are less likely to undergo diagnostic tests or autopsy. Autopsy rates in the elderly population are variable and often low, ranging from 3% in Japan to 36% in Sweden (11).

Where available, routine mortality statistics provide a reasonably reliable and convenient source of information for investigating trends (12). Within-country trends in these data over time are unlikely to be explained by changes in diagnostic fashion, certification practices or classification procedures. Between-country comparisons are, however, more prone to systematic differences.

The quality of information on disease-specific causes of death differs a great deal between countries. Data from many parts of Asia and Africa are often unavailable, and what data are reported include a large number of deaths attributed to nonspecific causes. Data from Latin America and the Caribbean are more reliable. The majority of deaths among older persons in much of Africa are still due to infectious diseases, while in Latin America and the Caribbean cardiovascular diseases are now the most important cause of death in old people. A variety of new methods, including the “verbal autopsy” (which relies on verbal information collected from a range of sources), are being developed for use in countries where national data are unavailable or unreliable (13). It is noteworthy that in several countries, for example France and Poland, there are many cases of cardiovascular disease that are not classified as either CHD or stroke; this phenomenon requires further investigation.

3.3 Cardiovascular disease mortality rates

The Group examined mortality patterns and trends among elderly people in 40 countries and territories – mainly developed ones – using data
collected by WHO (14). These countries are considered to have reliable mortality statistics; countries and areas with a total population of less than one million were excluded. Age-specific rates are presented for the age groups 65–74 years and 75–84 years, and are ordered within region according to the rates in the younger age group; the disease-specific data for the open-ended age group 85 years and over are considered to be less reliable, owing to greater uncertainty about the assignment of cause of death. Age-standardized rates for the population aged 65 and over were calculated using standard weighting procedures.

Age-specific death rates from cardiovascular disease increase dramatically with increasing age, as shown in Tables 6 and 7. The highest rates for the 65–74 year age group are in eastern European countries (2924 per 100,000 population in men in Czechoslovakia and 1836 per 100,000 in women in Romania), while the lowest are in Japan (men: 780 per 100,000) and France (women: 350 per 100,000). The highest figure is approximately four times the lowest for both men and women.

In most countries, CHD is the leading cause of CVD death in both men and women. Exceptions include countries as diverse as Argentina, Bulgaria, China, Greece, Japan, Portugal and former Yugoslavia. The countries with the highest death rates from CHD and stroke in the age group 65–74 years are the eastern European countries. There is a nearly tenfold difference (for both men and women) between the highest CHD death rates (in the former Czechoslovakia and the former USSR) and the lowest (in Japan), and a sixfold difference (also for both men and women) between the highest (Bulgaria) and lowest (France and Switzerland) stroke death rates.

Comparisons between countries in the same region show a wide variation for CHD mortality rates in Europe and the Western Pacific Region (highest figures 5–7 times the lowest) compared with the American Region (highest figure double the lowest). Similarly, there is a 6–7-fold difference in age-specific stroke death rates in the European Region, compared with a 3–4-fold difference within the American and Western Pacific Regions.

Within each country, age-specific death rates for all cardiovascular diseases show at least a twofold increase between the age groups 65–74 years and 75–84 years. This is true for both CHD and stroke, and for both men and women.

Table 8 shows age-standardized mortality rates in 1990 for men and women aged 65 years and over for all CVDs, CHD and stroke in 36 countries and territories. The countries have been ordered within each region by the rate of all CVDs in men.

Age-standardized cardiovascular disease mortality rates for men range from 5572 per 100,000 population in Bulgaria to 1532 per 100,000 in Hong Kong; the corresponding rates for women are 4555 to 1144 per 100,000, a fourfold difference. Death rates for CHD are higher, in
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^a 1989  
^b 1988
general, than those for stroke, although they are similar in countries where the overall rates are low. Death rates from CHD are highest in the former USSR and lowest in Japan for both men and women. Portuguese men and women have the highest stroke death rates and USA men and Canadian women the lowest. Death rates from CVD are about one-third higher in men than in women. Death rates from CHD are twice as high for men as for women, while for stroke the rates are more similar, although they are higher in men than in women in all countries. There is less geographical variation within the American Region for all CVDs, CHD and stroke (2-fold difference) than in the European Region (3-fold difference for all CVDs, 4-fold difference for stroke and 5-6-fold difference for CHD) and the Western Pacific Region (2-fold difference between the highest and lowest CVD and stroke rates, but a 4-5-fold difference in CHD rates).

The available data indicate that, within countries, there is an inverse association of cardiovascular disease mortality with social class in old age, as is well documented in younger people (15, 16).

3.3.1 Trends in mortality rates

In the majority of the countries for which time-trend data are available, CVD mortality rates have been declining in recent decades in people over 65 years of age as well as in younger age groups. The remarkable declines in death rates from coronary heart disease and stroke, which have occurred recently in older age groups in many countries, have been the principal reason behind the overall increases in life expectancy at older ages.

In men, the twentieth-century CHD epidemic reached its peak in a number of developed countries in the mid-1960s (Fig. 2). The countries with the earliest and most sustained declines in CHD mortality rates in men were Australia, Canada, Japan, and the United States of America. In these countries, CHD mortality rates have declined by up to 50% in both sexes over the past 25 years or so. Mortality rates have also declined in many other developed countries, but less dramatically. In contrast, CHD mortality rates among men have continued to increase in several eastern European countries. Another trend is the consistent decline in CHD mortality rates among women in almost all countries since the 1950s, although in some eastern European countries the initial large declines have been reversed. This difference between men and women has implications for understanding the etiology of CHD.

In developed countries, except some in eastern Europe, there has been a consistent decline in stroke mortality over at least the past 40 years, with an acceleration in this decline in the mid-1970s (Fig. 3). The decline in stroke mortality has been greater than the decline in CHD mortality. In Canada, Japan, Switzerland, and the United States of America, since the 1970s, there has been a decline of over 50% in stroke mortality in men and women aged 65–74 years.
Figure 2
Average annual death rates from coronary heart disease for men and women aged 65–74 years

Rate per 100 000 population

USA
Scotland
Finland
Australia
N. Ireland
New Zealand
Canada
England and Wales
Ireland
Czechoslovakia
Israel
Austria
Sweden
Denmark
Switzerland
Yugoslavia
Hungary
Netherlands
Fed. Rep. of Germany
Italy
Norway
Belgium
Portugal
Poland
Spain
Japan
France

WHO 95/032


18
Figure 3
Average annual death rates from cerebrovascular disease for men and women aged 65–74 years

Time-trend mortality data for elderly people are available for only a few developing countries. In Argentina and Mexico, the reported percentage decline in CVD mortality has been substantial in recent years, despite the fact that just over half the deaths attributed to CVD in Argentina are due to causes other than CHD and stroke; in contrast, there has been a striking increase in CVD mortality rates since the late 1970s in Costa Rica.

3.3.2 **Explanations for the trends in CVD mortality**

Many questions remain unanswered about the exact causes of the large reductions in CVD mortality. The declines have occurred in countries with very different baseline levels of CVD, different patterns of the well established risk factors, and diverse medical care systems. Within individual countries, reductions in CVD mortality have not been homogeneous across all socioeconomic and ethnic groups, and there is considerable scope for improvement if all subgroups in a country are to attain the mortality levels of the most advantaged.

A reduction in mortality may be due to a reduction in incidence (fewer new events), or to a reduction in case-fatality rates (i.e. a higher survival rate) due either to reduced severity of the disease or to better management in the acute phase. Population-based data are necessary for accurately ascertaining trends in the incidence of CHD or stroke; a substantial proportion of people who suffer a stroke are not admitted to hospital, and this poses particular challenges.

Most explanatory studies have focused on middle-aged populations (35-64 years); only a few community-based studies have examined trends in cardiovascular morbidity in the elderly population. Three-quarters of all strokes occur in people over the age of 65 years, but this age group is often excluded from population-based studies which have the potential to measure time trends in incidence, case-fatality and severity.

There is some evidence that the decline in CHD mortality in elderly people has been associated both with a decline in CHD incidence rates and with a more substantial decline in in-hospital case-fatality rates for acute myocardial infarction (17, 18). It is likely that favourable trends in some risk factors, for example, reduced smoking and improved diet, are involved in the decline in incidence of CHD, although more data are needed.

Possible explanations for the declining in-hospital case-fatality rates include: changes in hospital admission practices, such as admission of less severe cases, or shifts in the diagnostic classification of CVD. There have been improvements in diagnosis and treatment of CHD and acute myocardial infarction (AMI) and in the management of complications of both CHD and stroke. In addition, manifestations of CVD may have become less severe as a result of improved lifestyles and better
management of risk factors. There are no reliable data to assess trends in the prevalence of CHD or other CVDs in elderly people.

An increasing number of studies suggest that the recent improvements in stroke mortality are more likely to be explained by improvements in case-fatality rates than in incidence rates. The few studies reporting age-specific changes over time indicate that case-fatality rates have improved more in younger age groups than in the oldest age groups (19). Although a decline in case-fatality may be making an important contribution to the reduction in stroke mortality, there are critical gaps in our understanding of the trends. In particular, to explain improvements in case-fatality, information is needed on trends in stroke severity and stroke-related disability, as well as acute management. The limited available evidence suggests that improvements in case-fatality may be related to decreased severity of the disease, with the acute event becoming more mild (20-22). Improved management in the acute phase may also have contributed (22).

3.4 Hypertension

Strictly speaking, “hypertension” refers to a clinical entity; “blood pressure” is used in the context of discussions on risk factors. The measurement of blood pressure requires careful attention to methods of measurement, in elderly people as in every other age group. Elevated blood pressure is common in elderly people. Systolic blood pressure increases with age, at least until the eighth decade of life (23). In contrast, diastolic blood pressure rises only until about 50 years of age, and thereafter levels off or even decreases. These divergent trends in systolic and diastolic blood pressure lead to an increase in pulse pressure with age and increased prevalence of isolated systolic hypertension. It is noteworthy that the rise in blood pressure with age is not universal either within countries or between populations, which raises important research questions.

Global estimates suggest that 8-18% of adults are hypertensive (defined as either taking antihypertensive drugs or having a systolic blood pressure \( \geq 160 \text{ mmHg} \) and/or a diastolic pressure \( \geq 95 \text{ mmHg} \)) but, by the same definition, up to one-half of people 65 years and over have raised blood pressure. The prevalence of hypertension varies markedly even within regions. For example, data from the WHO MONICA project suggest that the prevalence of hypertension within Europe shows an approximately fivefold variation (24). Most estimates of the prevalence of hypertension have been based on casual (one-off) measurements; the proportion of people who have sustained hypertension is considerably lower and likely to be between one-quarter and one-third of those with casual hypertension (25, 26).

\(^1\) International Monitoring of Trends and Determinants in Cardiovascular Disease.
3.5 **Cardiac failure**

Each year approximately 1% of the population over the age of 65 experience cardiac failure. It occurs equally frequently in men and women, although the survival rate is poorer for men; even for women, only about 15% survive 10 years. More women than men are hospitalized for cardiac failure in the United States of America and the rates of hospitalization have increased fourfold during the last few decades (27). There has been little improvement in case-fatality following the onset of congestive heart failure during the past few decades, despite the decline in CHD mortality and the marked improvement in hypertension control. Improved survival of people with angina, myocardial infarction and hypertensive heart disease may result in an increased prevalence of chronic heart disease and, ultimately, cardiac failure. There is uncertainty about the prevalence of underlying etiologies for congestive heart failure, which may have shifted in recent years from predominantly hypertension to coronary heart disease.

3.6 **Vascular dementia**

In many countries, vascular dementia is the second most common cause of dementia after Alzheimer disease (28). On average, 5% of people over 65 years of age and 15–20% of people over 80 suffer severe dementia of which, in many countries, one-quarter to one-third is considered to be vascular in origin (29). Vascular dementia is apparently more common in some countries, such as China and Japan, where it may account for half or more of all dementia.

3.7 **Risk factors for cardiovascular disease**

There is a widespread but mistaken perception that risk factors for CVD, especially serum cholesterol, lose their predictive value for older people. The risk factors are essentially the same in elderly people as in middle age, although the magnitude of the associated relative risk tends to be lower over age 65. Since morbidity and mortality rates are higher and risk factors are common at older ages, population attributable risks are higher in elderly people than in middle-aged people. Observational data on men suggest that risk factors measured in middle age can predict the development of coronary heart disease in later life (30).

3.7.1 **Blood pressure**

Cross-sectional and longitudinal studies confirm that, even in elderly people, systolic hypertension, either alone or combined with high diastolic blood pressure, remains an important predictor of cardiovascular mortality and morbidity. In elderly people, the incidence of cardiovascular disease is more closely related to systolic than to diastolic blood pressure (31). High blood pressure is the most important risk factor for both ischaemic and haemorrhagic stroke (32).
In some elderly people, usually over 85 years of age, inverse relationships for blood pressure and survival have been described, which probably reflect confounding by concomitant disease (33, 34).

3.7.2 **Cholesterol**

Relationships between cholesterol and coronary heart disease are attenuated by age when relative risk is taken as the measure of association. In an overview analysis, serum total cholesterol and low-density lipoprotein (LDL) cholesterol in middle-aged and elderly men and women were predictive of CHD death; pooled relative risks were generally lower for older subjects, but absolute excess risk was greater (35). Data from 25 populations indicated that low levels of high-density lipoprotein (HDL) cholesterol were predictive of coronary heart disease in older women in the pooled analyses (35). The significance of triglycerides as an independent risk factor for CHD is uncertain in both middle-aged and elderly people. Haemorrhagic and thrombotic strokes appear to be associated with low and high levels of cholesterol, respectively (36). Recent analyses have lessened anxiety about an apparent association between low cholesterol and increased total mortality: the left limb of the J-shaped relationship appears to be due largely to existing or preclinical disease, to heavy smoking and excessive alcohol use and/or to lipid-lowering drugs (37).

3.7.3 **Smoking**

Smoking is usually less common in elderly people than in younger age groups. The increased risk of coronary heart disease associated with cigarette smoking tends to decrease in older age groups (39). However, in a cohort of Japanese-American men, cigarette smoking was an independent predictor of coronary heart disease in those over the age of 65 years; the effect was relatively undiminished compared with middle-aged men (40). Because of the higher absolute rates of disease in the older men, there was an approximate twofold increase in the absolute risk of coronary heart disease associated with current smoking in elderly men. The association of cigarette smoking with stroke has recently been confirmed (41).

To illustrate the strength and public health significance of the causal associations between smoking and cardiovascular disease in elderly people, relative risks for coronary heart disease and stroke in current smokers compared with people who have never smoked are shown in Table 9, together with numbers of deaths attributable to smoking in the USA in 1985 (42).

Although relative risks for current smokers compared with people who have never smoked are lower in elderly people, the number of deaths attributable to smoking is greater in the elderly population, because death rates increase steeply with age. Similarly, because death rates increase more steeply for men than for women, although relative risks for CHD
Table 9: Relative risk (RR) for CHD and stroke in current smokers compared with people who have never smoked, and deaths attributable to smoking, USA, 1985

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>CHD</th>
<th></th>
<th>Stroke</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>35-64</td>
<td>2.8</td>
<td>34</td>
<td>3.0</td>
<td>11</td>
</tr>
<tr>
<td>≥ 65</td>
<td>1.6</td>
<td>44</td>
<td>1.6</td>
<td>26</td>
</tr>
</tbody>
</table>

a Deaths attributable to smoking in thousands.
Source: (42)

and stroke are about the same in men and women, the excess number of deaths attributable to smoking is much higher for men.

3.7.4 Physical activity

Recent reviews and a meta-analysis of a number of studies indicate that physical activity is inversely related to the incidence of CHD. Powell et al. (43) inferred from their review of 43 studies that the relationship was causal and that the relative risk associated with physical inactivity was similar in magnitude to those associated with hypertension, hypercholesterolaemia and smoking. These authors also noted that the population attributable risk of a sedentary lifestyle is likely to be very high in countries such as the United States of America where such lifestyles are common. Although these results are based predominantly on men under 65 years of age, 11 studies included people over 65 and 7 included women. In a meta-analysis of the studies reviewed by Powell et al., as well as some additional studies, Berlin & Colditz (44) estimated the summary relative risk of death from CHD to be 1.9 for people in sedentary, as opposed to active, occupations. In a study of healthy men aged 45-84 years, Paffenbarger et al. (45) found that taking up moderately vigorous sports was associated with a lower risk of death from all causes and from CHD.

The reasons for the inverse association between physical activity and CHD include its effects of raising HDL cholesterol, reducing body weight and lowering blood pressure, and its impact on glucose tolerance. In addition to reducing these risk factors, physical activity has an overall beneficial effect on the cardiovascular system in general, and may also have benefits in other areas by, for example, reducing physical disability and increasing well-being and bone strength (46).

3.7.5 Alcohol

The protective effect of alcohol against CHD in middle-aged people appears to be causal, and there are a number of plausible mechanisms
There are only limited data on the effect of alcohol in elderly people, but it appears that the same association is present. An overview of epidemiological studies found a U-shaped relationship between ischaemic stroke and alcohol consumption: however, modest alcohol consumption increased the risk of haemorrhagic stroke. The excess stroke risk among heavy drinkers probably reflects the effect of alcohol on blood pressure.

3.7.6 **Social status**

In developed countries there is a strong inverse association in elderly people between CVD mortality and morbidity and social status, whether measured by occupation, income or education. Furthermore, in middle-aged people the reductions in CHD mortality rates have been greater in the higher social classes and the social class differentials have widened. In developed countries, there is a strong inverse relationship between level of education and the major CVD risk factors, including blood pressure levels.

3.7.7 **Nutrition**

Evidence continues to accumulate to support the role of diet in the development of cardiovascular diseases. Most evidence relates to the effect of diet on serum lipids and lipoprotein fractions, especially total and LDL cholesterol, and other mechanisms that may affect cardiovascular mortality, such as impaired glucose tolerance, platelet function and clotting-factor activity. There is growing evidence for the protective role of antioxidant vitamins (see section 4). However, most of the existing evidence relating diet to CVD risk is based on studies in middle-aged subjects and the question of whether the results are applicable to the elderly population is unresolved. There is some indication, however, that the diet-related risk factors for CVD can be favourably influenced by dietary modification and weight control in elderly people.

Dietary factors operating from infancy and childhood onwards may determine the development of CVD in adult life. Recent data on individual requirements for essential amino acids and total protein suggest that elderly individuals are particularly susceptible to various biological and environmental factors, as a result of which their protein needs are higher than those of younger adults. Considerable work still needs to be done to understand the relationship between nutrition and aging and to provide the scientific basis for nutrition advice and intervention in the elderly population. The importance of this work is highlighted by data from several populations indicating poor nutrition in elderly people.

3.7.8 **Diabetes**

Diabetes is an important risk factor for CVD, and its prevalence rises steeply with age. The predominant form of diabetes in elderly people
is non-insulin-dependent diabetes mellitus (NIDDM). NIDDM is more prevalent in some non-Caucasian populations and its association with CVD varies between both Caucasian and non-Caucasian populations. Atherosclerosis is the most common complication of diabetes, accounting for 75% of all diabetic deaths. In addition, premenopausal women with diabetes do not have the "protection" from myocardial infarction seen in non-diabetic women. Not only is CHD more frequent in diabetic individuals, but case-fatality is also higher. Similarly, diabetes mellitus is associated with an increased risk of stroke mortality and morbidity (55).

3.7.9 Other risk factors

Obesity is an independent risk factor for CHD in middle age, but its relationship to CVD in elderly people remains unclear except for its indirect contribution to risk through its association with hypertension and diabetes. The additional adverse consequences of excess abdominal or visceral fat for CVD and diabetes mellitus may apply to elderly people as well as to middle-aged people, but more research is needed. There is a U-shaped relationship between mortality and weight or body mass index, with the higher mortality at low body weights being due, in part, to confounding by cigarette smoking and clinical or preclinical disease (56).

The association of other risk factors with cardiovascular disease has recently been reviewed (57). Particularly important for the identification of people at high risk is the presence of established cardiovascular disease, for example, atrial fibrillation (AF) or previous coronary and ischaemic episodes. For example, in a comparison of the impact of AF, hypertension, CHD and cardiac failure on incidence of stroke, there was a nearly fivefold excess when AF was present (58). There is some evidence that levels of clotting factors and fibrinolytic activity are related to CHD in elderly people, as in younger people (59). The exact role of clotting factors needs to be clarified. Premature menopause and bilateral oophorectomy are strongly associated with increased CHD in elderly women (60).

4. Prevention of cardiovascular diseases in elderly people

4.1 Introduction

Prevention of cardiovascular diseases in elderly people presents opportunities and challenges that are different from those encountered in younger age groups. There is greater variation in physical and mental health in old age than at younger ages; nevertheless, age in itself should not be a barrier to promoting health and preventing or postponing
disease, disability and death. A small proportion of the elderly population is healthy, vigorous, disease-free and without major risk factors. At the other extreme, there are old people who have already had a heart attack or a stroke or who are suffering from congestive heart failure, peripheral arterial disease or non-cardiovascular diseases. Risk factors are present in a large proportion of elderly people, with atherosclerosis also highly prevalent in developed countries.

There are also great variations among countries and among subgroups of the population within countries. Recognition of the importance of and potential for preventing CVD in elderly people is a recent phenomenon, and it is not universally accepted or accorded high priority. The burden of these diseases and the resources for dealing with them vary from country to country. The attitudes of elderly people themselves, as well as those of health professionals, the general public and policy-makers, may be barriers to implementing measures to prevent CVD in older people.

Little information is available about the association of risk factors with CVD in elderly people or about the efficacy of specific interventions, especially in women, who have often been excluded from observational studies and clinical trials. Nevertheless, there is sufficient evidence that the major risk factors are important over 65 years of age for both men and women. Some clinical trials, for example of treatment for hypertension, have demonstrated benefits in elderly men and women. Several observational studies and clinical trials involving elderly people are under way, but it is not feasible, or necessary, to replicate all studies that have provided convincing results in younger age groups. Until the results of ongoing trials become available, it is reasonable to extrapolate information from middle-aged to elderly people bearing in mind that costs and benefits may vary with age. However, it is not clear whether the information can be usefully extrapolated to the very old, those aged over 80 years.

4.2 Preventive strategies

Preventive approaches cover measures that aim to prevent the development of risk factors (sometimes referred to as primordial prevention), primary prevention of clinical CVD events, and approaches designed to reduce recurrent events, disability and death (sometimes referred to as secondary or tertiary prevention) (61-63).

The emphasis in this section will be on lifestyle approaches and medical management of risk factors, rather than on treatment or rehabilitation of patients with advanced disease. Nevertheless, the importance of the latter approaches in the prevention of recurrent or new disease is recognized.

4.2.1 Strategies for primary prevention of cardiovascular disease

The population strategy and the high-risk strategy are both appropriate for preventing CVD in older people, and should complement one another.
The population strategy

The population approach to common diseases, such as coronary heart disease and hypertension, is based on the belief that the incidence of disease and its consequent morbidity and mortality can be reduced more effectively by bringing about a downward shift in the population distribution of risk factors, such as blood cholesterol, blood pressure, body weight, and glucose intolerance. Small shifts throughout the range and accompanying reductions in the mean population levels of several risk factors are likely to be more effective in reducing the incidence of disease than approaches targeted to people with elevated levels of those risk factors or people who meet diagnostic criteria for hypercholesterolaemia, hypertension, obesity or diabetes.

Prevention of cardiovascular disease should begin in childhood. Education of the general public about risk factors and about ways to reduce them is an essential component of the population strategy, which enlists health care providers, educators, voluntary groups and the mass media in this effort. The strategy uses community resources to disseminate the educational message and assist in implementing changes in behaviour and healthier lifestyles. Legislators may assist by raising taxes on undesirable products such as cigarettes and by establishing smoke-free environments if there is sufficient public support for such measures.

In several countries, the population strategy has resulted in substantial reductions in mean blood cholesterol, mean blood pressure and cigarette smoking, as well as improvements in eating habits. The efficacy of the population strategy can also be inferred in some countries, notably the United States of America, from the dramatic reductions in mortality from CHD and stroke in the past thirty years (64, 65). These changes have occurred across all age groups, including the elderly, which indicates that they too have benefited from risk-factor changes.

While consumption of low-fat dairy products, fruits and vegetables has increased and consumption of saturated fats, salt and alcohol has decreased in some countries, not all the changes in lifestyle have been in the right direction. High-fat “fast” foods are widely available, and a rising prevalence of obesity has been observed in the United States of America and Europe. Cigarette smoking is increasing in developing countries, and is still quite common in some developed countries. The high proportion of young women continuing to smoke will have implications for future cohorts of elderly people. Moreover, unfortunately, the beneficial changes have not affected all segments of the population equally. Elevated risk factors are clustered among the less well educated and less affluent members of society, among whom particular efforts are needed to prevent cardiovascular disease (66).

The special needs of the elderly and barriers to their understanding of the relevance of preventive approaches constitute another set of challenges, which may require modifications to the general strategy. Some of these
barriers include negative attitudes to changes in behaviour among elderly people and the belief that they are too old to benefit from such changes. Vigorous efforts are needed to combat these beliefs and to demonstrate ways in which risk can be reduced, while quality of life is maintained or improved.

Attention must be given to any adverse effects of intervention. One of the concerns about generalized recommendations to people to change their behaviour is that members of the general public who are at low risk of developing cardiovascular disease may suffer adverse consequences or reduced enjoyment of life as a result of unnecessary efforts to lower risk. Fortunately, recommendations such as stopping smoking, adopting a healthy eating pattern, engaging in moderate physical activity and controlling weight will benefit health overall, as well as reducing the risk of cardiovascular and other diseases.

The boundaries between the population strategy and the high-risk approach are blurred, especially in the elderly, among whom risk factors and overt disease are highly prevalent. Individual assessment and sound clinical judgement are particularly important; preventive approaches should be based on the composite risk-factor profile, as well as on the individual’s general state of health.

The high-risk strategy
The essential components of the high-risk strategy are the detection, evaluation and treatment of individuals with a high probability of developing new or recurrent CVD. Education is essential in this approach as well. It must be targeted on the general public, health care providers and policy-makers. The specific procedures to be adopted may vary depending on the magnitude of the problem, scientific knowledge, the resources available and the priority given to preventing cardiovascular disease rather than dealing with other health problems.

Old age itself is a marker of high risk, and many elderly people in developed countries are already under medical care. Those at especially high risk can therefore be detected by the simple procedure of taking a medical history and asking questions about diagnosed conditions, such as heart attack, angina pectoris, stroke or diabetes mellitus; by taking a family history; or by asking about habits and behaviour, including smoking, physical activity and diet. A simple measurement can detect high blood pressure; obesity is readily apparent, but a better indication of risk may be gained by measuring waist and hip girths or other markers of fat distribution. Detection of dyslipidaemias requires more sophisticated and expensive investigations, ranging from measurement of total cholesterol to extensive lipoprotein analyses. If universal screening is not feasible, or if it cannot be justified in terms of benefits and costs, selective screening can be done on the basis of medical and family history and presence or absence of other risk factors. The usual requirements for successful screening and early detection programmes
apply – namely that the tests used are appropriate and accurate, with high sensitivity and specificity, and high positive and negative predictive values. Counselling, follow-up and effective interventions must be available, and the health benefits must outweigh the costs.

The following sections will review the strategies for preventing hypertension, coronary heart disease and stroke and discuss the evidence that intervention is effective in the elderly. Factors that may be protective for elderly people will also be discussed.

4.3 Primary prevention of hypertension

Ability to prevent hypertension may be enhanced in the future by improved knowledge of genetic predisposition, which may indicate a need to modify behaviour in susceptible individuals, including those with a familial or genetic predisposition to obesity. It may also be possible to select the preventive measures that are most appropriate for particular susceptible groups, families or individuals, and to target people at high risk.

Prevention of hypertension should begin early in life, even though high blood pressure may not be present until old age. Studies in middle-aged people have shown that blood pressure can be reduced in the short term by losing weight, reducing sodium intake, increasing physical activity and reducing excessive alcohol intake. The long-term effect of these strategies on blood pressure is not known. The efficacy of interventions such as potassium, calcium or magnesium supplements, fish oil, high fibre consumption or stress management is unproven (67, 68).

Advice is currently directed to the general population, but special attention needs to be given to those with high normal blood pressure (systolic pressure, 130–139 mmHg, diastolic pressure 85–89 mmHg), a family history of hypertension, or obesity. Attention must also be paid to the overall reduction of cardiovascular risk, by encouraging people to stop smoking and to modify other risk factors (67, 68).

4.3.1 Weight control

Cross-sectional, prospective and intervention studies have shown a strong relationship between body weight and blood pressure in middle-aged people. Intervention trials have shown that with reduction of calorie intake the blood pressure decreases within a few weeks and this is maintained over several months. The decrease is independent of reduced sodium intake and increased physical activity. In the Trials of Hypertension Prevention (TOHP), reduction in calorie intake and moderate physical activity in middle-aged people with high normal blood pressure (diastolic pressure 80–89 mmHg) were associated with small falls in blood pressure (69).
Although body weight can be reduced in the short term, it is difficult to maintain the weight loss over time. The extent to which weight reduction will reduce blood pressure or prevent the development of hypertension in elderly people is not known. Weight reduction in the elderly should be considered as part of a more general effort to improve health and mobility (see section 4.4).

4.3.2 Reduced sodium intake

Many studies of the effect of reduced sodium intake on blood pressure have been reported in normotensive and hypertensive subjects. They provide strong evidence of a significant blood-pressure-lowering effect, which is greater for older patients and for those with higher pressures: the average reductions were 5 mmHg (systolic) and 3 mmHg (diastolic) in hypertensive subjects and 2 mmHg (systolic) and 1 mmHg (diastolic) in normotensive subjects (70).

In the elderly, attention should be given to the effect of reduced salt intake on appetite because of the risk of undernutrition. Any change in salt intake should be gradual, and alternatives to salt should be suggested. The food industry and national governments can encourage lower salt consumption by reducing the sodium content of processed foods and by labelling foods to show their sodium content.

4.3.3 Physical activity

Increased physical activity resulted in lower blood pressure in trials that included normotensive as well as hypertensive subjects and, in some studies, elderly men and women (67). The effect was independent of weight loss and occurred with all types of increased physical activity. The blood-pressure-lowering effect of exercise was more pronounced at higher baseline pressures. The average reduction in blood pressure in pooled results of several trials was 6 mmHg (systolic) and 7 mmHg (diastolic) (71).

Increased physical activity may be advocated for elderly people to decrease blood pressure and excessive body weight and to promote wellbeing, although there is still uncertainty about the level of exercise required for optimal blood pressure reduction. The level and type of exercise prescribed should be appropriate for the individual’s condition and circumstances (72).

4.3.4 Reduced alcohol consumption

Cross-sectional and prospective studies have generally shown a positive relationship between alcohol intake and blood pressure, although in some studies the relationship was J-shaped (73). Intervention studies have shown that lowering alcohol intake can decrease blood pressure; the decrease was independent of weight change (67, 73). Whether reducing
moderate alcohol intake will decrease blood pressure is not clear, but heavy drinkers should be advised to reduce their alcohol intake to no more than two drinks (20 g of ethanol) per day. The influence of alcohol on other cardiovascular diseases will be discussed later. The hazards of alcohol abuse are well known, and will not be discussed here.

4.4 Prevention of coronary heart disease

The risk factors for CHD in the elderly are essentially the same as in middle age; although relative risks are lower, absolute risks and population-attributable risks are higher (74–77). The modifiable risk factors for CHD are high blood pressure, total and HDL cholesterol, cigarette smoking, physical activity, diabetes mellitus and obesity (see section 3 for a detailed discussion).

4.4.1 Management of elderly patients with hypertension

Advice on lifestyle

Lifestyle changes aimed at preventing primary hypertension are also appropriate for managing high blood pressure. They include reducing salt intake and excess alcohol consumption, controlling body weight and increasing physical activity, as discussed in section 4.3. They may be sufficient by themselves to control a slight elevation of blood pressure, or may be used in conjunction with antihypertensive drugs to manage more severe hypertension (68).

Drug treatment

Recommendations have been published for the detection, evaluation and management of high blood pressure based on the results of trials in elderly patients (68, 78–81). Most trials recruited patients with both systolic and diastolic hypertension, but one trial involved patients with isolated systolic hypertension (Table 10) (68).

A meta-analysis of randomized trials in elderly hypertensive subjects showed a 22% decrease in overall mortality, a 26% decrease in cardiac mortality and a 33% decrease in cerebrovascular mortality (89). All stroke events (fatal and non-fatal) were reduced by around a third. The reduction in coronary mortality was higher than that reported in middle-aged patients and consistent with predictions from observational studies.

Non-fatal myocardial infarction decreased by about 20% and heart failure was reduced in the few trials that reported this condition. The incidence of peripheral vascular lesions and renal insufficiency was low in both the placebo groups and the treatment groups and it was therefore difficult to determine the influence of therapy on these conditions or on total mortality. There was no indication of any adverse effect of treatment on non-cardiovascular mortality.

The drugs used in these trials were mainly diuretics and β-adrenoceptor blocking agents (β-blockers), and both were effective in reducing
Table 10
Effects of therapy in elderly hypertensive patients

<table>
<thead>
<tr>
<th>Study *</th>
<th>No. of patients</th>
<th>Age range (years)</th>
<th>Mean blood pressure at entry (mmHg)</th>
<th>Relative risk (treated v. control)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Stroke</td>
<td>Coronary artery disease</td>
</tr>
<tr>
<td>Australian (82)</td>
<td>582</td>
<td>60-69</td>
<td>165/101</td>
<td>0.67</td>
</tr>
<tr>
<td>EWPHE (83)</td>
<td>840</td>
<td>60</td>
<td>182/101</td>
<td>0.64</td>
</tr>
<tr>
<td>Coope &amp; Warrender (84)</td>
<td>884</td>
<td>60-79</td>
<td>197/100</td>
<td>0.58 b</td>
</tr>
<tr>
<td>STOP- Hypertension (85)</td>
<td>1627</td>
<td>70-84</td>
<td>195/102</td>
<td>0.53 b</td>
</tr>
<tr>
<td>MRC (86)</td>
<td>4396</td>
<td>65-74</td>
<td>185/91</td>
<td>0.75 b</td>
</tr>
<tr>
<td>SHEP (87)</td>
<td>4736</td>
<td>60-80</td>
<td>170/77</td>
<td>0.67 b</td>
</tr>
<tr>
<td>HDPF d (88)</td>
<td>2374</td>
<td>60-69</td>
<td>170/101</td>
<td>0.56 b</td>
</tr>
</tbody>
</table>

* EWPHE: European Working Party on High Blood Pressure in the Elderly; STOP-Hypertension: Swedish Trial in Old Patients with Hypertension; MRC: Medical Research Council; SHEP: Systolic Hypertension in the Elderly Program; HDPF: Hypertension Detection and Follow-up Program.
1 Hypertension in the Elderly Program; HDPF: Hypertension Detection and Follow-up Program.
2 Statistically significant.
3 Myocardial infarction only; sudden deaths decreased from 13 to 4.
4 Includes data calculated by the HDPF Coordinating Center.
Source: (68).

Cardiovascular events. One trial specifically compared β-blocker and diuretic therapy and found that cardiovascular events were reduced only with the diuretic therapy; but in another trial β-blocker therapy was effective in reducing stroke morbidity. It is too early to make recommendations on the relative effectiveness of diuretic and β-blocker therapy. Calcium-channel blockers, α-blockers, and angiotensin-converting-enzyme (ACE) inhibitors are also being studied in trials in elderly hypertensive subjects, but no data are yet available on the influence of these drugs on cardiovascular morbidity and mortality, and they should not therefore be considered as first-line drugs for these patients.

Age and systolic blood pressure are the major risk factors for vascular dementia, but the influence of antihypertensive drug therapy on this condition has not been reported; it is currently being evaluated in at least one trial. Other issues that remain to be addressed include the extent to which antihypertensive therapy influences recovery in stroke patients, and the level to which blood pressure should be lowered. Concerns that lowering diastolic pressure below 80 mmHg might provoke myocardial infarction in elderly patients with CHD have not been substantiated by
data from trials (90). The Hypertension Optimal Treatment (HOT) trial, which includes patients up to the age of 80 years, may provide evidence on the relative benefits of blood-pressure goals.

At present, there are no data showing that treatment of hypertension reduces the incidence of cardiovascular events above age 80, but one trial (Hypertension in the Very Elderly Trial, HYVET) is currently under way. The diagnosis and treatment of hypertension in the elderly require special consideration of the presence and extent of other risk factors, end-organ damage, coexisting diseases and their treatments, and of general health and frailty, as well as of the presence and impact of cognitive impairment. To reduce cardiovascular risk, attention needs to be given to all modifiable risk factors, including cigarette smoking. Cost may be a consideration in the selection of antihypertensive drugs, and ease of administration and side-effects are other important determinants of compliance.

Management and treatment guidelines for hypertension in elderly subjects have been published: they advocate modification of lifestyle as a first step to reduce blood pressure, followed by pharmacological treatment if blood-pressure response is inadequate (Fig. 4) (68, 78-81). There is some variation in the guidelines from different organizations on the blood-pressure levels at which treatment should be commenced and the recommended first-line drugs.

4.4.2 Management of elderly patients with lipid abnormalities

Recommendations for detecting, evaluating and treating high blood cholesterol levels have been published (91-95) and have stirred up considerable controversy about the desirability of universal screening and the criteria for deciding to use lipid-lowering drugs. It is uncertain whether results of cholesterol-lowering trials in middle-aged patients can be extrapolated to the elderly, although it is reasonable to expect that lowering of cholesterol will have similar effects on the pathogenesis of CHD in both middle-aged and elderly people. There are some limited data to indicate that blood cholesterol levels in elderly subjects are lowered by drug and dietary treatments. Current trials are addressing this issue. The Antihypertensive and Lipid-Lowering Treatment to Prevent Heart Attack Trial (ALLHAT) will recruit patients over 60 years of age. A factorial trial in the United Kingdom is investigating the effects of lipid-lowering treatments and vitamin E supplementation in men and women up to the age of 75 years. In the meantime, general recommendations for managing high blood cholesterol can be followed, together with emphasis on HDL cholesterol and other risk factors. Recommendations for initiation of drug therapy should be appropriate to individual countries, but in all contexts caution is advised in the use of drugs in otherwise low-risk patients. Dietary recommendations to reduce intake of saturated fats and cholesterol and recommendations that patients should lose weight and increase physical activity are proposed as first-line
Figure 4
Treatment algorithm for patients with hypertension

Lifestyle modifications:
- Weight reduction
- Moderation of alcohol intake
- Regular physical activity
- Reduction of sodium intake
- Smoking cessation

Inadequate response

Continue lifestyle modifications
Initial drug selection:
- Diuretics or β-blockers are preferred because reduction in morbidity and mortality has been demonstrated
- ACE inhibitors, calcium antagonists, α-receptor blockers, and α-β-blockers have not been tested or shown to reduce morbidity and mortality

Inadequate response

Increase drug dose or Substitute another drug or Add second agent from different class

Inadequate response

Add second or third agent and/or diuretic if not already prescribed

Source: (68).
therapy. Drug therapy should be initiated only after dietary therapy has been attempted.

4.4.3 Cigarette smoking

The dramatic decline in the prevalence of cigarette smoking in many developed countries shows that smokers can be persuaded to give up, either on their own or in response to a variety of programmes and policies (42, 96). The efficacy of an antismoking intervention was demonstrated in the Multiple Risk Factor Intervention Trial (97) among high-risk middle-aged men. Other studies, including some in elderly people, have found reductions in CHD and stroke from cessation of smoking (96). Many elderly people have already stopped smoking, in some cases after disease has developed, and there is good evidence that stopping smoking is beneficial even in old age. In general, cardiovascular disease rates decline progressively after cessation, but some of the benefits of stopping smoking are realized immediately. Stopping smoking also has beneficial effects on non-cardiovascular morbidity and mortality (42, 96). In many countries, the cohorts of women who started smoking during and after the Second World War are now entering old age, which makes it even more important to include elderly women in smoking cessation programmes.

The increase in cigarette smoking in developing countries is of considerable concern. Governments, policy-makers and health workers should accord high priority to tobacco control. Measures to restrict the export and promotion of tobacco require international collaboration and legislation (8).

4.4.4 Physical activity

There is consistent evidence from observational studies that include elderly people that physical activity reduces CHD risk (see section 3.7.4). Intervention studies on exercise training have shown that physical activity can lower blood pressure (see section 4.3.3), increase HDL cholesterol, lower ratios of total cholesterol to HDL cholesterol, and lower triglycerides (98–100). A clinical trial is planned to determine whether interventions in health care settings can increase habitual physical activity and cardiorespiratory fitness in sedentary men and women at increased risk for CHD; there is no upper age limit. Effects on maximum oxygen uptake, blood pressure and lipoprotein profiles will be assessed.

The sample size and duration of follow-up that would be needed for a primary prevention trial of physical activity, with incidence of CHD as the end-point, make it unlikely that such a trial will ever be conducted. However, the evidence from observational studies of CHD events and intervention trials to improve risk profiles indicates that there is potential for preventing CHD in the elderly by promoting physical activity.
The potential risk of engaging in vigorous exercise for previously sedentary persons can be reduced by medical evaluation, supervision and education regarding the type, intensity and frequency of physical activity to be undertaken. This is particularly important for elderly people, who require less intensive physical activity than younger people.

The benefits of physical activity for secondary prevention of cardiovascular disease are discussed in section 5.

4.4.5 *Diabetes mellitus*

Primary prevention of non-insulin-dependent diabetes mellitus (NIDDM) may be possible using either the population or the high-risk strategy. The population approach involves lifestyle changes similar to those recommended for primary prevention of CHD and hypertension. The high-risk approach may be more appropriate in non-Caucasian populations and when the risk lies predominantly among certain subgroups or families, for whom screening for asymptomatic glucose intolerance may be cost-effective *(101)*.

4.4.6 *Obesity*

The benefits and risks of weight loss are difficult to determine from published observational studies because it is not possible to distinguish voluntary from involuntary or disease-induced weight loss. Loss of excess weight results in improvement in CVD risk factors, including high blood pressure, dyslipidaemia, glucose intolerance and diabetes, as discussed above. Repeated episodes of weight loss and weight gain, however, have been related to increased morbidity in middle-aged cohorts. It is also known that attempts to lose weight are generally unsuccessful, in that the weight lost is usually regained within a few years. Thus the available evidence is consistent with recommendations to maintain a healthy body weight and avoid obesity. Management of hypertension and diabetes mellitus requires weight loss in the obese. Further research is needed to determine whether, under what circumstances, and by what means weight loss is beneficial in the elderly *(102)*. Optimal body weights need to be determined for the elderly and for other age groups.

4.5 *Prevention of stroke*

Control of hypertension and smoking cessation are of the utmost importance for stroke prevention, but other approaches should also be considered since many strokes occur in people who do not have high blood pressure.

In addition to the risk factors for cardiovascular disease described in section 3, the presence of cardiovascular diseases, such as coronary
heart disease, cardiac failure, atrial fibrillation, carotid artery lesions and intermittent claudication, is known to predispose to stroke (32, 76). Ischaemic stroke is also recognized as a predisposing trait for coronary heart disease, and patients with transient cerebral ischaemic attacks are at risk of myocardial infarction and recurrent stroke (32).

The population strategy for preventing coronary heart disease is, for the most part, also appropriate for preventing stroke. However, modest alcohol consumption has been reported to increase the risk of haemorrhagic stroke, while a J-shaped association has been observed between ischaemic stroke and alcohol intake (103).

As regards modifiable risk factors for stroke, other than hypertension and cigarette smoking, antithrombotic therapy for chronic atrial fibrillation has been found to be useful in intervention trials for primary prevention of stroke in the elderly. The value of antiplatelet therapy in the primary prevention of stroke in healthy older individuals requires further study.

Vascular dementia is one of the most serious sequelae of cerebrovascular disease. It usually follows clinical episodes of stroke symptoms, but this is not always the case. Risk factors for vascular dementia have been reported to be similar to those for lacunar infarction. Control of hypertension may be a key to reducing vascular dementia. Standardized procedures for identifying vascular dementia in community studies are needed in order to compare its frequency among different populations.

4.6 Protective factors for cardiovascular disease

The number of lifestyle and pharmacological approaches to preventing cardiovascular disease is growing, as knowledge about protective factors increases. Among the most firmly established and least controversial protective factors are high levels of serum HDL cholesterol, physical activity and diets that are low in saturated fat, low in cholesterol and high in fruits and vegetables. Consumption of vitamin E, β-carotene, other antioxidants, low-dose acetylsalicylic acid (aspirin), and a moderate amount of alcohol also appears to offer protection against CHD. On the other hand, excessive alcohol use increases blood pressure and has been associated with increased incidence of cerebral haemorrhage and cerebral infarction in some studies, although not in others (104). For postmenopausal women, there is substantial evidence that estrogen replacement therapy is associated with a lower risk of coronary heart disease. Randomized controlled clinical trials and additional observational studies are being conducted to test several of these hypotheses and elderly men and women are included in most studies. It is clear that excessive alcohol intake is harmful, and caution is advisable in recommending moderate use of alcohol, although its beneficial effect on HDL cholesterol and CHD incidence indicate that it need not be discouraged.
4.7 Secondary prevention of cardiovascular disease

People with CVD, or a history of CVD, have lower rates of recurrent or new events if their elevated lipids or blood pressure is reduced and if they stop smoking (42, 67, 68, 95). There is substantial evidence from clinical trials that lowering serum cholesterol levels in patients with existing CHD reduces recurrent CHD (91); a meta-analysis indicated relative risks of 0.74 and 0.86 for nonfatal and fatal myocardial infarction, respectively. There is also evidence that atherosclerotic lesions and left ventricular hypertrophy may regress, but it is uncertain whether these observations are applicable to the elderly.

Case-fatality rates for acute myocardial infarction (AMI) have been reduced substantially since the introduction of intensive care units and various medical and surgical treatments. Randomized controlled trials of thrombolytic agents showed improved survival rates after AMI, and several drugs, including ACE inhibitors and β-blockers, have been found to improve survival and reduce recurrent MI and congestive heart failure in patients with chronic CHD. Antiplatelet therapy for the secondary prevention of ischaemic stroke has been successful, though the optimal dose of the drugs has not yet been determined (32). Warfarin may be more effective than acetylsalicylic acid, but careful monitoring of coagulation is required; trials comparing these treatments are currently under way. ACE inhibitors improved survival in patients with overt heart failure and reduced ejection fraction (105, 106). In patients with non-disabling cerebral ischaemic episodes, carotid endarterectomy was effective in preventing strokes when stenosis was over 70%, but its effect on patients with stenosis between 30% and 69% and in asymptomatic people is unknown.

Further consideration of therapy for CHD and stroke is beyond the scope of this report. Recent overviews of trends in management and their influence on prognosis are available elsewhere (103, 107).

4.8 Economic perspective on preventive strategies

4.8.1 Population strategies

Economic analyses, primarily carried out in middle-aged populations in developed countries, suggest that inexpensive strategies for CVD prevention aimed at the whole population offer the best value for money and may even be cost-saving (108-110). A combination of population strategies with the high-risk approach is also favourable. Mass screening for cholesterol is expensive (111), but opportunistic identification of subjects with raised blood pressure involves little extra cost (112).
4.8.2 Strategies aimed at high-risk individuals

Smoking
The cost-effectiveness of smoking interventions depends on the intensity of advice and the smoking cessation rate but, because of the high excess mortality associated with smoking, even a brief advice package associated with modest success is cost-effective in the elderly (113).

Antihypertensive treatment
The key economic issue is the level of blood pressure at which antihypertensive treatment becomes “affordable”. This depends on the absolute risk associated with a particular level of pressure (measured for any population by the stroke, CHD and congestive heart failure rates), the magnitude of the benefit to be derived from antihypertensive treatment, the costs of antihypertensive treatment including detection, evaluation and management, and the consequences (economic and quality-of-life) of not providing treatment.

Analyses of the treatment of hypertension have shown that cost-effectiveness is greatest where absolute risk is highest, for example at higher levels of blood pressure (diastolic pressure of 100 mmHg and over), at older ages, and when other risk factors are present. Few studies have calculated cost-effectiveness ratios for people over 60, but the ratios are likely to be favourable because of the increased absolute risk in this age group.

Assuming that all treatments produce an equal benefit for stroke reduction (an assumption which has not yet been substantiated in randomized controlled trials), then the most cost-effective drugs will be the cheapest; these are currently the diuretics. The cost of antihypertensive treatment affects individuals as well as policy, and treatment costs have been shown to contribute to poor compliance and poor hypertension control.

Considerable variation exists between countries in drug prices, which highlights the need for a critical review of pricing policies (114). Other opportunities for cost containment in hypertension management include the rational use of costly investigations, such as continuous ambulatory (24-hour) blood pressure monitoring and echocardiograms, until the benefits of the routine use of such techniques have been established.

The impact of different antihypertensive treatments on quality of life should also be considered when recommending treatment. However, there are methodological concerns about the adjustment of life expectancy by quality of life (quality-adjusted life year, QALY). Arbitrary values have been used to describe the quality of life resulting from side-effects of treatment, or after a stroke or myocardial infarction. Cost-effectiveness ratios are extremely sensitive to these values, with even minor variations cancelling the gains in life expectancy from treatment. The lack of robustness of the methodology suggests that the
results of analyses of costs per QALY for hypertension should be treated with caution.

The magnitude of cost-effectiveness ratios for hypertension treatment varies considerably between studies. Cost-effectiveness analyses have underestimated the potential benefits of treatment to elderly people by using models based on observations in middle-aged people. Moreover antihypertensive treatment may also alleviate other common conditions in the elderly, such as heart failure and vascular dementia.

*Treatment of high cholesterol levels*

Data on the benefits of cholesterol-lowering drugs in the elderly are not yet available. Cost-effectiveness analyses of cholesterol-lowering drugs have modelled the expected benefits in terms of life expectancy on the basis of CHD reduction in observational studies, but this assumption is controversial and the question is unlikely to be resolved in the near future. The results of cost-effectiveness analyses of cholesterol-lowering drug treatments must therefore be regarded with caution. The studies indicate that treatment is most cost-effective for high cholesterol levels (for example above 7.8 mmol/l), in middle-aged and elderly men, in elderly women and, especially, in those with concomitant risk factors such as raised blood pressure and smoking (115). Secondary prevention, in both men and women, was considerably more cost-effective than primary prevention.

*Treatment of other risk factors*

Use of anticoagulants for the primary prevention of stroke in elderly subjects with atrial fibrillation is of similar cost-effectiveness to use of diuretics in the treatment of hypertension, provided that the bleeding complications of treatment are low. The benefits of other health care interventions in the elderly need to be evaluated before an informed decision can be made about what is affordable. Exercise programmes in the elderly may confer benefits in terms of blood-pressure control and increased HDL cholesterol, but more substantial evidence of their cost-effectiveness is required. Such programmes may be good value in the elderly because they affect a range of outcomes other than the cardiovascular, such as greater social participation and enhanced well-being. Screening for abdominal aortic aneurysms and hormone replacement therapy are being promoted in some countries, but they will require a full evaluation of risks, benefits and costs before policy recommendations can be made.

**4.8.3 Cost-effective interventions in developing countries**

Generalization across developing countries is problematic, since countries differ in the levels of disease, population-attributable risk and risk-factor prevalence and in health care delivery and financing.
The World Bank has estimated the costs per disability-adjusted life year (DALY) for a range of communicable and noncommunicable disease interventions (8, 116). The costs per DALY for CVD interventions were derived from estimates in developed countries, and were subject to the methodological problems described above for QALYs. Campaigns to reduce smoking, primarily using educational strategies targeted at children or young adults, were judged to be highly cost-effective, especially if some costs can be met from taxes on tobacco. The World Bank view that the treatment of hypertension is unaffordable, and that population strategies in developing countries would be adequate to lower blood pressure (116), is not based on any substantial evidence. Population strategies may be achievable in developing countries at a small cost, but this has yet to be demonstrated. Similarly, any decision that drug treatment in developing countries is too expensive requires a full appraisal of the burden of stroke, CHD and other hypertension-related diseases, which will vary considerably across countries. Generic diuretics may be considered for the individuals at highest risk in countries with high levels of stroke. Decisions must be made in the context of the overall economic position of the country, the health care budget and competing health care interventions.

Cost-effectiveness analyses have become influential in determining health policy. While they can be useful in indicating the likely magnitude of costs of health interventions, caution is required in their interpretation and application, especially in different contexts. Two technical issues are of particular concern because they considerably affect decisions concerning the economic value of therapy: the discounting of health benefits and the extraordinary sensitivity of the models to minor variations in values assigned to quality of life. Discounting health benefits as well as costs produces less favourable ratios for the elderly, who benefit less from future health gains than do younger people. Summary estimates represented by cost-per-QALY or cost-per-DALY may obscure important outcomes and ethical issues; disaggregated results should always be presented (117).

4.9 Comprehensive preventive programmes

4.9.1 Community programmes

Community programmes aim to use multiple resources and a variety of strategies in a comprehensive effort to reduce cardiovascular risk factors, morbidity and mortality in defined populations of all ages (118). Recent studies have used quasi-experimental designs and have evaluated impact in treated and control communities. The North Karelia Project (119), the Stanford Five-City Project (120), the Minnesota Heart Health Program (121) and the Pawtucket Project (122) are examples of such programmes, which emphasize health education, mobilization of existing community
organizations and use of many different channels, including the mass media and personal communication, to improve cardiovascular health.

Assessment of the effectiveness of these programmes is based on the degree of public awareness of CHD and its risk factors, as well as on changes in population profiles of cholesterol, blood pressure, cigarette smoking and body mass index. The ultimate test will be whether morbidity and mortality are reduced.

While some promising results have been reported, there are major difficulties in conducting and evaluating studies of this type when concurrent national educational programmes reduce the contrasts between intervention and control communities. In countries such as the United States of America where populations are highly mobile and continued participation in long-term studies is difficult to maintain, the results of community interventions may be less satisfactory than in other settings.

Intervention studies to reduce blood pressure by limiting salt intake have been conducted in small communities in Portugal and Belgium (123, 124). The Portuguese study found significantly lower blood pressures and sodium excretion in the intervention study, while the Belgian study found no significant effects on blood pressure.

4.9.2 National programmes

National prevention programmes encompass a broad range of activities from basic and clinical research to dissemination of results, development of guidelines for preventive programmes and monitoring of the effect of public and professional educational programmes on levels and trends in risk factors, morbidity and mortality. National programmes have focused on diet, cholesterol, blood pressure, smoking, and other aspects of a healthy lifestyle. In some countries, the educational message emphasizes the need for routine checking of blood pressure and cholesterol, lifestyle changes and medical evaluation and, if necessary, treatment of risk factors.

Measurement of risk factors, medical evaluation and drug treatment of elevated blood pressure or cholesterol may not be feasible in developing countries, and there may be low compliance with recommendations in affluent countries. Nevertheless, efforts to teach the general public about healthy lifestyles should be encouraged for all populations. The educational messages should be aimed at people of all ages, including schoolchildren and elderly men and women.

National goals to promote health and prevent disease should include reduction of cardiovascular morbidity in the elderly as a high priority. The document “Healthy people 2000”, issued by the US Department of Health and Human Services, states: “a growing body of evidence shows that changing certain behaviours, even in old age, can benefit health and
quality of life” (125). In some countries, national goals have focused on premature death from CHD (126, 127), and the elderly have been excluded. Though not specific to the elderly, United States goals for the year 2000 include reductions in deaths from CHD and stroke and reductions in risk, to be achieved by increasing the proportion of hypertensive subjects whose blood pressure is under control, reducing mean serum cholesterol levels and the prevalence of high cholesterol levels, and reducing dietary fat intake, the prevalence of obesity and the prevalence of cigarette smoking. Other targets are to increase the proportions of people who are moderately physically active and to increase the proportions of adults who have had blood pressure measurements within two years and cholesterol measurements within five years. If these goals are to be reached, elderly people must be included.

The Victoria Declaration on Heart Health (128) advocates health promotion and prevention or postponement of cardiovascular disease in the elderly. It emphasizes prevention rather than treatment of cardiovascular diseases and notes that healthy lifestyles, including healthy nutrition, smoking cessation and physical activity, have the potential to improve the quality of life of the elderly. Other reasons for favouring prevention include the high cost of providing care, the hazards of overtreating the elderly and, in some countries, shortages of health personnel and of drugs.

The European Targets for Healthy Aging (127) include a life expectancy of at least 75 years and improvement in the health of all people aged 65 years and over, with an increase in the number of years of life free from disability for people aged 65 and over and an improvement in the quality of their lives. The strategies for reaching these goals include promotion of lifestyle changes, creation of supportive environments and provision of appropriate services to support elderly people in need.

5. **Rehabilitation of elderly people with cardiovascular disease**

5.1 **Disability in elderly people**

This section is directed mainly towards the problems of disability in elderly people, and highlights the importance of considering the functional status of the individual, his or her coping mechanism and the presence of an adequate support system, in addition to the clinical manifestations of cardiovascular disease. Disability and handicap are important measures in old age (129). Thus, the goal of intervention in the elderly is not only to increase life expectancy, but also to maintain autonomy and self-sufficiency, i.e. to increase the active life expectancy (130-134).
The few longitudinal studies that have been made of the relationship between increasing longevity and disability, mainly in the United States of America and Canada, indicate that the population may be living longer with increasing disability (135). It seems that, as the age of onset of major chronic diseases and problems has not changed, there is an increased prevalence of disability in later life (136). Disability affecting one or more of the basic activities of daily living increases in both sexes with age and is greater in women (136). Among those aged 85 and over, 35% of men and 50% of women need continuous assistance for daily functioning. The relationships between aging, disease, disability and survival are illustrated in Fig. 5, which demonstrates the potential for both prevention and reversal at all stages. Prevention at younger ages will delay morbidity and death to a more advanced age, while successful treatment and rehabilitation in old age will postpone disability and death.

Disability in old age is due in large part to the aging process itself. Part of this process involves a decrease in cardiac output and diminution in cardiovascular reserve (137), compounded by pathological changes to the heart and blood vessels. Chronological age is not, however, a good predictor of functional capacity, and there is considerable variation among individuals. At older ages, the effects of disease (impairments) are greater because they are superimposed on organs with an already reduced capacity. Old people suffer from an average of 4-10 chronic conditions (138), of which cardiovascular disease is the most frequent (139).

5.2 Rehabilitation of the elderly patient with heart disease

Rehabilitation is an essential part of the care that should be given to all patients. In the case of CVD, the goals are to improve functional capacity, alleviate or lessen symptoms, and enable the patient to return to a useful and personally satisfying role in society (135).

A recent report by a WHO Expert Committee (140) has described the current state of cardiovascular rehabilitation, including rehabilitation of severely disabled cardiac patients with medically complex problems. Only special features applying to elderly people will be outlined here.

Thorough evaluation and management of the elderly patient with CVD are essential and should include careful diagnostic work-up, appropriate

Figure 5
The relationship between aging, disease, disability and death

![Diagram](WHO6026)
treatment, identification of the appropriate type of rehabilitation, and social support (141). In some countries this comprehensive assessment is performed by multidisciplinary geriatric teams but it can be adapted to the health care system and take place in primary or secondary care settings. Functional assessment can be done by nurses or other health workers, as appropriate in the individual context.

Acute care of elderly people with heart disease is, in principle, the same as that of younger patients. Aging may, however, affect the presentation and the course of disease. Elderly patients with myocardial infarction tend to be diagnosed later. In some societies, it appears that elderly women have less access than men to cardiac rehabilitation (142).

Elderly patients must be protected both from undertreatment ("agism") and overenthusiastic investigation. The precarious condition of frail elderly patients means that regimens need to be closely monitored and adjusted. Careful discharge planning is important (143), especially in order to ensure continuity of care.

Functional limitations resulting from myocardial infarction, e.g. in walking and performing everyday tasks, can be improved by physical rehabilitation (140). Physical training has four components — endurance, strength, flexibility and balance — implemented in supervised or independent exercise rehabilitation programmes. Early ambulation is important in maintaining muscle, bone and joint mobility. The adaptation of rehabilitation methods to suit communities with very limited resources has been described in a WHO publication (144). The physiological adaptation of elderly patients to exercise training is improved by a lower intensity, increased frequency and longer duration of exercise training, with more time allowed after exercise for the heart rate to return to its resting level. Extended periods of warm-up and cool-down exercises are appropriate. Electrocardiographic monitoring is indicated only for selected high-risk patients. A walking programme may be the ideal regimen for elderly patients.

The psychosocial consequences of disease are now recognized as important, yet some remain difficult to assess or quantify. Psychosocial support includes awareness of inappropriate coping strategies common in the elderly (passive or depressive behaviour) and advice regarding changes in lifestyle. In certain cultures, religious and spiritual leaders are involved in the care of elderly people.

Very few clinical trials of the value of rehabilitation after myocardial infarction have included elderly people. Furthermore, most of the literature on rehabilitation is confined to physical training (145), whereas elderly patients need comprehensive evaluation and management. One study in Copenhagen (146) demonstrated the importance of regular support and follow-up in the home, in addition to physical rehabilitation, in reducing mortality and readmission to hospital and improving well-being.
5.3 **Stroke rehabilitation**

Primary prevention of stroke and treatment in the acute stage have attracted far more interest than rehabilitation after stroke. Secondary and tertiary prevention in the form of stroke rehabilitation is, however, effective (32, 147). Stroke rehabilitation follows closely the principles for geriatric evaluation and management, but the best evidence for the usefulness of stroke rehabilitation has been provided by studies in special stroke units. An accurate diagnosis is important for prognosis and for deciding where the patient should be cared for after leaving hospital (institution or home); all available diagnostic techniques should therefore be made use of.

The success of rehabilitation depends on the severity of neurological deficits, and whether the patient has had previous strokes. Age and side of hemiplegia do not have a significant influence. Improvement in function and speech mainly takes place in the first three months after the stroke. Additional improvement with further treatment after six months is rare, but continued functional recovery may occur for more than one year. Only one-fifth of patients are unable to walk alone after one year.

Most of the controlled and randomized studies indicate that rehabilitation of stroke patients by a care team of a physician, a nurse and others (depending on resources), started immediately after the attack and continued as necessary after discharge, will accelerate recovery, reduce length of stay in hospital and bring a lasting improvement in function. It has been estimated that one-half of patients resumed their pre-stroke status within six months of their first stroke, compared with only one-quarter after a recurrent stroke. Fewer women than men returned to their pre-stroke status and fewer people (men and women) 75 years and over recovered compared with people aged 65-74 years (32, 147, 148).

5.4 **Autonomy**

The goal of rehabilitation is to maximize the functioning and independence of the individual. It therefore needs to address not only the disability itself but also the handicaps that may result from physical and social conditions. For an old person, the ideal is considered to be autonomy within his or her normal surroundings. In the case of cardiovascular disease, physical rehabilitation is the first step, but attention must also be paid to factors that affect the social and mental well-being of the individual. The physical environment can be a support or a deterrent to optimal function. Social support from family, neighbours and friends is an important element in the achievement and maintenance of autonomy. For many families, however, a severely disabled elderly member can be a considerable burden and many schemes have been designed to support carers, such as home helps, community nurses and respite care. Many of the tasks, in developing and developed countries
alike, are performed by voluntary and charitable organizations. However, in many countries the family is still the main resource for support to a person with a disability.

6. **Health policy and cardiovascular diseases in the elderly**

6.1 **The demographic imperative**

The formulation of a health policy requires an appraisal of the social and economic burden of ill-health and an examination of the strategies available for prevention and amelioration. In the present case, this process is complicated by the impact on society of aging populations and by the limited information available, both globally and locally.

The world population of elderly people is increasing rapidly, the percentage annual growth rate being up to three times higher in developing countries (see section 2.1.1). In both developing and developed countries, the consequences of aging present a major social challenge. Increased longevity is one of the major achievements of the twentieth century, but there is, at present, scant evidence for any reduction in morbidity.

Given the exponential increase in the incidence of the major cardiovascular diseases with age, together with the aging of the population, we can expect an increase in the total burden of CVD. Reductions in mortality from coronary heart disease and stroke in many countries give some cause for optimism, although for several countries, notably those of eastern Europe, death rates have not declined (see section 3.3). It should be noted that statistics derived from the main underlying cause of death give only part of the picture. When deaths in which CVD is a contributing cause are included, the total burden of CVD mortality may be as much as 50% greater (136).

There will be a cohort effect in all countries as successive generations reach older ages with different experiences of disease and nutrition in early life. It is expected that prevention strategies will postpone the incidence of CVD to even later years while, as a result of successful treatment, more old people may survive with residual cardiovascular pathology and limitation of activity. Women, by virtue of their greater life expectancy, account for a high proportion of cases of CVD in the elderly. They often have lower socioeconomic status than men and are more likely to live alone, which puts them at particular disadvantage; the diagnosis and treatment of their condition are often delayed (149).

Given the strong interaction between the cardiovascular diseases, their risk factors, the decrements of old age and the importance of socioeconomic support for the health of elderly people (130, 134, 141), economic aspects of cardiovascular disease in elderly people assume
considerable importance. Policies need to be directed to the overall goal of maintenance of autonomy, and should include prevention, treatment and rehabilitation as integral parts. Such a comprehensive approach is a logical extension of community intervention studies \((118, 150)\).

Ethical considerations are important and principles of equity apply as much to elderly people as to any other group. Old people, particularly older women, are often not given the same priority or even the same opportunities for treatment and prevention as young and middle-aged people.

6.2 **Policy development**

The scientific basis for health policy depends on:

- an estimate of the size of the problem (see section 3);
- evidence for the efficacy, effectiveness and efficiency of interventions and the resource consequences of their implementation (see section 4).

6.2.1 **CVD as a national priority**

Each country and, in some areas, each community will have to decide for itself the priority to be assigned to CVD. The distribution of responsibility between the national and community levels, the situation of elderly people and the prevalence of CVD make the process complicated.

An adequate database is required for the formulation of policy. Data based on census or population surveys must be supplemented by information on the health, living conditions, and social and economic status of elderly populations and the utilization of health services. Where such information is not already available, surveys will need to be conducted: suitable instruments have been developed by WHO and used in various regions \((130, 151-153)\).

Information on the incidence and prevalence of CVD will be even more difficult to obtain in populations where data on health and service utilization are inadequate. Information about patients who consult physicians or other health workers, or about admissions to hospital, can give only a general impression, but may serve as a stimulus for further investigation and for the establishment of databases and information systems to monitor cardiovascular and other diseases as well as risk factors in all age groups \((118, 128)\). The need for improvements in death certification (both registration of death and classification of cause of death) in developed and developing countries has been discussed earlier (see section 3).

6.2.2 **Promotion of cardiovascular health of elderly people**

While general principles apply to the promotion of cardiovascular health in elderly people, they need to be expanded to meet this group’s special
needs. The community approach is particularly suitable for health promotion in elderly people, a very high proportion of whom are at risk (154, 155). Using interventions that will do no harm and may well do good is a sound policy until other evidence is available. It is never too late to change one’s lifestyle, and elderly people are as amenable to change as middle-aged people (146).

Secondary prevention and early treatment will need to be provided for those with disease and those at high risk (see section 3). There are special problems linked to pharmacological treatment and cardiovascular surgery in old people, calling for close coordination between specialists in cardiology and geriatrics, although the primary care team still has a central role to play in referral and follow-up of patients.

Rehabilitation is an essential and growing component of cardiac care at all ages (156): it is especially important – and difficult – for the elderly. For the increasing numbers of very old people, rehabilitation services and long-term care facilities must be provided for a variety of conditions, the principles and goals of treatment being very similar for all of them (157).

6.2.3 Setting targets

Each country needs to set its own specific targets for health of the elderly; indeed, this is part of the strategy of “health for all”. Countries of the European Region of WHO have set general targets for the reduction of cardiovascular mortality and other noncommunicable diseases. Unfortunately, these are usually confined to middle-aged people. Only a few countries have set targets for elderly people, or included elderly people in national targets (see section 4). It is preferable to include elderly people in overall targets rather than treating them as a special population. Elderly people should be involved in target-setting and in the implementation of strategies.

Meanwhile, in addition to targets for reduction of mortality due to specific diseases, process targets may also be set, as for general programmes on the prevention of heart disease and stroke (118). For elderly people, these will include access to and utilization of health services, case-fatality, changes in health behaviour, and improvements in social and economic environments.

6.3 Policy implementation

Policies to support health are required in many sectors – economic, housing, welfare, transport, etc.

6.3.1 The role of governments

An understanding by governments of the problem of cardiovascular diseases, and a determination to improve the situation, are essential
for the development and success of any intervention programme. Governments should take a leading role in formulating national strategies for the active promotion of cardiac health and the prevention and control of cardiovascular disease (128). This will require mechanisms to coordinate the activities of the many agencies involved. Formulation and fine-tuning of national policies will be possible only if there are reliable statistics on incidence, prevalence and mortality, service statistics that monitor the workings of the health and welfare services, periodic surveys of disability, health behaviour and community activities, and medical audits relevant to the national strategies (see section 4.9.2). An example of a successful government initiative in promoting health in elderly people is provided by Japan, where legislation has ensured the provision of routine screening clinics for elderly people (158).

Governments and nongovernmental organizations should take responsibility for the dissemination of relevant information and for educating, or facilitating the education of, the public on healthy behaviour and ways of preventing CVD at all ages. The association of cardiovascular diseases with affluence in some societies, and with poverty in others, means that special attention may need to be paid to disadvantaged groups, in particular elderly people from ethnic minorities and those in poor socioeconomic circumstances.

6.3.2 Intersectoral collaboration

The cornerstone of prevention and control of CVD is a concerned public, supported by policies designed to facilitate changes in public and individual behaviour – healthier eating habits, stopping smoking, limitation of alcohol and salt consumption, and increased physical activity.

The policies needed make up an interlocking network. For smoking, for instance, they will include taxes on tobacco, control of advertising and sales, health education in schools and workplaces, provision of no-smoking areas in public places and the encouragement of public pressure against smoking. The expansion of healthy eating habits in the population may include legislation governing the content of prepared foods, subsidies for healthy products and special preparation of healthy food for vulnerable groups.

6.3.3 Health services

Appropriate services for diagnosis, secondary prevention, treatment and rehabilitation are essential for all comprehensive programmes for the control of CVD. The need to give elderly people their fair share of these services has been noted and policies must be developed to ensure that this is done.

Comprehensive programmes for the prevention and control of CVD should include activities and settings appropriate for old people.
The improvement of rehabilitation services and activities and their extension to long-term care facilities, together with the incorporation of secondary preventive activities, are examples of outreach programmes. It is important to ensure coordination of such programmes.

Special units, such as geriatric units and those for the treatment and early rehabilitation of stroke patients, are examples of ways of improving the quality of care and limiting disability for older patients.

Coordination of health and welfare services is crucial for the prevention and amelioration of disability in elderly people (141, 157). Programmes to maintain income and to provide concessions in the purchase of food and medicines will help to increase equity in health for underprivileged populations.

It should be noted that increase in health costs for elderly people in many societies reflects an increase in the standard of care as well as an increase in the number of elderly people.

6.3.4 **Education and training**

Basic training of health professionals is an important aspect of public policy. The principles of health promotion, cardiovascular care and care of the elderly population should become integral parts of the curricula of physicians, nurses, physiotherapists, social workers, home helps and other allied health and social-work professionals. Of particular importance is the training of primary health workers in methods of assessment and care of old people. Individuals who need such education and training should be identified in developing countries.

Education of the public about CVD prevention has been mentioned above. For the education of elderly people about healthy lifestyles, disease prevention and rehabilitation, activities could be organized at community centres and day-care facilities, as well as retirement homes and other sheltered housing. Making use of the media, with special television and radio programmes at convenient times, is an important option.

6.4 **Data for policy formulation**

The basic data needed to develop a policy for improving the health of elderly people are summarized in section 6.2.1. However, for the development of detailed policies, monitoring their execution and evaluating their impact, data from multiple sources are needed. Data needs for general health policy in an aging population have recently been summarized (17) although mainly from the perspective of the USA. Well-designed studies such as the WHO MONICA project (which has no age limit for participation) can yield information useful for policy formulation (19).
7. Conclusions and recommendations

7.1 Conclusions

The number of elderly people is large and increasing rapidly. The growth in the numbers of old people in developing countries has received inadequate attention from policy-makers and may have an even greater social and economic impact than the growth of old populations in developed countries. Issues of particular demographic importance are the increase in the “oldest old” and the large numbers of elderly women living alone.

These demographic changes have considerable resource implications. Age dependency ratios (the ratio of the number of people aged 65 or over to the number aged 15-64 years) — a measure of elderly people’s economic dependence on the working population — will rise as the working population declines and the elderly population increases, since the proportion of the population which is generating income will be smaller.

Cardiovascular disease is the leading cause of death in the population aged 65 years and above worldwide, with most such deaths occurring in the developing world. The variation between countries in cardiovascular disease mortality rates in people over 65 years of age indicates the large potential for effective prevention programmes. Cardiovascular disease mortality rates are falling in many developed countries, and available data indicate that there have been declines in both the incidence and the case-fatality of CVD. However, such trends are not apparent in some eastern European countries and in many developing countries.

There is strong evidence that risk factors for CVD are the same in elderly people as in younger populations. Moreover, risk measured in middle age is predictive of the development of cardiovascular disease in old age. Elevated risk-factor levels, particularly hypertension and hypercholesterolaemia, are common in elderly people. Even small increases in relative risk in elderly people will be of public health importance because of their higher absolute rates of disease. Little information is available on the significance of risk factors in people aged over 80 years.

There is considerable potential for prevention of cardiovascular diseases in elderly people. Although preventive measures benefitting elderly people should ideally be adopted early in life, there remains scope for prevention even in later life, so that fatal or disabling events may be postponed until extreme old age.

There is evidence that lifestyle changes (stopping smoking, adopting a healthy eating pattern, engaging in moderate physical activity and controlling weight) can reduce cardiovascular disease and improve overall health in all age groups, including elderly people.
The scientific basis of health policy depends on the effectiveness and efficiency of the proposed intervention; the actual strategy adopted must be based on an estimate of the size of the problem. Each country (or community) needs to address these points in order to determine priorities for policy formulation.

Health policy for elderly people must be directed towards the overall goal of maintaining autonomy and should include prevention and treatment of CVD and rehabilitation of patients. The principles of equity should apply as much to elderly people as to any other age group. Ethical questions will arise in connection with resource allocation from limited budgets, and these must be considered and discussed as part of the process of policy formulation.

Population strategies offer the greatest opportunity for lifestyle changes in countries with a high prevalence of cardiovascular risk factors. Such strategies will be wide-ranging, covering legislation on food and tobacco policy, media communication, and advice delivered by health workers. They should be tailored to the culture and method of delivery of health care of specific populations. The costs and effectiveness of different strategies need to be evaluated.

In countries or communities where rates of CVD and risk factors are low at present, primordial prevention should be the key strategy. Healthy lifestyle approaches, in particular to combat smoking, should focus on schoolchildren and young people in order to prevent CVD in later life.

High-risk strategies will be relevant to a high proportion of the over-65 population, because certain CVD risk factors – high blood pressure, high serum cholesterol, diabetes – are common in the elderly. Patients with CHD or a history of myocardial infarction or stroke are at increased risk of recurrent major events.

Evidence from intervention trials is required to confirm the value of hormone replacement therapy and vitamin supplementation in the prevention of CVD in elderly people.

National policy should set specific targets based on assessed needs and should provide guidelines that take account of the needs of elderly people within the overall targets, rather than as a special group.

Intersectoral support is essential for the success of health policy. An intersectoral approach is needed to the planning and monitoring of health and other services related to the general welfare of elderly people.

National policy will be put into effect only if health and allied personnel at all levels, especially at the primary health care level, are trained – or retrained – in the principles of health promotion and cardiovascular care of elderly people. Policy on secondary prevention, early treatment and rehabilitation should recognize the central role of primary health care in the care of elderly people.
7.2 Recommendations

7.2.1 General recommendations

1. More data, especially for the “oldest old” and for developing countries, are needed to produce population projections, to plan preventive approaches and to formulate policy, including the allocation of resources for the prevention and management of CVD.

2. There is great need for vital registration data in the large number of countries where such data are not available. In other countries, existing vital registration schemes should be improved.

3. There is an urgent need to improve the quality of cause-of-death coding, including multiple-cause coding. In countries where cause-of-death data do not exist, new methods such as the verbal autopsy may be of use, but they require further development and testing.

4. All future epidemiological studies of CVD, including clinical trials, should include people over 65 years of age.

5. Population trends in CVD mortality, morbidity and risk factors, including those for elderly people, should be monitored in selected sites in developed and developing countries.

6. Further etiological studies of CVD in elderly people are required in a variety of locations to try to account for differing patterns in the occurrence of CVD.

7. The economic burden of cardiovascular disease in the elderly population requires further study, particularly in developing countries.

8. Efforts should be made to combat negative attitudes towards prevention of CVD in elderly people; they should include education of health workers and policy-makers, as well as the general public.

9. Appropriate preventive strategies should be developed for socially disadvantaged groups, including ethnic minorities.

10. Guidelines for the management of risk factors in elderly people require further development and interpretation in the context of individual populations and in relation to health care budgets.

7.2.2 Research recommendations

1. Research is needed on the following topics in the field of etiology:
   – identification of genes predisposing to hypertension, CHD and their risk factors (e.g. obesity, salt sensitivity);
   – the role of risk factors in very elderly people (aged 80 years and over);
   – variability in the rate of rise of blood pressure with age across different populations and the factors that govern the rate of rise;
- the role of ambulatory (24-hour) blood pressure monitoring in epidemiological studies of elderly people;
- blood clotting and fibrinolytic activity as predictors of CVD events in the elderly population;
- the role of antioxidants and minerals in reducing CVD risk;
- the interaction of co-morbid conditions in relation to CVD risk factors, morbidity and mortality;
- ethnic differences in cardiovascular disease.

Many other areas requiring further investigation were identified by a WHO Scientific Group (57), and are not repeated here.

2. Research is needed on the following topics in the field of prevention and management of CVD:

- determination of the optimum systolic and diastolic blood pressure goals for hypertensive patients, in order to maximize risk reduction;
- the benefits and risks of antihypertensive treatment in people aged 80 years and over;
- the value of antiplatelet activation in the primary prevention of stroke;
- whether lowering blood pressure reduces the risk of vascular dementia;
- the most appropriate management of risk factors in diabetic patients;
- optimal rehabilitation in elderly people after myocardial infarction;
- improvement of treatment of CVD in the very old with co-existing diseases.

3. Research is needed on the following general topics:

- measures of outcome in the elderly, including quality of life and the adjustment of life expectancy by quality of life and disability;
- methods of monitoring quality of cardiovascular care;
- motivational factors for lifestyle changes in elderly people, and to improve compliance with medication;
- assessment of costs and benefits of interventions.

7.2.3 Recommendations to national governments

1. All national governments should address the prevention and control of cigarette smoking, as a priority.

2. National governments should support the development of food and nutritional policies that help to prevent CVD in the elderly, e.g. requiring appropriate labelling of pre-packaged foods.

3. National governments should plan now for the future cardiovascular health needs of the elderly population.

4. National governments should include the elderly population in health goals and targets.
5. National governments should make resources available for CVD preventive strategies that include the elderly population.

6. National governments should encourage the participation of elderly people in all aspects of the design and implementation of preventive strategies.

7. National governments should initiate and support intersectoral activities to prevent cardiovascular diseases in elderly people.

7.2.4 Recommendations to WHO

1. WHO should support global efforts to reduce the promotion and uptake of tobacco use, especially in developing countries.

2. WHO should collaborate with other United Nations agencies such as UNESCO in efforts to promote cardiovascular health education for children and young people, especially in developing countries.

3. WHO should work with national governments to stimulate cardiovascular disease prevention programmes for the elderly population.

4. WHO should encourage nongovernmental organizations concerned with cardiovascular health to implement CVD prevention programmes and to ensure that they are appropriate for elderly people.

5. WHO should encourage nongovernmental organizations concerned with health promotion and education to include elderly people in their target groups.

6. WHO should promote the further development and use of standard methods for epidemiological studies, preventive interventions and surveillance of CVD, with special attention being paid to elderly people.

7. WHO should support the extension of the coverage of vital registration systems.

8. WHO should continue to develop methods for improving cause-specific mortality data.

9. WHO should monitor the global epidemiology of cardiovascular disease and prevention activities.

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