TOBACCO USE AND EFFECTS ON HEALTH

Ann McNeill

1. INTRODUCTION

This chapter discusses the effects of tobacco use on the health of individuals, as well as the effects on public health, in other words the overall impact on populations across Europe. Although the focus of this chapter is the effect of smoking cigarettes, which are by far the dominant form of tobacco use across Europe, the effects of other forms of tobacco used in Europe are also briefly examined, including pipe and cigar smoking, hand-rolled tobacco smoking, water-pipe smoking, bidi smoking and use of smokeless tobacco.

As smoking is the most researched topic in biomedical history, this opening chapter can only provide the briefest overview of current knowledge. Furthermore, scientists are continuing to discover the precise mechanisms by which tobacco causes disease in the human body, refining our understanding of the overall impact of smoking and causing us to recalculate the scale of the epidemic.

This chapter draws on leading authoritative reviews of the literature published in this field, in particular those of the World Health Organization International Agency for Research on Cancer (IARC), the UK Royal College of Physician reports and the US Surgeon General reports. On the whole, the evidence from these different reviews is very consistent, but this chapter highlights where there are still uncertainties. Due to constraints on space, this chapter does not offer explanations of why and how cigarette smoking causes specific diseases.

2. THE EFFECTS OF TOBACCO ON INDIVIDUAL HEALTH

2.1. Cigarette smoking

Cigarette smoking harms nearly every organ of the human body, thereby causing a broad range of diseases, at least 24 of which are fatal, as well as a massive burden of chronic illness.

The long-term risks of smoking have been quantified in a cohort study of British doctors that compared the overall survival of smokers and non-smokers over time. This study attempted to recruit all the doctors registered in Britain in 1951. Over 34,000 male doctors were enrolled and the 50-year follow-up, which included over 25,000 deaths, was published in 2004.

The proportions who died in middle age (defined as aged 35-69 years) varied from 24% of never-smokers (defined as those who have never reported having smoked as much as one cigarette or 1 g of tobacco per day for as long as 1 year) to 42% of cigarette smokers for those born in 1900-1909, but were 15% versus 43%, respectively, for those born in the 1920s. The risks to heavy smokers (defined as smokers of 25 or more cigarettes a day) were more marked, with ~50% of those born in the first three decades of the 20th century dying in middle age.

The absolute differences in the probability of survival of smokers and non-smokers were less extreme in old age, because almost all people die by age 100. Nevertheless, even

\[ \text{\textsuperscript{a}} \] These definitions of never-smoker and heavy smoker are used consistently throughout this chapter unless otherwise specified.
after middle age, the difference in mortality rates between smokers and non-smokers remained significant. For males born around the 1870s, only 10% of smokers aged 70 survived to 90 years compared with 12% of never-smokers; and for those born during the 1910s, 7% of smokers aged 70 survived until they were 90 years compared with 33% of never-smokers.

These survival data are for British male physicians observed in a particular historical period, and the pattern of survival will differ somewhat in different countries, for different classes and at different times. This study showed that, for continuing cigarette smokers, the eventual risk of dying as a result of their smoking varied from about one-half to about two-thirds; however, for the purposes of generalisability, the authors concluded that smoking killed about one-half of those who regularly smoked. The important message is the relative survival rather than the absolute percentages. The findings have been supported by studies in other countries. For example, a study relating life expectancy to smoking in 31,000 Danish people found similar survival curves for smokers versus never-smokers, among both males and females.

Estimates have also been made from the Danish data for health expectancy, i.e. the average lifetime in good health. This study found that, in addition to the years lost from dying earlier from smoking, a greater number of years survived are marred by poor health. Males who continued to smoke heavily (defined here as at least 15 g tobacco per day) had 8 more years in poor health than never-smokers. Females who continued to smoke heavily had an average of 12 more years spent in poor health, in addition to the loss of life. A study from the Netherlands found similar results.

The largest similar study is the American Cancer Society's second Cancer Prevention Study involving more than one million adults from the USA aged 30 years or over at the start of the study in 1982. This study found that, among males in the USA, smoking is associated with about two-thirds of all the deaths in middle age among those who smoke cigarettes regularly.

In general, there is a strong dose-response relationship between smoking and the diseases caused by smoking, such that heavier smoking and longer duration of smoking are related to a higher risk of disease.

Whilst the composition of the cigarette smoke inhaled varies depending on the type of tobacco used, the design of the cigarette (including the presence or absence of filters and use of additives) and the way cigarettes are smoked, the overall health risks to smokers do not differ greatly for cigarettes with different design features.

Peto et al. have recently estimated mortality from smoking in the European Union (EU) (updating a similar study published in 1994). They estimate that, in EU countries, smokers who die in middle age as a result of their smoking lose an average of 22 years of life. Even those dying as a result of their smoking at age 70 or older lose 8 years. On average, smokers who die as a result of their smoking die 14 years earlier than never-smokers. These new data allow a comparison between the risks of dying from tobacco use compared with other factors. In the year 2000, for every 1,000 individuals across all EU countries who smoke regularly, one will be murdered and seven will be killed in road crashes, but 500 will be killed by their smoking.

\[b\] EU25 are the 25 Member States of the newly enlarged EU
2.1.1. Diseases caused by cigarette smoking

Table 1 lists the diseases and other adverse health effects caused by cigarette smoking. It is important to note that, overall, males and females who smoke face similar risks for these major causes of death, although there are unique risks faced by females, as indicated in the table. The following sections focus on the major causes of death: cancers, respiratory diseases and cardiovascular diseases. Reproductive diseases are also included because of the important cross-generational effects of smoking.

2.1.1.1. Cancers

In 2004, the IARC published a Monograph\textsuperscript{10} concerning the carcinogenicity of tobacco smoking, which updated their earlier review of these issues, the Monograph published in 1986\textsuperscript{11}. The 2004 report indicated that there is now sufficient evidence for a causal association between cigarette smoking and 16 different cancers. This indicates a doubling over the last 18 years in the number of cancers found to be caused by cigarette smoking, showing that, even today, 54 years after the first links between smoking and lung cancer were established, yet more diseases are being found to be caused by smoking.

Table 1 lists the cancers which are identified in the revised IARC Monograph\textsuperscript{10} as being caused by smoking. In these cancers, the observed relative risks range from ~2 for stomach cancer to more than 20 for lung cancer. In addition, there is suggestive evidence (not yet sufficient to infer a causal relationship) that smoking causes other cancers, such as colorectal cancer. There appears to be a small decreased risk of endometrial cancer among smokers.

From the British doctors study\textsuperscript{2}, current cigarette smokers have over twice the risk\textsuperscript{c} of dying from all cancers combined than never-smokers. For heavy smokers the risk is three-fold compared with never-smokers.

Lung cancer is by far the most common cause of death from cancer in Europe when both sexes are considered, and tobacco smoking increases the risk of all major histological types of lung cancer\textsuperscript{10} for both males and females. Cigarette smoking is the major cause of lung cancer: “In populations with prolonged cigarette use, the proportion of lung cancer cases attributable to cigarette smoking has reached 90%.”\textsuperscript{10}

Duration of smoking is the strongest determinant of risk of lung cancer\textsuperscript{10}. Risk also increases in proportion to the number of cigarettes smoked, so that mortality from lung cancer is 25 times higher in heavy smokers than in never-smokers\textsuperscript{2}.

Further details of the relationship between smoking and the various different forms of cancer can be found in the recent IARC report\textsuperscript{10}.

\textsuperscript{c} Relative risks are a function of the age, time and smoking characteristics of the population studied, and are not absolute values. Therefore, they vary from study to study. This report gives relative risks taken from the British doctors study\textsuperscript{2} unless otherwise stated. These risks are, therefore, illustrative.
Table 1. - Diseases and adverse health effects caused by active cigarette smoking

<table>
<thead>
<tr>
<th>CANCERS</th>
<th>RESPIRATORY DISEASES AND ADVERSE HEALTH EFFECTS</th>
<th>CARDIOVASCULAR DISEASES AND ADVERSE HEALTH EFFECTS</th>
<th>OTHER DISEASES AND ADVERSE HEALTH EFFECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lung</td>
<td>Chronic obstructive pulmonary disease (COPD)</td>
<td>Coronary heart disease (CHD)</td>
<td>Gastric ulcer</td>
</tr>
<tr>
<td>Oral cavity</td>
<td>Acute respiratory illnesses including pneumonia</td>
<td>Cerebrovascular disease</td>
<td>Cataract</td>
</tr>
<tr>
<td>Pharynx</td>
<td>Premature onset of and an accelerated decline in lung function</td>
<td>Aortic aneurysm</td>
<td>Periodontitis</td>
</tr>
<tr>
<td>Larynx</td>
<td>All major respiratory symptoms in adults, including coughing, phlegm, wheezing &amp; dyspnoea</td>
<td>Peripheral arterial disease</td>
<td>Duodenal ulcer</td>
</tr>
<tr>
<td>Oesophagus (squamous cell carcinoma)</td>
<td>Poor asthma control</td>
<td></td>
<td>Adverse surgical outcomes related to wound healing and respiratory complications</td>
</tr>
<tr>
<td>Oesophagus (adenocarcinoma)</td>
<td></td>
<td></td>
<td>Hip fracture</td>
</tr>
<tr>
<td>Pancreas</td>
<td></td>
<td></td>
<td>Reduced fertility in females</td>
</tr>
<tr>
<td>Urinary bladder</td>
<td></td>
<td></td>
<td>Crohn’s disease¶</td>
</tr>
<tr>
<td>Renal pelvis</td>
<td></td>
<td></td>
<td>Age-related macular degeneration¶</td>
</tr>
<tr>
<td>Kidney (renal cell carcinoma)</td>
<td></td>
<td></td>
<td>Tobacco amblyopia¶</td>
</tr>
<tr>
<td>Stomach</td>
<td></td>
<td></td>
<td>Osteoporosis¶</td>
</tr>
<tr>
<td>Uterine cervix</td>
<td></td>
<td></td>
<td>Reproductive problems:</td>
</tr>
<tr>
<td>Granulocytic cells of bone marrow (myeloid leukaemia)</td>
<td></td>
<td></td>
<td>Pregnancy complications</td>
</tr>
<tr>
<td>Nasal cavities#</td>
<td></td>
<td></td>
<td>Preterm delivery and shortened gestation</td>
</tr>
<tr>
<td>Nasal sinuses#</td>
<td></td>
<td></td>
<td>Foetal growth restrictions and low birth weight</td>
</tr>
<tr>
<td>Liver#</td>
<td></td>
<td></td>
<td>Sudden infant death syndrome (SIDS)</td>
</tr>
</tbody>
</table>

Respiratory effects in utero with maternal smoking

**In young people and adolescents who smoke:**

- Impaired lung growth
- Early-onset of lung function decline
- Respiratory symptoms including coughing, phlegm, wheezing dyspnoea
- Asthma-related symptoms (wheezing)

Data are from 1, 10¶, 12¶.
2.1.1.2. Respiratory diseases

Smoking is the most important cause of emphysema and chronic bronchitis, collectively known as chronic obstructive pulmonary disease (COPD). Smoking causes nearly 90% of all cases of emphysema. Mortality from COPD is 14-times higher in cigarette smokers than in never-smokers. Again, dose is important, with mortality from COPD being nearly 24-times higher among heavy smokers than never-smokers. There has been a suggestion that females may have more symptoms of COPD than males even if they have smoked the same amount over the same number of years.

A causal relationship exists between smoking and contracting acute respiratory illnesses, including pneumonia, in people without underlying smoking-related COPD. Smoking is also linked to an increased risk of contracting infectious diseases, such as tuberculosis, influenza and the common cold. In addition, smoking exacerbates asthma. A causal relationship has also been identified between smoking and a premature onset of and an accelerated age-related decline in lung function, as well as all common respiratory symptoms among adults, including cough, phlegm, wheeze and dyspnoea.

The risk of dying from any respiratory disease is three times higher for smokers than never-smokers and nearly five times higher for heavy smokers as compared with never-smokers. However, death rates from respiratory diseases will vary according to other country-specific factors (see also Mortality from smoking across Europe section).

Children and adolescents who smoke are also damaging their lungs. A causal relationship has been identified between smoking in adolescence and impaired lung growth, early onset of lung function decline, respiratory symptoms including cough, phlegm, wheeze and dyspnoea, and asthma.

2.1.1.3. Cardiovascular diseases

Smoking increases a person’s risk of cardiovascular disease, which is an umbrella term for coronary heart disease (CHD), cerebrovascular disease (ischaemic and haemorrhagic stroke), aortic aneurysm and peripheral arterial disease. The risk of mortality from any cardiovascular disease in all cigarette smokers is greater than 1.6 times that of never-smokers, with the figure rising to 1.9 times in heavy smokers.

The relative risk of cardiovascular disease associated with smoking is low in comparison to lung cancer and COPD. Unlike lung cancer and COPD, cardiovascular disease has multiple causes. Smoking acts synergistically with these other risk factors, such as diet and lack of physical exercise, to increase the risk of cardiovascular disease. Thus, the high rate of cardiovascular disease in European populations means that there are similar numbers of deaths from cardiovascular disease and lung cancer attributable to smoking in the population (see Mortality from smoking across Europe section).

Over the age of 60 years, the relative risk of heart attack doubles, but under the age of 50 years smoking is associated with a more than five-fold increase in risk. There is a synergistic action in females who smoke and use the contraceptive pill, resulting in a substantial increase in the risk of myocardial infarction.
The relative risks of stroke are also very dependent on the age of the population in which they are measured\textsuperscript{18}. The risk of stroke increases dramatically at older ages, but the relative risk from smoking declines with age. The reasons for this are not fully understood, but may relate to very early onset of illness in individuals who are particularly susceptible to some of the adverse effects of smoking.

2.1.1.4 Reproductive diseases

Maternal smoking during pregnancy is an important cause of ill health for both mother and foetus\textsuperscript{19}.

Smoking causes “cot death” or sudden infant death syndrome (SIDS)\textsuperscript{20, 21}, the commonest cause of death between the ages of 1 month and 1 year (fig. 1).

Fig. 1. - Risk of cot death from maternal smoking in pregnancy

![Figure reproduced with permission from Mitchell et al.\textsuperscript{21}.]

Maternal smoking is also a cause of low birth weight\textsuperscript{22}, and the greater the exposure the greater the risk of having a low birth weight baby\textsuperscript{23}. Full-term infants born to females who smoke during pregnancy weigh ~200 g less than those born to females who do not smoke\textsuperscript{10}. Maternal smoking during pregnancy also increases the risk of miscarriage and of premature birth\textsuperscript{19}, and is a cause of several complications in pregnancy, including premature rupture of the membranes, placenta praevia and placental abruption\textsuperscript{1}. There is also a causal relationship between maternal smoking during pregnancy and a reduction in lung function in infants\textsuperscript{1}. In addition, smoking has a causal relationship with reduced fertility in females\textsuperscript{1, 19}. Some experts have stated that there is a causal relationship between smoking and sperm damage\textsuperscript{19}, but not all agree that the evidence is yet sufficient to say that this is more than a statistical association\textsuperscript{1}. Similarly, smoking is linked to erectile dysfunction\textsuperscript{1}. 
2.1.5. Other diseases and adverse health effects

In addition to those diseases and adverse health effects known to be caused by smoking, smoking aggravates a wide variety of illnesses, such as chronic rhinitis\(^{24}\), multiple sclerosis\(^{25}\) and goitre\(^{26}\), and has been identified as a risk factor in a range of other diseases and adverse health effects, such as rheumatoid arthritis\(^{27}\) and skin aging\(^{28}\). An enhanced risk for premature mortality has also been found from the combination of smoking and diabetes\(^{29}\).

There is evidence that smoking is associated with increased absenteeism from work and increased use of medical care services.

2.1.6. Interactions with other causes of disease

There is evidence of synergy between smoking and other causes of disease. For example, the combination of heavy alcohol and heavy tobacco consumption has a synergistic effect on the risk of some cancers, including oral cavity, pharynx and larynx\(^{10}\).

2.1.2. Diseases inversely associated with smoking

Smoking is associated with a reduced incidence of some diseases, including Parkinson’s disease, ulcerative colitis, aphthous ulcers, allergic alveolitis, cancer of the body of the uterus, fibroids, nausea, and vomiting in pregnancy and pre-eclampsia. Most of these diseases are uncommon or seldom fatal. Any smoking-attributable decrease in mortality from these diseases amounts to <1% of the overall mortality increase caused by smoking\(^{12}\).

2.2. Other forms of tobacco use

The health consequences of smoking all forms of tobacco are broadly similar, as all deliver substantial amounts of carcinogens and other harmful combustion products\(^{10}\); however, the small variations worth noting are described below.

2.2.1. Hand-rolling tobacco

In some countries in Europe, hand-rolled cigarettes are becoming increasingly popular. For example, in the UK, over one-fifth of smokers (22%) now smoke hand-rolled cigarettes, compared with 10% in 1984\(^{30}\). Hand-rolled cigarettes do not need to comply with the tar, nicotine and carbon monoxide machine-based maximum yields required by the EU (see also Chapter 5). A UK study found that, even with standardised-sized tubes and amounts of tobacco, there is still considerably more variation of these yields within brands of hand-rolling tobacco in the UK than within brands of machine-manufactured cigarettes\(^{31}\). There are fewer studies on the health impact of hand-rolled than on manufactured cigarettes, but the available evidence indicates that risks are as great or even greater \(^{32,33,34}\).

2.2.2. Cigar and pipe smoking

The IARC report\(^{10}\) identified a causal relationship between cancer of the oral cavity, oropharynx, hypopharynx, larynx and oesophagus, and cigar and pipe smoking, with the magnitude of risk similar to that from cigarette smoking and there is a comparable dose-response profile. A causal relationship has been identified between cigar and/or pipe smoking
with cancer of the lung, as well as cancer of the pancreas, stomach and urinary bladder.

The extent to which cigar and pipe smoking increases an individual's risk of some cancers, cardiovascular disease and COPD depends on whether a smoker inhales 35. The risk of smoking cigars or pipes for individuals who have never been regular smokers of cigarettes, so-called primary cigar or pipe smokers, is considerably lower than in former cigarette smokers, principally because members of the primary group tend not to inhale the smoke but rely on nicotine absorption from the buccal mucosa, the lining of the mouth. Cigarette smokers who switch to cigars or pipes tend to continue to inhale the smoke and suffer similar rates of smoking-related disease to cigarette smokers.

2.2.3. Bidi smoking

Bidis are manufactured in India and exported worldwide. They consist of tobacco rolled in a dried tree leaf and are usually unfiltered. Bidis are available in a variety of flavours. They are not currently popular in Europe.

Bidi smoke is carcinogenic 10. The new IARC report summarises case-controlled studies, demonstrating a strong association between bidi smoking and cancers in the oral cavity, pharynx, larynx, oesophagus, lung and stomach, and almost all of these studies showed significant trends with duration of bidi smoking and number of bidis smoked.

2.2.4. Water-pipe smoking (also known as hubble-bubble smoking)

This is becoming increasingly popular in some parts of Europe, e.g. Denmark. Although there is little research on this type of smoking, it has been established that it involves the inhalation of nicotine similar to other forms of tobacco use 36, and also the inhalation of carcinogens and toxins 37. There is emerging evidence of risks to health from this behaviour 38.

2.2.5. Smokeless tobacco

There are various different types of smokeless tobacco products in use around the world and the health risks of these vary considerably. Smokeless tobacco comes in two main forms: snuff (finely ground or cut tobacco leaves that can be dry or moist, loose or portion packed in sachets, and administered to the mouth, or the dry products to the nose or mouth) and chewing tobacco (loose leaf, in pouches of tobacco leaves, “plug” or “twist” form). When administered orally, the tobacco can also be mixed with other psychoactive ingredients.

In the EU, one form of smokeless tobacco, oral snuff, is banned (see also Chapter 3). A derogation was granted for Sweden, where a form of moist snuff, known as snus, is popular, with some 20% of males using it. A derogation was also granted for the European Economic Area Member State Norway, where about 7% of males use snus daily.

In India, use of their domestic types of chewing tobacco is a major cause of oral cancer 39 and is also harmful in pregnancy 40. Given these types of tobacco are allowed in Europe, this is also a cause of concern here. The use of chewing tobacco is largely restricted to members of the Indian, Pakistani and especially Bangladeshi communities, which, for example, in the UK, make up 4.5% of the population, just over two million people.
The health risks associated with the use of smokeless tobacco in individuals are considerably less than those associated with cigarettes. The reason for this is that smokeless tobacco products do not contain the toxic pyrolysis or combustion products responsible for the great majority of the health effects from cigarettes. Several reviews of the health effects of smokeless tobacco products have been published (e.g. 41, 42, 43), but relatively less research has been carried out in comparison with cigarette smoking. Concerns focus mainly on oral cancers 44 and cardiovascular disease45.

In Sweden, snus is manufactured and stored in a manner that causes it to deliver lower yields of some of the more harmful chemicals, in particular tobacco-specific nitrosamines, than other smokeless tobacco products43. Snus does not appear to cause cancer, respiratory diseases or stroke43, 46. Snus may cause an increase in the risk of cardiovascular disease, although a much lower risk than caused by smoking47, 48 and it may be a risk factor for diabetes for heavy snus users49, although this relationship has not been found in other studies50. Snus is dependence forming and can deliver high doses of nicotine51, but the maximum serum levels are similar among all nicotine users. Snus is harmful to the developing foetus52.

2.3. Impact of tobacco use on others

Tobacco smoke is a serious environmental hazard and a significant cause of ill health. A review commissioned by the “Europe Against Cancer” Programme of the European Commission in 1997 concluded that: “Tobacco smoke is the most important source of indoor contaminants in environments where smoking occurs.”53

Tobacco smoke consists of side-stream smoke emanating from the burning tip of a cigarette or other smoking device (~85%), and main-stream smoke that has been inhaled and exhaled by a smoker (~15%). Other terms to describe tobacco smoke pollution include second-hand smoke, environmental tobacco smoke or air pollution caused by tobacco smoke. The exposure of non-smokers to tobacco smoke is referred to as passive smoking or involuntary smoking.

The composition of tobacco smoke will vary depending on the way the tobacco is smoked, as well as the design and composition of the delivery device. Cigarette smoke has been the most extensively studied. Main-stream and side-stream smoke consist of a gas phase and a particulate phase. As many of the gases are odourless, it is not always easy to sense when the air is not safe54, 55. Tobacco smoke contains over 4,000 chemicals, including many regulated hazardous air pollutants and hazardous wastes, more than 50 known carcinogens and more than 100 chemical poisons53. When tobacco is burned to create side-stream smoke, larger amounts of some toxic constituents are generated than when tobacco is burned to generate main-stream smoke, resulting in the tobacco smoke containing substantial amounts of these carcinogens even when extensively diluted56. It is generally believed that for many of the carcinogenic constituents that are genotoxic (i.e. cause damage to cellular DNA, resulting in mutations or cancer) there is no safe level of exposure.

Since 1986, there has been a series of authoritative reports analysing the evidence, and concluding, beyond doubt, that there are significant risks to health caused by passive smoking (table 2).
### Table 2. - Reports on the health effects of passive smoking

<table>
<thead>
<tr>
<th>Year</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1986</td>
<td>US Dept of Health and Human Services: the Health Consequences of Involuntary Smoking&lt;sup&gt;57&lt;/sup&gt;</td>
</tr>
<tr>
<td>1986</td>
<td>Australian National Health and Medical Research Council: Effects of Passive Smoking on Health&lt;sup&gt;58&lt;/sup&gt;</td>
</tr>
<tr>
<td>1986</td>
<td>German MAK-Commission: Passive Smoking at the Workplace&lt;sup&gt;59&lt;/sup&gt;</td>
</tr>
<tr>
<td>1986</td>
<td>US National Research Council: Environmental Tobacco Smoke&lt;sup&gt;60&lt;/sup&gt;</td>
</tr>
<tr>
<td>1987</td>
<td>World Health Organization IARC Monograph&lt;sup&gt;11&lt;/sup&gt;</td>
</tr>
<tr>
<td>1992</td>
<td>US Environmental Protection Agency: Respiratory Health Effects of Passive Smoking&lt;sup&gt;61&lt;/sup&gt;</td>
</tr>
<tr>
<td>1994</td>
<td>US Occupational Safety and Health Administration: Indoor Air Quality&lt;sup&gt;62&lt;/sup&gt;</td>
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<tr>
<td>1997</td>
<td>Australian National Health and Medical Research Council: Health Effects of Passive Smoking&lt;sup&gt;63&lt;/sup&gt;</td>
</tr>
<tr>
<td>1997</td>
<td>California Environmental Protection Agency: Health Effects of Exposure to Environmental Tobacco Smoke&lt;sup&gt;64&lt;/sup&gt;</td>
</tr>
<tr>
<td>1997</td>
<td>Europe Against Cancer: Passive Smoking: The Health Impact&lt;sup&gt;53&lt;/sup&gt;</td>
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<td>1998</td>
<td>UK Scientific Committee on Tobacco and Health: Environmental Tobacco Smoke&lt;sup&gt;65&lt;/sup&gt;</td>
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<td>1999</td>
<td>US Institute for Global Tobacco Control: Environmental Tobacco Smoke&lt;sup&gt;66&lt;/sup&gt;</td>
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<td>German MAK-Commission: Passive Smoking&lt;sup&gt;67&lt;/sup&gt;</td>
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<td>1999</td>
<td>WHO Expert Consultation: Environmental Tobacco Smoke (ETS) and Child Health&lt;sup&gt;68&lt;/sup&gt;</td>
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<td>2000</td>
<td>WHO: Air Quality Guidelines for Europe&lt;sup&gt;69&lt;/sup&gt;</td>
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<td>2000</td>
<td>American College of Occupational &amp; Environmental Medicine: Epidemiological basis…&lt;sup&gt;70&lt;/sup&gt;</td>
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<tr>
<td>2001</td>
<td>European Network for Smoking Prevention: Smoke Free Workplaces&lt;sup&gt;71&lt;/sup&gt;</td>
</tr>
<tr>
<td>2001</td>
<td>Report to the French Director General of Health: Passive Smoking&lt;sup&gt;72&lt;/sup&gt;</td>
</tr>
<tr>
<td>2001</td>
<td>Finnish Report on Environmental Tobacco Smoke and its Effects on Health&lt;sup&gt;73&lt;/sup&gt;</td>
</tr>
<tr>
<td>2002</td>
<td>British Medical Association: Towards Smoke-Free Public Places&lt;sup&gt;74&lt;/sup&gt;</td>
</tr>
<tr>
<td>2002</td>
<td>Health Council of the Netherlands: The Impact of Passive Smoking on Public Health&lt;sup&gt;75&lt;/sup&gt;</td>
</tr>
<tr>
<td>2004</td>
<td>Irish Office of Tobacco Control and Health and Safety Authority: Report on the Health Effects of ETS in the Workplace&lt;sup&gt;76&lt;/sup&gt;</td>
</tr>
<tr>
<td>2004</td>
<td>WHO IARC Monograph on the Evaluation of Carcinogenic Risks to Humans: Tobacco Smoke and Involuntary Smoking&lt;sup&gt;10&lt;/sup&gt;</td>
</tr>
</tbody>
</table>
A range of conditions, including fatal illnesses, are caused by passive smoking and these are shown in table 3, which has been adapted from the recent review by the British Medical Association (BMA)^74.

Table 3. - Health effects of second-hand smoke

<table>
<thead>
<tr>
<th>EVIDENCE THAT SECOND-HAND SMOKE CAUSES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adults</strong></td>
</tr>
<tr>
<td>Lung cancer</td>
</tr>
<tr>
<td>Coronary heart disease</td>
</tr>
<tr>
<td>Onset of symptoms of heart disease</td>
</tr>
<tr>
<td>Asthma attacks in those already affected</td>
</tr>
<tr>
<td>Worsening of symptoms of bronchitis</td>
</tr>
<tr>
<td>Stroke</td>
</tr>
<tr>
<td>Reduced foetal growth (low-birth-weight baby)</td>
</tr>
<tr>
<td>Premature birth</td>
</tr>
<tr>
<td><strong>Children</strong></td>
</tr>
<tr>
<td>Cot death (Sudden infant death syndrome)</td>
</tr>
<tr>
<td>Middle-ear disease (ear infections)</td>
</tr>
<tr>
<td>Respiratory infections</td>
</tr>
<tr>
<td>Development of asthma in those previously unaffected</td>
</tr>
<tr>
<td>Asthma attacks in those already affected</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OTHER PROVEN HEALTH EFFECTS OF SECOND-HAND SMOKE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shortness of breath</td>
</tr>
<tr>
<td>Nausea</td>
</tr>
<tr>
<td>Airway irritation</td>
</tr>
<tr>
<td>Headache</td>
</tr>
<tr>
<td>Coughing</td>
</tr>
<tr>
<td>Eye irritation</td>
</tr>
</tbody>
</table>

Table adapted from the British Medical Association^74.
The risks to health are summarised in the following sections. Many of these adverse outcomes show a linear dose response, with risk increasing as exposure increases (but see cardiovascular risks below). The increased risks associated with passive smoking are consistent with those estimated from extrapolating the risk in smokers, using biochemical measures, and with evidence of tobacco-specific carcinogens found in the blood and urine of non-smokers exposed to tobacco smoke.\(^74\)

2.3.1. Acute and sub-acute effects

Many non-smokers feel immediate effects on breathing in tobacco smoke. They can suffer from coughing, headache, eye irritation, sore throat, sneezing and runny nose, nausea, breathing problems, and irregular heartbeat (particularly for people with heart disease).\(^74\)

2.3.2. Chronic effects

2.3.2.1. Cancers

Extended exposure to tobacco smoke causes lung cancer in non-smokers. IARC recently determined tobacco smoke pollution to be carcinogenic to humans:\(^10\) “There is sufficient evidence that involuntary smoking causes lung cancer in humans.”

IARC found that non-smokers living with a smoker have a 20-30% increase in risk of lung cancer compared with those who live in non-smoking households, controlling for some potential sources of bias and confounding. As with active smoking, there is a dose-response relationship between a non-smoker’s risk of lung cancer and the number of years of exposure to the tobacco smoke.\(^77\)

For non-smokers exposed in the workplace, IARC reviewed other published meta-analyses, which give an increased risk of lung cancer of 16-19%.\(^10\)

Finland, Germany and the US National Toxicology Programme have listed tobacco smoke as a workplace carcinogen and, as long ago as 1992, the US Environmental Protection Agency classified tobacco smoke as a Class A (known human) carcinogen.\(^61\)

2.3.2.2. Respiratory diseases

IARC reported that adverse effects of tobacco smoke on respiratory symptoms have been observed, with the strongest evidence being for a causal relationship with chronic respiratory symptoms.\(^10\) In 1998, a review found a small but significant association between passive smoking and adult-onset asthma and COPD.\(^78\) This review estimated that adults exposed at home or in the workplace had a 40-60% increased risk of asthma compared with adults who were not exposed in these places.

In people with asthma, exposure to tobacco smoke is associated not only with more severe symptoms, but also with lower quality of life, reduced lung function and increased use of health services for asthma, including hospital admissions.\(^79\)

In 2001, the European Community Respiratory Health Survey\(^80\) (involving nearly 8,000 adults aged 20-48 years from 46 centres in 16 countries) found that passive smoking was significantly
associated with nocturnal chest tightness, nocturnal breathlessness and increased bronchial responsiveness. Further analyses from this study have found that both intra-uterine (see below) and environmental exposure to parental tobacco smoking was related to children having more respiratory symptoms and poorer lung function in adulthood.

2.3.2.3. Cardiovascular diseases

People who live with smokers have a 25% increased risk of coronary heart disease. Exposure to tobacco smoke has consistently been found to be associated with an increased relative risk of CHD in cohort studies and case-controlled studies, in males and females, and for exposure at home and in the workplace.

It may seem odd that the relative risks for active and passive smoking on lung cancer are very different, namely, ~20 for active smoking and ~1.2 for passive smoking, while the relative risks for active and passive smoking on CHD are relatively close, namely 1.8 for active smoking and 1.25 for passive smoking. However, the dose-response relationship for CHD is non-linear, and we now understand that the mechanisms concerning smoking and cancer and smoking and cardiovascular disease are very different. Even small amounts of smoke may have immediate influences on clotting and thrombus formation, and long-term effects on the development of arteriosclerosis, all important factors in CHD and cardiovascular disease. Such a non-linear response helps make the epidemiological estimates of the cardiovascular effects of passive smoking biologically plausible.

There is some evidence that second-hand smoke increases the risk of stroke. Bonita et al. found that regular exposure to tobacco smoke pollution increased the risk of stroke in non-smokers by 82%. A recent cohort study found a 50% increased risk of first ischaemic stroke among females exposed to environmental tobacco smoke at home.

2.3.2.4. Effects of tobacco smoke on the health of children

Exposure to tobacco smoke is especially dangerous to young children and infants. It increases the risk of lower respiratory tract infections, such as pneumonia and bronchitis, causes coughing and wheezing, and is associated with reduced lung growth and with middle-ear disease, including recurrent ear infections in children. It is also a risk factor for new cases of asthma and increases the severity of symptoms in children with asthma. A Dutch review of the evidence recently estimated that the increase in risk of respiratory infections in children with or without asthma varied from 20-50%. In the UK, it has been estimated that, each year, more than 17,000 children aged under 5 years are admitted to hospitals because of respiratory illness caused by exposure to other peoples' cigarette smoke.

2.3.2.5. Exposure to tobacco smoke during pregnancy and infancy

As with maternal smoking in pregnancy, passive smoking (i.e. when non-smoking females are exposed to other peoples' smoke during pregnancy) also reduces birth weight in the offspring of non-smoking mothers. There is also evidence that exposure to tobacco smoke pollution after birth is a risk factor for SIDS in babies of non-smoking mothers.

Exposure to tobacco smoke in pregnancy and infancy adversely affects certain cognitive abilities and behavioural characteristics of children.
2.3.2.6. Other effects

Second-hand tobacco smoke is especially dangerous to people with pre-existing respiratory or cardiovascular conditions. Such individuals make up a substantial proportion of the population.74

2.3.2.7. Summary of increased risks from passive smoking studies

The increased risks of passive smoking are summarised in table 4.

<table>
<thead>
<tr>
<th>DISEASE</th>
<th>INCREASED RELATIVE RISKS %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lung cancer: exposure at home</td>
<td>25-35</td>
</tr>
<tr>
<td>Lung cancer: exposure at work</td>
<td>20</td>
</tr>
<tr>
<td>CVD: exposure at home</td>
<td>25</td>
</tr>
<tr>
<td>Stroke: exposure at home</td>
<td>50</td>
</tr>
<tr>
<td>Respiratory diseases: children</td>
<td>20-50</td>
</tr>
<tr>
<td>Asthma onset: adults</td>
<td>40-60</td>
</tr>
</tbody>
</table>


3. THE EFFECTS OF TOBACCO ON PUBLIC HEALTH

When he examined the effects of tobacco on many different conditions, Doll12 commented: “That so many diseases - major and minor - should be related to smoking is one of the most astonishing findings of medical research...less astonishing perhaps than the fact that so many people have ignored it.”

This section focuses on the impact of continuing use of tobacco on population health. In addition to mortality trends, morbidity effects and the impact of tobacco on health inequalities are briefly described.

3.1. Mortality from smoking across Europe

Data from the study conducted by Peto et al.8 in 2000 are used to give a snapshot of current mortality across Europe (table 5). Mortality figures are given for the EU25 and the European Free Trade Association (EFTA) countries. These figures are likely to be underestimates for a number of reasons, including that no data were available for Cyprus and Iceland, although 0.2% of the EU25 total was added to cover these, and deaths from passive smoking have not been included (see below). The figures from the study by Peto et al.8 use a standard method and, therefore, the totals for different countries are directly comparable. However, some countries use different estimates of deaths caused by smoking. In these cases both figures are presented.

It is important to note that these data reflect the consequences of tobacco consumed two or three decades previously. For example, currently, more males than females are dying as a
result of their tobacco use in all EU countries and it will take some time for the current high prevalence of the use of tobacco by females across Europe to show up in these figures. For comparative purposes, the prevalence figures are given in Chapter 4.

Table 5. - Absolute deaths in 2000 attributable to smoking

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>SMOKING-ATTRIBUTABLE DEATHS PER YEAR, 2000</th>
<th>OWN COUNTRY ESTIMATES</th>
</tr>
</thead>
<tbody>
<tr>
<td>AU</td>
<td>8,903</td>
<td></td>
</tr>
<tr>
<td>BE</td>
<td>18,646</td>
<td></td>
</tr>
<tr>
<td>CY#</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CZ</td>
<td>17,746</td>
<td></td>
</tr>
<tr>
<td>DK</td>
<td>12,329</td>
<td></td>
</tr>
<tr>
<td>EE</td>
<td>2,751</td>
<td></td>
</tr>
<tr>
<td>FI</td>
<td>5,102</td>
<td></td>
</tr>
<tr>
<td>FR</td>
<td>60,578</td>
<td>66,400&lt;sup&gt;93&lt;/sup&gt;</td>
</tr>
<tr>
<td>DE</td>
<td>108,835</td>
<td>143,390&lt;sup&gt;94&lt;/sup&gt;,&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>EL</td>
<td>13,332</td>
<td></td>
</tr>
<tr>
<td>HU</td>
<td>29,070</td>
<td>28,000&lt;sup&gt;95&lt;/sup&gt;</td>
</tr>
<tr>
<td>IE</td>
<td>5,653</td>
<td></td>
</tr>
<tr>
<td>IT</td>
<td>80,061</td>
<td>80,000&lt;sup&gt;96&lt;/sup&gt;</td>
</tr>
<tr>
<td>LV</td>
<td>4,131</td>
<td>4,380&lt;sup&gt;97&lt;/sup&gt;</td>
</tr>
<tr>
<td>IS</td>
<td></td>
<td>390&lt;sup&gt;98&lt;/sup&gt;</td>
</tr>
<tr>
<td>LI#</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LT</td>
<td>4,671</td>
<td>7,000&lt;sup&gt;99&lt;/sup&gt;</td>
</tr>
<tr>
<td>LU</td>
<td>570</td>
<td></td>
</tr>
<tr>
<td>MT</td>
<td>295</td>
<td>358&lt;sup&gt;100&lt;/sup&gt;</td>
</tr>
<tr>
<td>NO</td>
<td>5,544</td>
<td></td>
</tr>
<tr>
<td>PL</td>
<td>68,629</td>
<td></td>
</tr>
<tr>
<td>PT</td>
<td>8,405</td>
<td></td>
</tr>
<tr>
<td>SK</td>
<td>8,039</td>
<td></td>
</tr>
<tr>
<td>SI</td>
<td>2,808</td>
<td></td>
</tr>
<tr>
<td>ES</td>
<td>45,342</td>
<td></td>
</tr>
<tr>
<td>SE</td>
<td>8,205</td>
<td>6,500&lt;sup&gt;101&lt;/sup&gt;</td>
</tr>
<tr>
<td>CH</td>
<td>6,978</td>
<td></td>
</tr>
<tr>
<td>NL</td>
<td>25,725</td>
<td></td>
</tr>
<tr>
<td>UK</td>
<td>114,771</td>
<td></td>
</tr>
</tbody>
</table>

#: no data available; ¶: tobacco-smoking-attributable mortality was estimated taking the smoking prevalence in Germany into consideration. Data taken from Peto et al.<sup>8</sup>. 
CHAPTER 1

Table 6 and figure 2 give the total estimated tobacco-attributable deaths for the EU25. There were 656,000 deaths overall caused by smoking in the year 2000, more than one in seven of all deaths across the EU25. In the 10 new Member States alone, smoking caused nearly one in five of all deaths. There were 668,000 deaths caused by smoking in the EU25 and Switzerland and Norway in the year 2000.

Table 6. - Overall mortality due to smoking as a proportion of all deaths in the EU25 (year 2000 data)

<table>
<thead>
<tr>
<th>CAUSE</th>
<th>DEATHS DUE TO SMOKING/TOTAL DEATHS N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MALES</td>
</tr>
<tr>
<td></td>
<td>FEMALES</td>
</tr>
<tr>
<td></td>
<td>ALL</td>
</tr>
<tr>
<td>Lung cancer</td>
<td>156,000/171,000 (91)</td>
</tr>
<tr>
<td></td>
<td>34,000/53,000 (65)</td>
</tr>
<tr>
<td></td>
<td>190,000/224,000 (85)</td>
</tr>
<tr>
<td>All cancer</td>
<td>239,000/626,000 (38)</td>
</tr>
<tr>
<td></td>
<td>46,000/493,000 (9)</td>
</tr>
<tr>
<td></td>
<td>285,000/1,119,000 (25)</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>136,000/846,000 (16)</td>
</tr>
<tr>
<td></td>
<td>48,000/1,028,000 (5)</td>
</tr>
<tr>
<td></td>
<td>184,000/1,873,000 (10)</td>
</tr>
<tr>
<td>Respiratory</td>
<td>78,000/194,000 (40)</td>
</tr>
<tr>
<td></td>
<td>34,000/178,000 (19)</td>
</tr>
<tr>
<td></td>
<td>113,000/371,000 (30)</td>
</tr>
<tr>
<td>All causes</td>
<td>508,000/2,214,000 (23)</td>
</tr>
<tr>
<td></td>
<td>148,000/2,238,000 (7)</td>
</tr>
<tr>
<td></td>
<td>656,000/4,452,000 (15)</td>
</tr>
</tbody>
</table>

#: denominator of the fraction is the number of deaths due to that disease, the numerator is the number attributable to smoking; ¶: the total deaths figure rises from 656,000 to 668,000 with the addition of Norway and Switzerland (the only two EFTA countries for which data is available). Data are taken from Peto et al.

Fig. 2. - Deaths caused by smoking as a per cent of total deaths in the EU, 2000

Figure modified from Peto et al.

Fig. 3. - Proportion of deaths from smoking by disease group in the EU, 2000

Figure modified from Peto et al.

Attributable proportions will vary according to country characteristics, such as the prevalence of smoking in the population, but also the prevalence of other factors related to diseases caused by smoking.
3.1.1. Breakdown by disease group

Cancers, cardiovascular diseases and respiratory diseases together account for the great majority of the deaths caused by smoking, representing, respectively, 43, 28 and 18% of all deaths due to smoking (table 6 and figure 3). In absolute terms, smoking caused nearly as many deaths from cardiovascular disease as from lung cancer.

3.1.1.1. Cancers

About one in four (26%) of all deaths from cancer in the EU is caused by smoking (table 6). Among the 10 new Member States only, this figure rises to 30%. Eighty five per cent of lung cancer deaths across the EU are caused by smoking.

Lung cancer is the leading cause of death from cancer among males. In 2000, in Denmark and the UK, lung cancer surpassed breast cancer as the most important cause of fatal cancer among females. In these countries the epidemic of smoking among females is well established (similar to the USA where lung cancer is the leading cause of death from cancer among females) and the same pattern is likely to occur in other countries where the prevalence of smoking among females is still rising or has recently peaked.

3.1.1.2. Respiratory diseases

In the EU, three in 10 (30%) of all deaths from all respiratory disease are caused by smoking (table 6), but this rises to 40% in the new Member States. Nearly two-thirds (64%) of deaths from COPD are caused by smoking. As with other diseases, death rates vary from country to country according to many factors. For example, the death rate from COPD and bronchial asthma is higher in Denmark than in other western European countries, although it is not yet clear why this is the case, but differences in cigarette consumption may play a role.

Although tuberculosis was almost eradicated in Europe by 1980, rates have been increasing in eastern European countries in recent years and increased resistance to drugs commonly used to treat tuberculosis has been observed. Smoking is only one factor in this epidemic, although a recent study from India found that smoking was a cause of half of deaths from tuberculosis in males.

3.1.1.3. Cardiovascular diseases

One in ten (10%) of all deaths from cardiovascular diseases in the EU is caused by smoking (table 6). Among the 10 new Member States only, this figure rises to 14%.

Whether smoking-attributable deaths from cancer exceed those from cardiovascular disease varies across the different EU countries, depending on the background risk of cardiovascular disease in specific nations or regions and the age of the population studied. Death rates from stroke are higher in central and eastern Europe than the other regions, and death rates from CHD are generally higher in northern, central and eastern Europe than in southern and western Europe. This relates to the other risk factors for CHD and also to their synergistic effects with smoking. For example, data from the Seven Countries Study have shown an interaction between smoking and cholesterol levels, smoking being more dangerous for those who also have high blood cholesterol levels. The impact of smoking on
mortality and morbidity from cardiovascular disease has been much higher in Finland when compared with southern Europe, and this interaction has also been found elsewhere.\(^{107}\)

### 3.1.2. Trends in mortality

Mortality patterns are now indicative of the impact of smoking trends two to three decades ago. This is best illustrated in figure 4, which shows the stages of the smoking epidemic. In general, levels of smoking have been seen as following four stages. The first is a rapid rise in smoking by males, the second a rise in smoking by females, the third a plateau in smoking among males, and the fourth a plateau and then decline in smoking in females. These trends in prevalence are followed two to three decades later by similar peaks and falls in mortality caused by smoking.

Fig. 4. - The four stages of the tobacco epidemic

The tobacco epidemic is at different stages in different European countries. In general, western European males began smoking early in the 20th century with females taking up smoking most commonly in the second half of that century. From 1950 onwards, the proportion of males smoking started to decline, but declines in females smoking only followed from the mid 1970s. Only some western European countries (most notably UK, Germany, Denmark and Finland) are in stage four of the epidemic.

The situation is different in the eastern and central European countries. The closed societies of the Soviet bloc were largely deprived of public education on the harmful effects of smoking. Reports from scientific studies of the relationship between smoking and cancer and other diseases, undertaken chiefly in the UK and the USA since the 1950s, apparently did not penetrate central and eastern European countries. Awareness of the harm to health due to smoking was very low until the 1980s. This attitude towards tobacco, which prevailed until almost the end of the 1980s, put these countries on top of the list of world tobacco
consumption from the early 1960s until the end of the 20th century. The prevalence of smoking by males in these countries is now peaking or only just beginning to decline, whereas smoking is still increasing amongst females. Most central, eastern and southern European countries are, therefore, in stage three of the epidemic.

Figure 5 shows the overall trends in mortality for smoking-attributable deaths over the last half of the 20th century for all the EU25 countries. The proportion of smoking-attributable deaths (fig. 5a) peaked among males in the 1980s, but the proportion of smoking-attributable deaths among females is still rising. Given that the smoking-attributable proportion of deaths could be affected by significant changes in other causes of death, figure 5b shows absolute figures for smoking-attributable deaths across the EU. This shows a similar pattern to figure 5a.

Fig 5. - Smoking-attributable deaths: a) as a proportion of all deaths and b) in thousands per year, in the EU25, 1965-2000

Figure reproduced with permission from Peto et al. 8.

Figure 6 gives these trends for people aged 35-69 years, a closer approximation to the impact of smoking, as the patterns in mortality and the separation of smokers and never-smokers are more pronounced for this age group.

Figures 7 and 8 illustrate the smoking-attributable deaths as a proportion of all deaths for 35-69 year olds and in absolute numbers, in the EU15 and the 10 new Member States separately.

EU15 are the 15 Member States of the former EU
Fig 6. - Smoking-attributable deaths a) as a proportion of all deaths and b) in thousands per year, for 35-69 year olds in the EU25, 1965-2000

Fig 7. - Smoking-attributable deaths a) as a proportion of all deaths and b) in thousands per year, for 35-69 year olds in the former EU15, 1955-2000

Figure reproduced with permission from Peto et al.8.
TOBACCO USE AND EFFECTS ON HEALTH

In the EU15, smoking-attributable mortality among males aged 35-69 years peaked at ~34% of all deaths in the mid 1980s and has been declining ever since. Absolute numbers of deaths started an earlier decline, which might indicate that smoking-related deaths were not falling as quickly as deaths from other causes of disease. Smoking-attributable mortality is still rising among females aged 35-69 years.

In the EU10 new Member States, smoking-attributable mortality among males aged 35-69 years peaked slightly later (~1990) and at a higher level (~41% of all deaths). Hence, in these countries, two out of every five deaths for 35-69 year olds at that time were caused by smoking. This peak is later than that observed in the EU15, reflecting different trends in prevalence in these countries, where rises in male smoking happened later than in some of the former Member States. The peak is also higher than that observed in the EU15. This could be due to a decline in deaths unrelated to smoking in the 1990s in the new Member States compared to countries of the former EU, which experienced the smoking epidemic at an earlier stage when there were many other diseases, such as infectious diseases, killing people. Females in the EU10 new Member States are now showing similar trends to the other 15 Member States, although their smoking-attributable mortality is lower but rising in a similar fashion.

In order to understand these trends better, it is important to look at country-specific data, as the nations of Europe are at different stages of the smoking epidemic. The closeness of the relationship between cigarette smoking and mortality from lung cancer is profound, and therefore is used here, as it provides a useful marker for the evolution of the smoking epidemic. Caution is needed with comparisons between countries because of possible differences in standards of diagnosis in lung cancer, methods of reporting and collecting data, as well as the reliability of lung cancer death statistics in different countries.

Figure reproduced with permission from Peto et al.8.

Fig 8. - Smoking-attributable deaths a) as a proportion of all deaths and b) in thousands per year, for 35-69 year olds in the EU10 new member states, 1965-2000
3.1.2.1. Trends in mortality from lung cancer

The following figures illustrate mortality rates at country level for cancer, and then trends in lung cancer mortality for males and females aged 35-54 years separately, as this is the age group in which the differences in mortality between smokers and never-smokers are most pronounced. Figure 9[111] shows the standardised mortality rates for lung cancer averaged over the three most recent years for which data are available.

Fig 9. - Standardised mortality rates from lung cancer; average value for last 3 available years[1].

Standardised mortality rates for lung cancer are lower in countries predominantly but not exclusively from the EU15 (most notably Sweden, Finland and the UK), whilst much higher levels are found predominantly but not exclusively among the new 10 Member States. Hungary stands out as having very high standardised mortality rates for lung cancer, twice as great as Poland, which has the second highest rate. Sweden has the lowest rate.

Figure 10 shows the year-on-year changes in lung cancer mortality rates among males over the most recent 10 years for which data are available. The greatest rate of decrease in lung cancer mortality is found in the UK. This trend began from a very high baseline level in the early 1960s and has been occurring for a few decades. In other countries the decrease began later and the change has been less dramatic. In some countries, such as Hungary and Lithuania, the decline only began in 1993/1994. In four countries, Portugal, Greece, Spain and France, where the rates have historically been low, an increase in lung cancer mortality is still observed.

For females the picture is very different (figs 11 and 12). The current standardised mortality rates generally are lower than in males (fig. 9), but the between-country variation is again marked. Once again, females in Hungary have the highest standardised mortality rate for lung cancer, their level exceeding lung cancer mortality rates in males in more than half of the EU.
Fig 10. - Average yearly change in lung cancer mortality over 10 last available years, usually 1991-2000#.

MALES aged 35-54

Fig 11. - Standardised mortality rates from lung cancer, average value for 3 last available years#.

FEMALES aged 35-54

# for Belgium 1987-1996; for Hungary, Lithuania and Romania the decline began in 1993-1994; data not available for Lichtenstein or Cyprus. Norway is also excluded because only 5 years of data were available. **: Statistically nonsignificant.

Figure reproduced with permission from Zatonski111.
Figure 12, however, shows that the vast majority of the countries in Europe are still observing increases in mortality from lung cancer among females. Only the UK and Ireland are showing systematic decreases. The greatest rates of increase in the last decade have been in France and Spain (from very low baseline levels), and Hungary. In these and other European countries, the impact of the current high prevalence of smoking among young females will not manifest itself for a few decades. Hence, female mortality from smoking is likely to rise in many European countries for many years to come.

3.2. Impact of other forms of tobacco

Although cigarette smoking has been very heavily researched, little is known about the public health impact of other forms of tobacco. For example, there is little evidence of the impact of smokeless tobacco use across Europe, although the widespread use of snus in Sweden over time provides some data (see Swedish case study below).

3.2.1. Low tar cigarettes

As discussed in Chapter 5, following expert advice, the European Commission has followed a policy of progressively reducing machine-based maximum tar yields of cigarettes in the EU (from 1 January 2004 the maximum tar yield was 10 mg tar; Greece was granted a derogation until 1 January 2007). Many European smokers have moved to lower tar cigarettes over the last few decades in the belief that these are less dangerous than ordinary cigarettes\textsuperscript{112}, a perception that was also encouraged by the tobacco industry\textsuperscript{113}.

Recent reviews of the scientific literature have concluded that there is no convincing evidence of any benefit to public health from reductions in tar yields\textsuperscript{1, 114, 115}. 

### Figure 12. - Average yearly change in lung cancer mortality over 10 last available years, usually 1991-2000\# 

- **IE; -1.3%**
- **UK; -0.4%**
- **FI; 1.3%**
- **EL; 1.8%**
- **SI; 3.1%**
- **CH; 4.2%**
- **PL; 4.2%**
- **AU; 0.0453**
- **DE; 0.0496**
- **HU; 0.06**
- **ES; 0.0679**
- **FR; 0.0722**

**LT; -1.92%
** DK; -0.11%
** LV; 0.03% **

- **SE; 0.0276**
- **SK; 2.1%**
- **SE; 0.0176**
- **PT; 0.0162**
- **AT; 0.30% **
- **IT; 0.0118**
- **SE; 1.3%**
- **EE; 1.33%**
- **PT; 3.0162**
- **NL; 4.0%**

#: For Belgium 1987-1996; data not available for Lichtenstein or Cyprus, Norway is also excluded because only 5 years of data were available. \textsuperscript{**}: Statistically nonsignificant, very small numbers for Lithuania, Estonia and Malta. Figure reproduced with permission from Zatonski\textsuperscript{111}. 

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3.3. Case studies

A few countries have been selected to discuss these issues in more detail:

• UK, because it is illustrative of stage four of the smoking epidemic;
• France, because the epidemic in females has not yet peaked, and mortality from lung cancer has been rising in both females and males in the last decade;
• Poland and Hungary, because tobacco-related mortality is high in these new Member States;
• Sweden, because it has the lowest mortality rates for lung cancer in males and also because the use of a form of smokeless tobacco, snus, is widespread among Swedish males.

As mortality patterns can only be fully understood in relation to changing patterns of tobacco consumption a few decades earlier, trends in use of tobacco for each of the country case studies are also briefly described. Further information on prevalence is given in Chapter 4.

3.3.1. UK (see figure 13)

The UK was the first country in the world to observe very high prevalences of smoking (~80% at the end of World War II among males) and (with Finland) high rates of smoking-attributable deaths. It is now considered to be in stage four of the smoking epidemic. Smoking-attributable mortality has been decreasing steadily since the mid-1960s and now accounts for 23% of all deaths among 35-69 year olds. As mentioned above, younger males in the UK now have one of the lowest mortality rates for lung cancer in Europe and they had the fastest rate of decline in lung cancer mortality in the 1990s (fig. 10). Among females the picture is different; figure 13 illustrates how female smoking-attributable deaths continued to increase after males peaked and only recently have begun to decline. Also notable in the UK is the fact that smoking is much more common among poorer groups in society (see also Chapter 4).

The sharper reduction in absolute numbers of deaths observed for males in figure 13b compared with that observed in male deaths as a proportion of all deaths in figure 13a suggests that deaths from causes of disease other than smoking were falling more quickly than smoking-related deaths during this time.
CHAPTER 1

3.3.2. France (see figure 14)

The picture in the UK can be contrasted with that of France, where overall smoking-attributable deaths among 35-69 year old males are still very high, albeit at a lower level than that observed in the UK in the 1960s. Female smoking-attributable mortality only became measurable in the mid 1980s and is now increasing steadily.

Fig. 14. - Smoking-attributable deaths  a) as a percentage of all deaths and  
b) in thousands per year, for 35-69 year olds in France, 1950-2000

Figure reproduced with permission Peto et al.8.
As mentioned earlier, mortality from lung cancer amongst middle-aged French males was still rising in the last decade (fig. 10). For males aged 35-54 years, mortality from lung cancer is showing largely the opposite pattern to males in that age group in the UK (fig. 15).

3.3.3. Poland (see figures 16 and 17)

After World War II, the manufacturing of tobacco products was standardised across the entire Soviet bloc via national tobacco monopolies, and the tobacco market consisted nearly exclusively of factory-made cigarettes produced locally. The state promoted cigarettes as important basic goods and smoking was not only an acceptable behaviour but also a social norm. The prevalence of smoking among health professionals, especially females, was higher than in the general population.

This situation continued in Poland until the beginning of the 1980s, when the Solidarity movement began the transformation to democracy in Poland and the health effects of smoking were widely debated. Cigarette consumption peaked in the late 1970s and then decreased for the first time in history. Male deaths from smoking peaked in the late 1980s, but only began to decline in the 1990s. Female smoking-attributable mortality began to increase markedly in the 1970s and is still increasing.
3.3.4. Hungary (see figures 18, 19 and 20)

Trends in smoking in Hungary followed a similar pattern to those in Poland. Although cigarette consumption started to decrease in the second half of the 1990s, mainly due to tobacco control measures taken by successive governments, Hungarians are still one of the heaviest smoking countries, ranking 8th in the world based on per capita cigarette consumption in adults (15+).
This history of very heavy cigarette consumption could help explain the very high rates of standardised mortality for lung cancer observed among males and females in Hungary (fig. 19) and as discussed above. Figure 20 shows the close relationship between cigarette consumption and cancers of the respiratory tract. Between 1948 and 2001, lung cancer mortality increased 10 fold.\textsuperscript{116}

Fig. 18 - Smoking-attributable deaths a) as a percentage of all deaths and b) in thousands per year, for 35-69 year olds in Hungary, 1955-2000

Figure reproduced with permission from Peto et al.\textsuperscript{8}.

Fig. 19 - Trends in mortality from lung cancer in males and females aged 35-54 years in Poland

Figure modified from Zatonski\textsuperscript{111}. #Mean of annual rates in component 5-year age groups.
3.3.5. Sweden (see figures 21, 22 and 23)

While half of the adult males (but <10% of adult females) were smokers in the mid-1940s, cigarettes accounted for less than one-third of the total tobacco consumption, with snus accounting for 40% and pipe tobacco accounting for one-fifth. Soon after the war, cigarette consumption began increasing rapidly, especially among the youth and females. In 1963, cigarettes accounted for almost 65% of total tobacco consumption and 80% of the tobacco smoked. Smoking among males reached its peak by the end of the 1960s and started to decrease during the 1970s. Among females, the increase continued and the decrease began only at the end of the 1970s. In 2002, 16% of adult males were daily smokers, compared with 19% of adult females. However, there has been an increase in the prevalence of occasional smoking. (If occasional smokers are included, the prevalences of smoking are 29% for males and females alike.)

In 2001, cigarettes accounted for almost 40% of total tobacco consumption and ~83% of the tobacco smoked. Snus accounted for ~53% of the total tobacco consumption and it is predominantly used by males.

Smoking-related mortality never reached the same high levels as in many other European countries (fig. 22). A decrease is now seen among males but still awaited among females. Indeed, figure 9 shows that Sweden had the lowest standardised mortality rate of lung cancer in males across the EU and EFTA countries.

Given the use of smokeless tobacco, rates of oral cancer in Sweden have been compared with other countries. Sweden has a low rate of oral cancer by international standards and this low rate has been falling over the past 20 years117 whereas use of snus has been increasing since the late 1960s.

Data are presented as observation points and least square regression lines. Reproduced with permission from Foulds et al. [43].

Fig. 22. - Smoking-attributable deaths  
a) as a percentage of all deaths and 

Figure reproduced with permission from Peto et al. [8].
3.4. Morbidity from smoking across Europe

As described earlier in this chapter, a wide range of illnesses and diseases are associated with or caused by smoking. Therefore, many more people are harmed by tobacco use than estimates of mortality indicate. The burden of morbidity is hard to estimate. Regarding COPD, community surveys in Europe have indicated that at least 4-6% of the adult population suffers from COPD\textsuperscript{118} (for which active tobacco smoking is the single most important risk factor). A report from the USA suggested that the impact of smoking on morbidity may be 20 times greater than the mortality figures\textsuperscript{119}: “For every tobacco-attributable death that occurs, there are approximately 20 people alive who are suffering from a serious, chronic disease that is attributable to cigarette smoking.”

Using this estimate would indicate that more than 13 million Europeans suffer from a serious, chronic disease as a result of cigarette smoking.

3.5. Smoking and health inequalities

As we will read in Chapters 2 and 4, use of tobacco and poverty are now inextricably linked. This is a reversal of the earlier picture of the smoking epidemic in European countries, where smoking was common first among males and females in the higher socio-economic groups. In general, as they gave-up, poorer groups took up smoking. In most European countries, smoking is now more prevalent in lower socio-economic groups\textsuperscript{120}, which also have a higher burden of other risk factors\textsuperscript{121, 122}. In addition, in the UK, cessation rates are lower in the most disadvantaged groups, which may be linked to higher nicotine dependence among these smokers, even after adjusting for cigarette consumption\textsuperscript{123}.

Studies in Poland and the UK have demonstrated an association between poverty and an increase in tobacco-related mortality\textsuperscript{122, 124}. For example, in Poland, researchers have estimated that tobacco use is responsible for about two-thirds of the excess risk of death in
middle age for those with only primary-level education compared with those with university education.

3.6. Mortality and morbidity due to passive smoking across Europe

Estimates of the number of deaths caused by passive smoking are harder to derive than those for active smoking because of the difficulties in establishing the level of exposure over a lifetime (both at home and in the workplace). Some estimates of exposure have been made, however, and these are summarised below.

In the UK, in 1988, it was estimated that 42% of children and 21% of non-smoking adults lived in a household where at least one person smoked\(^7\). Given that smoking prevalences among adults in many other countries are higher than they are in the UK, this could result in a potentially high prevalence of exposure to tobacco smoke among children\(^1\).\(^2\)

Another study estimated that in the EU15, 79% of the population aged 16 years and above were routinely exposed to tobacco smoke pollution (39% often and 40% from time to time) in 1992\(^1\). A study of seven western European countries\(^f\) involving over 1,500 subjects surveyed between 1998 and 1994 about their exposure to second-hand smoke reported a similar proportion. This study found a combined estimate of passive exposure to tobacco smoke from a spouse or workplace of 79%\(^1\).\(^2\)

Exposure to tobacco smoke has decreased in some countries over recent years. A study in England found that exposure to passive smoking among children approximately halved from 1988 to 1998\(^1\).\(^2\). In addition, a study from Finland found that exposure to tobacco smoke at work decreased from ~20% in 1985 to ~6% in 2000\(^\).\(^1\)

Nevertheless, exposure is still extensive across many countries in Europe and, given the high background incidence of some of the relevant conditions both in adults (cardiovascular diseases) and in children (lower respiratory tract infections), even the small relative risks described earlier in this chapter translate into substantial levels of mortality and morbidity across Europe\(^1\).\(^2\). One study estimated that exposure to tobacco smoke caused 50,000-100,000 deaths in the former EU15\(^\).\(^2\)

Estimates of morbidity from passive smoking are even harder to make. For example, the WHO has estimated the proportion of lower respiratory tract illness in infants attributable to exposure to tobacco smoke as 15-26%, assuming that 35% of the mothers smoke at home, although the latter figure may be an overestimate\(^1\).\(^2\). When these estimates were applied to the population of the WHO European Region (51 countries) this resulted in between 300,000 and 555,000 episodes of lower respiratory illness in infants per year related to passive smoking\(^1\).\(^2\). Another recent review in England and Wales estimated that the percentage of childhood lower respiratory illness and middle-ear disease typically attributable to exposure to tobacco smoke from either parent smoking ranged from 9% for asthma prevalence and for referral for glue ear, to 25% for hospital admission for lower respiratory illness\(^1\).\(^2\)

As discussed earlier in this chapter, passive smoking can exacerbate underlying conditions. Given the high prevalence of some of these conditions in the population, many millions will be affected across Europe. Table 7 gives an estimate of the prevalence of conditions affected by passive smoking in the UK.

\(^f\) France, Germany, Italy, Portugal, Spain, Sweden and the UK.
All the risks from passive smoking are entirely preventable.

4. BENEFITS OF STOPPING SMOKING

No matter where you come from in Europe, or the world, stopping smoking is beneficial and has a dramatic effect. The British doctors study, using 50-year follow-up data, compared the survival of cigarette smokers who stopped with that of those who continued to smoke. Those who stopped before 35 years of age had a survival curve that did not differ significantly from that of never-smokers. Figure 24, from the British doctors study, shows the impact of stopping before the age of 44 years.

Table 7. - Prevalence of conditions affected by passive smoking in the UK

<table>
<thead>
<tr>
<th>GROUP AT RISK</th>
<th>PEOPLE AT RISK N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lung disease</td>
<td>8,000,000</td>
</tr>
<tr>
<td>Angina</td>
<td>2,100,000</td>
</tr>
<tr>
<td>Previous heart attack</td>
<td>1,300,000</td>
</tr>
<tr>
<td>Previous stroke</td>
<td>400,000</td>
</tr>
<tr>
<td>Females of childbearing age</td>
<td>10,800,000</td>
</tr>
<tr>
<td>Pregnant females</td>
<td>750,000</td>
</tr>
<tr>
<td>Children with asthma</td>
<td>1,500,000</td>
</tr>
</tbody>
</table>

Table modified from the British Medical Association.

Fig. 24. - Effects of survival for male doctors who stopped smoking aged 35-44, 1951-2001

Figure modified from Doll et al.
The effect of stopping, shown in figure 24, can best be seen by looking at a particular age. Thus, for example, at age 70, just under 60% of current smokers in the study were still alive, compared with about 80% of those who had stopped smoking by 45 years. This is not a small difference. Even at age 90 years the difference is still marked. Only ~5% of smokers are still alive compared with ~25% of those who had stopped by age 35, almost five times as many.

For those who stopped later, this study showed that survival was intermediate between that of never-smokers and that of continuing smokers. But even those who stopped at 65-74 years of age had age-specific mortality rates beyond 75 years that were appreciably lower than those occurring among doctors who continued to smoke. Furthermore, the benefit of stopping in late middle age or old age is probably underestimated in these analyses, as some of those who stopped in later life are likely to have done so specifically because they had already developed serious diseases caused by smoking. Thus, if they were taken out of the analysis, the survival rates for healthier smokers stopping at that age would likely be better.

As Doll et al.\textsuperscript{129} put it: “Even in middle age stopping smoking substantially increased the subsequent expectation of life.” Stopping smoking in middle age before developing cancer or some other serious disease avoids most of the later excess risk of death from tobacco use.

On the basis of this work Peto and colleagues have argued that if the goal is to reduce smoking-related disease in a population as quickly as possible, the most rapid results will be obtained by focusing on reducing the proportion of adults who continue to smoke, because this will alter patterns of disease within ~20-25 years. Encouraging and supporting adults to quit will itself help to deter children from taking up smoking.

As with the mortality data, it is possible to see that stopping smoking delays the onset of disease and disability; these data also show that stopping even in later life brings benefits.

The following findings are drawn from the 1990 US Surgeon General's report\textsuperscript{130} on the benefits of stopping. This concluded that the risk of serious disease starts going down immediately on quitting:

- in 20 hours carbon monoxide is eliminated from the body;
- in 3 days breathing becomes easier, the bronchial tubes begin to relax;
- in 3 months circulation improves;
- in 3-9 months lung function improves by ~10%;
- in 1 year the risk of heart attack falls to about half that of a continuing smoker;
- long-term stopping smoking reduces the risk of lung cancer, heart disease, strokes, chronic lung disease and other cancers.

Indeed Lightwood and Glantz\textsuperscript{131} found rapid improvements in heart disease and stroke from cessation of smoking; the excess risk of an acute myocardial infarction or stroke falls by ~50% within the first 2 years of stopping smoking. They estimated that a national programme reducing the prevalence of smoking by 1% per year in the USA would, in 1 year, result in a mean of over 900 fewer hospitalisations for acute myocardial infarction and over 500 for stroke, resulting in immediate savings of between $26 and 44 million. We recommend similar calculations be carried out for all European countries.
Even those who have survived an acute myocardial infarction benefit from stopping smoking, which can diminish their risk of a recurrent event by up to half over the first year.\textsuperscript{132}

In summary, stopping smoking has substantial immediate and long-term benefits to health for smokers of all ages. The excess risk of death from smoking falls soon after cessation and continues to do so for many years.

Of course, stopping smoking or indeed use of other forms of tobacco can be difficult, largely because of dependence on nicotine.

5. Tobacco use and nicotine addiction

Nicotine, delivered from tobacco through smoking or oral use, is an addictive drug and tobacco use is, for the majority of smokers, essentially a form of nicotine self-administration.\textsuperscript{115,133} The tobacco industry was aware of this in the early 1960s, as revealed by the following quotation from a general counsel to the tobacco company Brown & Williamson: “Moreover, nicotine is addictive. We are, then, in the business of selling nicotine, an addictive drug….”\textsuperscript{134}

The most common form of nicotine use is through cigarette smoking. Cigarette smokers have precise control of nicotine intake. The very rapid absorption of nicotine (once tobacco smoke is in the lungs, nicotine takes just 10 seconds to reach the brain) and the high blood levels that result, promote rapid and strong behavioural reinforcement from smoking. Tolerance to the toxic effects of nicotine, like nausea, develops rapidly and persists. The reinforcing effects of nicotine are renewed with each cigarette because the fall in nicotine level between cigarettes allows resensitisation of the nicotinic receptors in the brain. In summary, cigarettes are extremely efficient nicotine delivery devices which, combined with the pharmacokinetics of nicotine, promote a powerful physical and psychological addiction. How soon people smoke their first cigarette after waking is a measure of addiction. In the UK for example, just over one-third (34%) of smokers in the UK have their first cigarette within 15 minutes of waking.\textsuperscript{115}

There are two well known and widely used systems for classifying diseases that address the issue of tobacco use, the WHO’s International Classification of Diseases (ICD-10) and the American Psychiatric Association’s Diagnostic and Statistical Manual of Mental Disorders (DSM-IV). Both clearly classify tobacco use as an addiction and highlight the occurrence of a withdrawal syndrome as a key characteristic of addiction. The withdrawal syndrome, which can be severe, is one of the most important factors in maintaining smoking in individuals. Tobacco withdrawal symptoms include: anxiety, restlessness, poor concentration, irritability, depression, craving, decreased heart rate and increased appetite. Craving, the urge to smoke, is the clearest predictor of relapse to smoking in ex-smokers.

Looking just at data from nicotine users who have been through a treatment programme and stopped smoking emphasises this point from a different perspective. About 75% of those stopping smoking in intensive, professional treatment programmes will be smoking again one year later.\textsuperscript{115}

Finally, nicotine has been compared with other addictive drugs, according to several characteristics of addiction or causes of concern. The 1998 Report of the US Surgeon General concluded that: “the pharmacologic and behavioural processes that determine tobacco
addiction are similar to those that determine addiction to drugs such as heroin and cocaine\textsuperscript{130}, a finding endorsed by the English Royal College of Physicians in its report on nicotine\textsuperscript{115}.

Since cigarette smoking causes more deaths than these other drugs and yet tobacco is the most used psychoactive drug in the world after caffeine, we can summarise all these findings by saying that nicotine is a classic drug of addiction\textsuperscript{115}. However, despite this, stopping smoking is possible. Indeed, many millions of smokers in the EU have managed to give up smoking permanently.

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