

INTRODUCTION

Last year's 150th anniversary report, presented a wide range of information on the demographic statistics collated and published by GROS since the start of civil registration in 1855. However, though there was a section on deaths, space did not permit any consideration of cause of death. This chapter is designed to complete the picture. It looks at the background to the collection of information on cause of death. It gives information on long-term trends for selected broad groupings of diseases, including recent trends in some of the most important causes of death.

Table 2.1 presents a selection of statistics that highlights the dramatic changes that have occurred during the past 150 years.

BACKGROUND TO THE COLLECTION OF CAUSE OF DEATH INFORMATION

Since 1855, much information on cause of death has been published in the Registrar General's Annual Reports. Indeed, in some years, the reports contained several hundred pages of detailed statistical tabulations. However, for a number of reasons, it is not easy to interpret the long-term trends. This section highlights some of the problems of interpretation including coverage, quality of information, improvements in medical diagnosis and changes to the systems of coding and classification.

Coverage

Since the start of civil registration on 1 January 1855, it is believed that virtually all deaths occurring in Scotland have been registered, though, as will be seen below, some of the information collected on cause of death was far from perfect.

Uncertified deaths

Nowadays, cause of death details are invariably supplied by a registered medical practitioner or, following investigations of specific categories of deaths, a procurator fiscal. That was not always the case. Though information is not available for 1855, it is known that some 11 per cent of the deaths in Scotland in 1881 were uncertified and that in some rural areas the proportion was over 50 per cent. For uncertified deaths, registrars simply recorded the cause of death information supplied by the person registering the death. The cause of death information for most of these deaths was probably inaccurate or incomplete. By 1905, the proportion of uncertified deaths had dropped to 2.3 per cent. It fell below 1 per cent in 1922 and was only 0.02 per cent (15 deaths) in 1955.

Quality of information collected

In the earlier years, cause of death information was missing for a significant proportion of all deaths. For example, in 1855, no cause of death was recorded for 5,732 (9.2 per cent) of the 62,004 deaths. Moreover, vague terms were used in many of the other register entries. For example, 5,685 (9.2 per cent) were classified as being due to 'age', and a further 2,068 (3.3 per cent) were classified as being due to 'premature debility'. A study of the early Annual Reports reveals the use of many other imprecise terms.

By the turn of the century, the quality of information showed some improvement. For example, under the different classification used in 1905, the number of deaths classified as being due to 'old age' had fallen to 3,852 (5.2 per cent of the 74,536 deaths registered in that year). Nevertheless, a further 2,609 (3.5 per cent of the total) were classified to other 'ill-defined or not specified' causes. Fifty years later, the position had improved markedly. For the 61,645 deaths in 1955, the comparable figures were 839 (1.4 per cent) and 290 (0.5 per cent), respectively. And for the 55,747 deaths in 2005, the comparable figures were 210 (0.4 per cent) and 115 (0.2 per cent) respectively, with 20 of the 115 ill-defined deaths coded as 'sudden infant death syndrome'.

Definitions and classifications

Over the years, medical and scientific advances and improved diagnoses have meant that doctors can give ever more detailed and accurate information on cause of death. This has inevitably led to the need to review definitions and classifications. Moreover, subtle changes in terminology may also be observed. These facts make comparisons over time increasingly difficult. A simple example demonstrates these points. Only 871 deaths from cancer were recorded in 1855 whereas the total in 2005 was over 15,000. Even allowing for the smaller size and the younger age structure of the Scottish population at that time, the figure for 1855 is almost certainly an under-estimate of the true total. It is thought likely that many cancer deaths were classified to other causes, such as phthisis (consumption).

The first 'International Classification of Causes of Death' (ICD) was developed at the end of the nineteenth century. During the twentieth century, periodic revisions, latterly co-ordinated by the World Health Organisation (WHO), were produced almost every decade. The Second Revision was the first to be used in Scotland, in the Registrar General's Annual Report for 1911, and the later revisions were all adopted in turn. Since 2000, GROS has used the Tenth Revision of what is now called the International Statistical Classification of Diseases and Related Health Problems (ICD10). More details on the coding and classification of the cause of death information collected at death registration may be found in the **Annex** to this Chapter.

CHAPTER 2 – CAUSES OF DEATH

Table 2.1 Selected statistics on deaths and causes of death for 1855, 1905, 1955 and 2005

	1855	1905	1955	2005
Total deaths	62,004	74,536	61,645	55,747
Population ('000s)	2978.1	4592.6	5111.3	5094.8
Crude death rate (deaths per 1,000 pop.)	20.8	16.2	12.1	11.0
Infant deaths				
– number	11,691	15,275	2,811	284
– rate per 1,000 live births	125.2	116.2	30.4	5.2
Deaths of people aged under 5				
– number	22,671	23,952	3,222	344
– as a % of all deaths	36.6	32.1	5.2	0.6
Maternal deaths	493	450	43	4
Deaths of people aged 75 and over				
– number	7,906	9,102	23,453	33,306
– as a % of all deaths	12.8	12.2	38.0	59.7
Uncertified deaths	n/a	1,741	15	0
Old age	5,685	3,852	839	210
Other ill-defined cause or no cause stated	5,732	2,609	290	95
Selected infectious diseases				
Tuberculosis	10,007	9,619	982	49
Whooping cough	1,903	2,243	10	0
Measles	1,180	1,662	20	0
Circulatory disorders	2,006	12,173	32,944	20,060
Cancer	871	4,132	10,585	15,135
Selected respiratory diseases				
Pneumonia	2,094	6,672	1,828	2,483
Bronchitis	3,036	4,821	2,086	98
Influenza	n/a	912	212	11
Accidents and injuries (external causes)	1,913	2,949	2,920	2,212
Transport – road	n/a	315	635	294
Burns/scalds	311	328	144	53
Drowning (incl. suicide/undetermined)	440	552	260	91
Homicides	n/a	26	25	80
Suicides (excl. undetermined)	103 ¹	305	394	547

¹ 1856 data.

TRENDS, 1911 – 2005 BY BROAD GROUPING

Data and methods

Because of the constantly improving range and quality of the information and the changing classifications used to tabulate data on cause of death, consideration of long-term trends is far from straightforward. This is particularly true for the nineteenth century data but it is still difficult for the first half of the twentieth century. However, building on work done by the Office for National Statistics and others (*Griffiths C and Brock A, Twentieth Century Mortality Trends in England and Wales, Health Statistics Quarterly, 18, 2003*) it has been possible to prepare trend data covering the period 1911-2005 for broad groupings of diseases that essentially equate to current ICD Chapters. As would be expected from the evolutionary nature of the ICD classifications, it was not always possible to select exactly equivalent codes, but the groupings chosen are adequate for consideration of broad trends. The precise ICD2 – ICD10 codes included in each grouping are not reproduced here, but they may be obtained by contacting 'Statistics Customer Services' on the GROS website (<http://gro-scotland.gov.uk/contacts/contact-form.html>) or in the ONS article referred to above. The causes of death illustrated in this Chapter accounted for some 50,000 deaths in 2005 – about 90 per cent of all deaths.

The trends are presented as charts of age-standardised rates per 100,000 population showing males and females separately. The information on deaths by age, sex and cause comes from the Annual Reports of the Registrar General and the population denominators are taken from the mid-year population estimates. The latter are based on the decennial censuses of population and take into account any revisions made following subsequent censuses. Finally, the rates have been directly age-standardised using the European Standard Population. This technique removes the effect of changing age and sex distributions in the population by applying the observed age/sex mortality rates to a standard, fixed population structure.

Despite the difficulties of comparison, one theme dominates the earlier years – the reduction in the number of deaths caused by infectious diseases. For this reason, some additional information on the major epidemic diseases is presented. And because diagnosis and reporting of these diseases was relatively straightforward, it has been possible to incorporate data from 1855-1910.

Infectious diseases

Figure 2.1 Infectious diseases – Age standardised mortality rate (per 100,000), 1911-2005

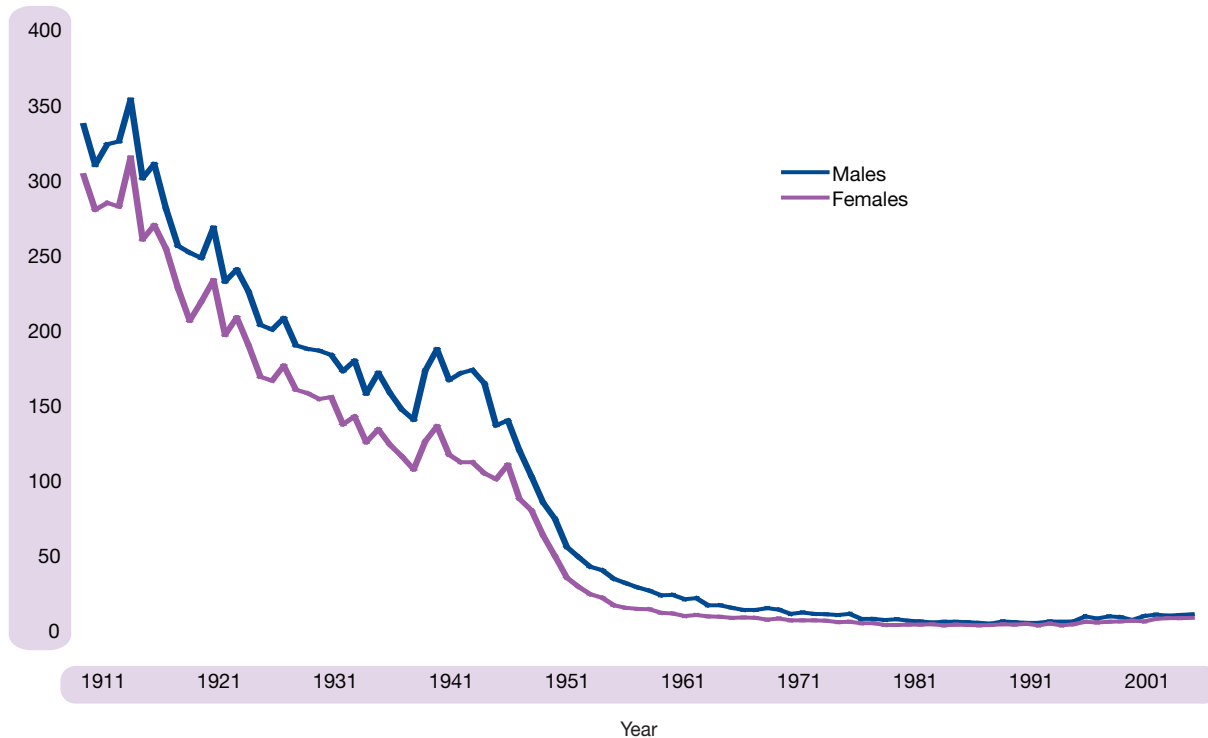
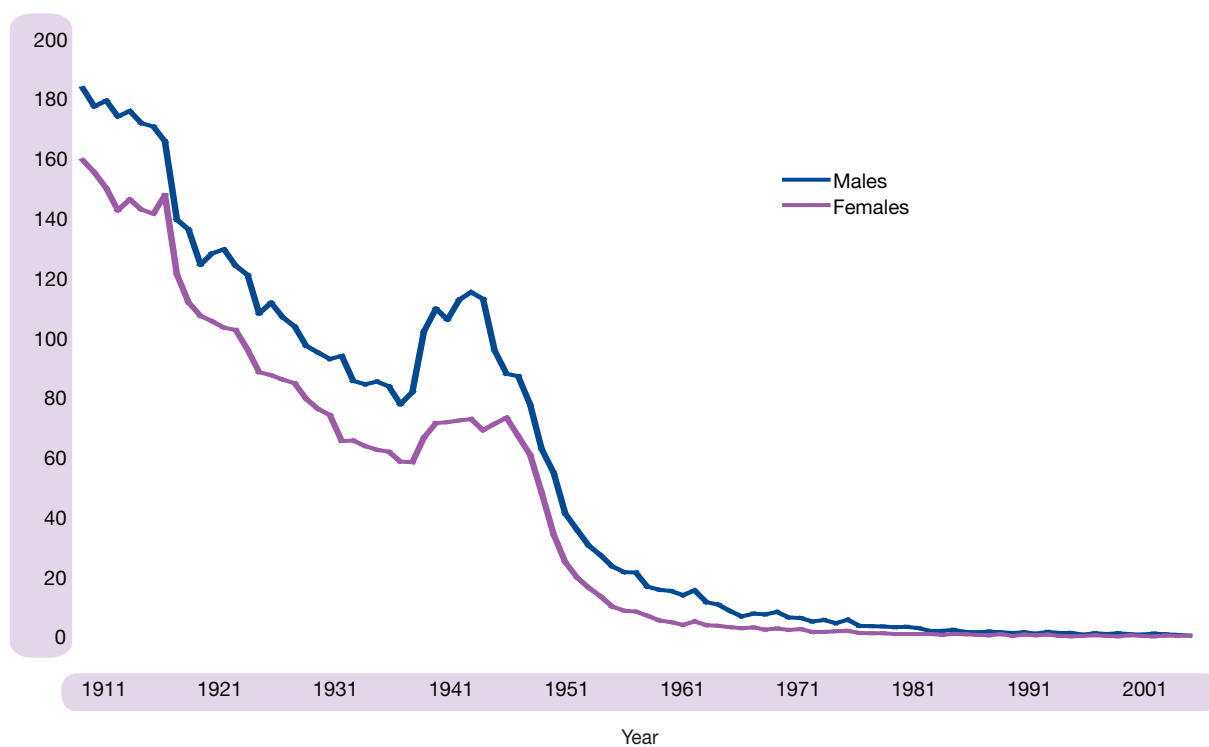


Figure 2.1 clearly shows the dramatic decline in infectious disease mortality that took place in the twentieth century. A substantial component of this disease grouping is tuberculosis, so it is not surprising that the changes for tuberculosis alone (**Figure 2.2**) follow a similar pattern, with a long-term decline briefly interrupted by a temporary increase around the time of the Second World War. The steep fall in the 1950s is associated with the use of the BCG vaccine and more effective antibiotics.

Figure 2.2 Tuberculosis – Age standardised mortality rate (per 100,000), 1911-2005



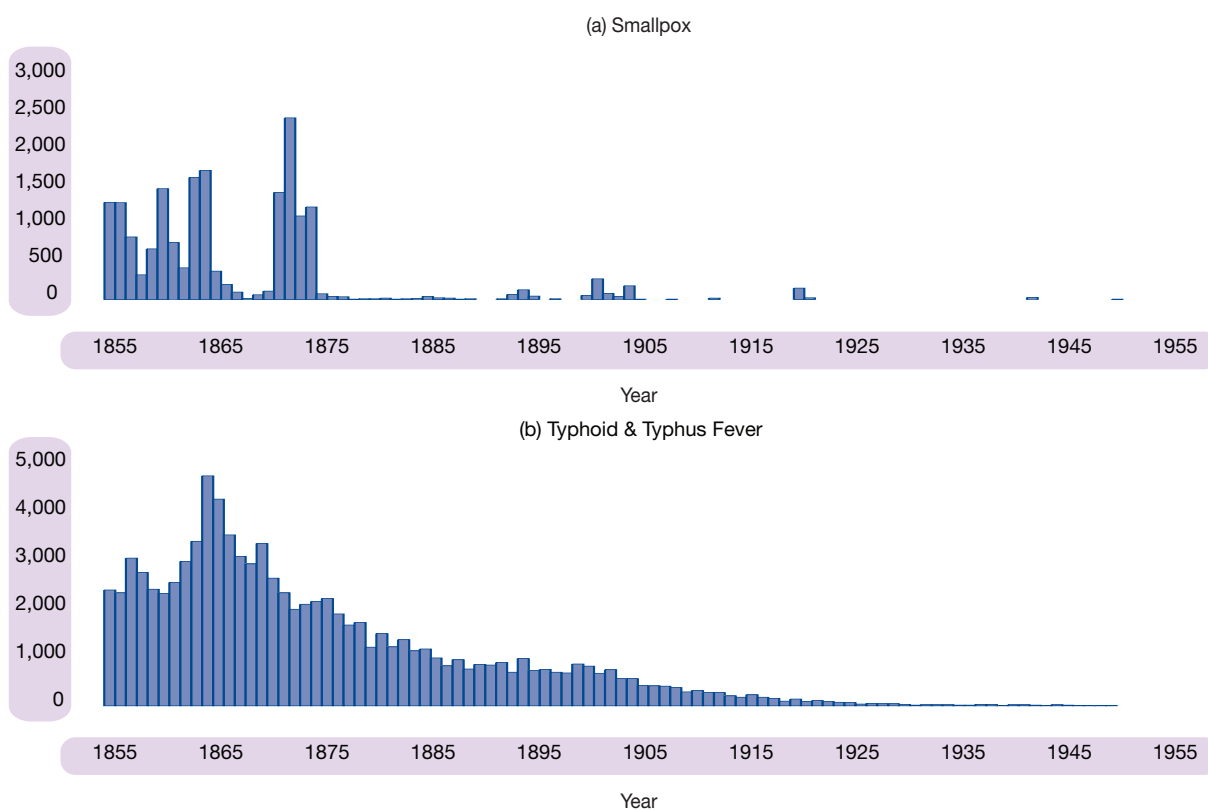
CHAPTER 2 – CAUSES OF DEATH

There were also substantial improvements for other epidemic diseases. These can be seen in **Figure 2.3 (a-f)** which displays the numbers of deaths from selected epidemic diseases over the period 1855-1955. For some diseases (e.g. smallpox) the reductions were brought about by better treatment or vaccination whereas for others (e.g. typhoid and typhus fever) the reductions were related to more general public health measures such as improved sanitation. Several of the charts, notably those for measles and whooping cough, display continued high levels of mortality well into the twentieth century. Indeed it was not until the second half of the twentieth century, and widespread childhood immunisation, that steady low levels were attained.

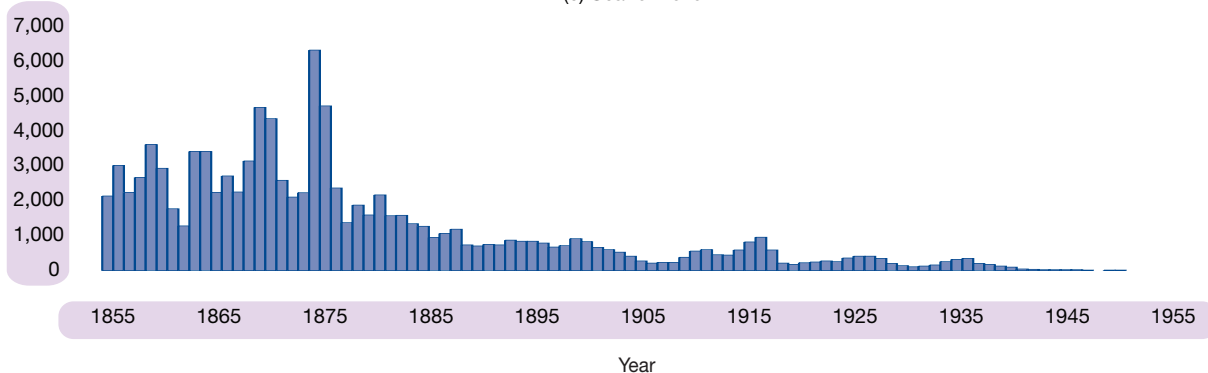
In the earlier years, many of these diseases took a high toll among infants and other young children. In 1905, for example, 96 per cent of deaths from whooping cough and 93 per cent of deaths from measles involved children aged under 5. The substantial falls in the infant mortality rate during the twentieth century are, in large part, due to the eradication of such deaths.

The last 20 years or so have seen a small though significant rise in the number of deaths from infectious disease. Though a small part of this increase will be due to the inclusion of deaths from HIV/AIDS, the main reason for the more recent rise is an increasing number of deaths attributed to bacterial septicaemia. Some of these will have been the result of ‘hospital acquired infections’.

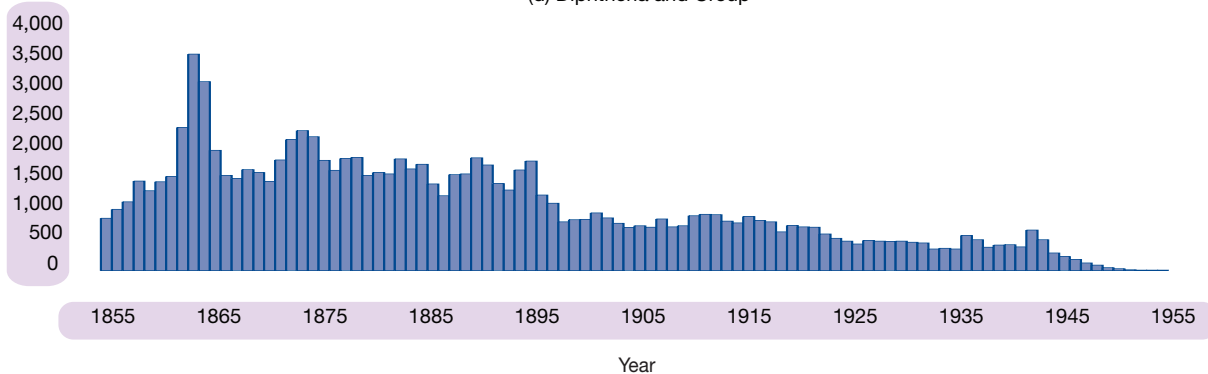
Figure 2.3 a-f: Deaths from selected epidemic diseases, Scotland, 1855-1955



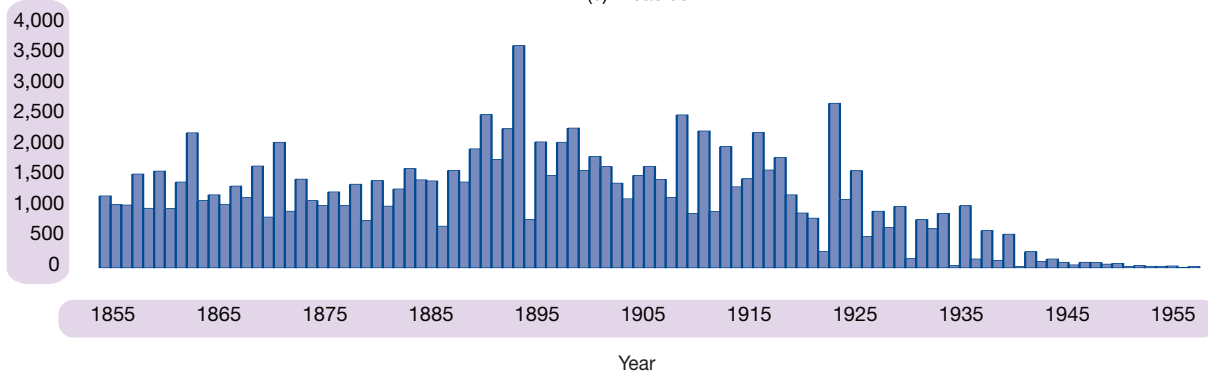
(c) Scarlet Fever



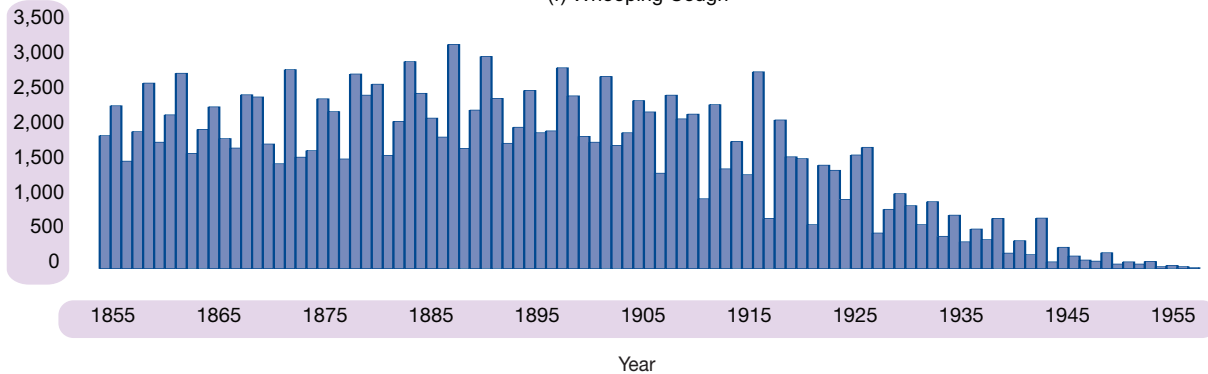
(d) Diphtheria and Croup



(e) Measles

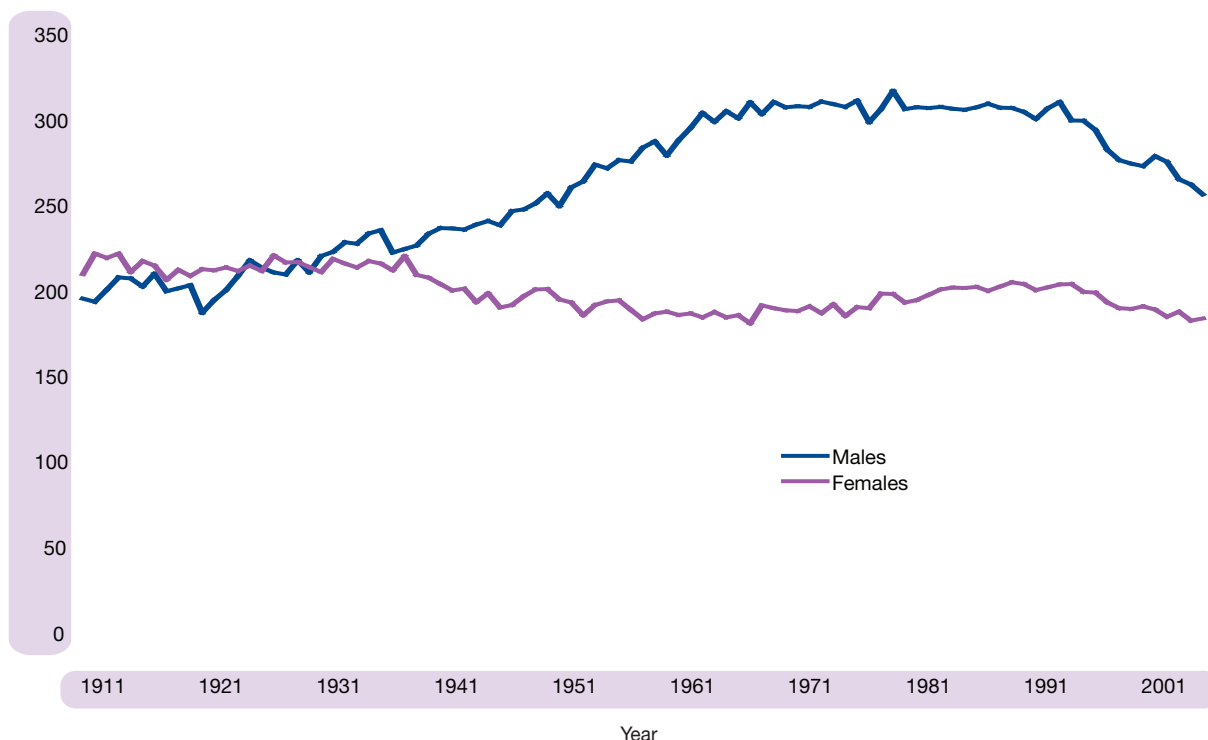


(f) Whooping Cough



Cancer (Neoplasms)

Figure 2.4 Cancer – all types – Age standardised mortality rate (per 100,000), 1911-2005



Though cancer has been recognised as a disease for thousands of years, it is generally accepted that it was under-diagnosed in the nineteenth century and that diagnosis was unreliable until the middle of the twentieth century. **Figure 2.4** shows that the recorded death rates from cancer (all types) were broadly similar for men and women at the start of the twentieth century. However, those for men increased significantly from the 1920s to the 1960s whilst those for women dipped slightly. From the 1960s to the 1990s the rates for men were broadly steady whilst those for women rose slightly. The last decade or so has seen a fall in the rates for both sexes, but particularly for men.

To understand these patterns it is necessary to consider trends for the main types separately. For many types of cancer, individual ICD codes were not introduced until the Fifth Revision (used from 1940); and there was a further rationalisation of key codes in the Sixth Revision (used from 1950). For these reasons, the trends for specific types of cancer presented in **Figures 2.5a** and **2.5b** focus on the period since 1950.

Figure 2.5a Cancers – males – Age standardised mortality rate (per 100,000), 1950-2005

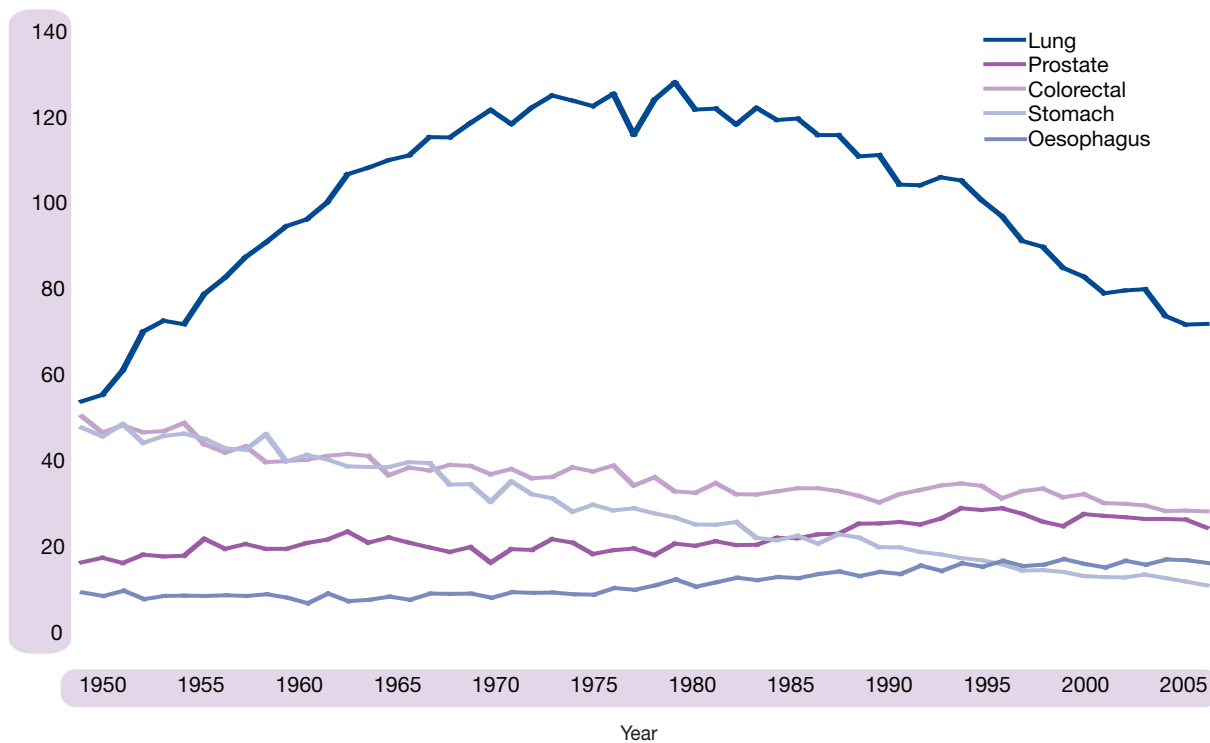
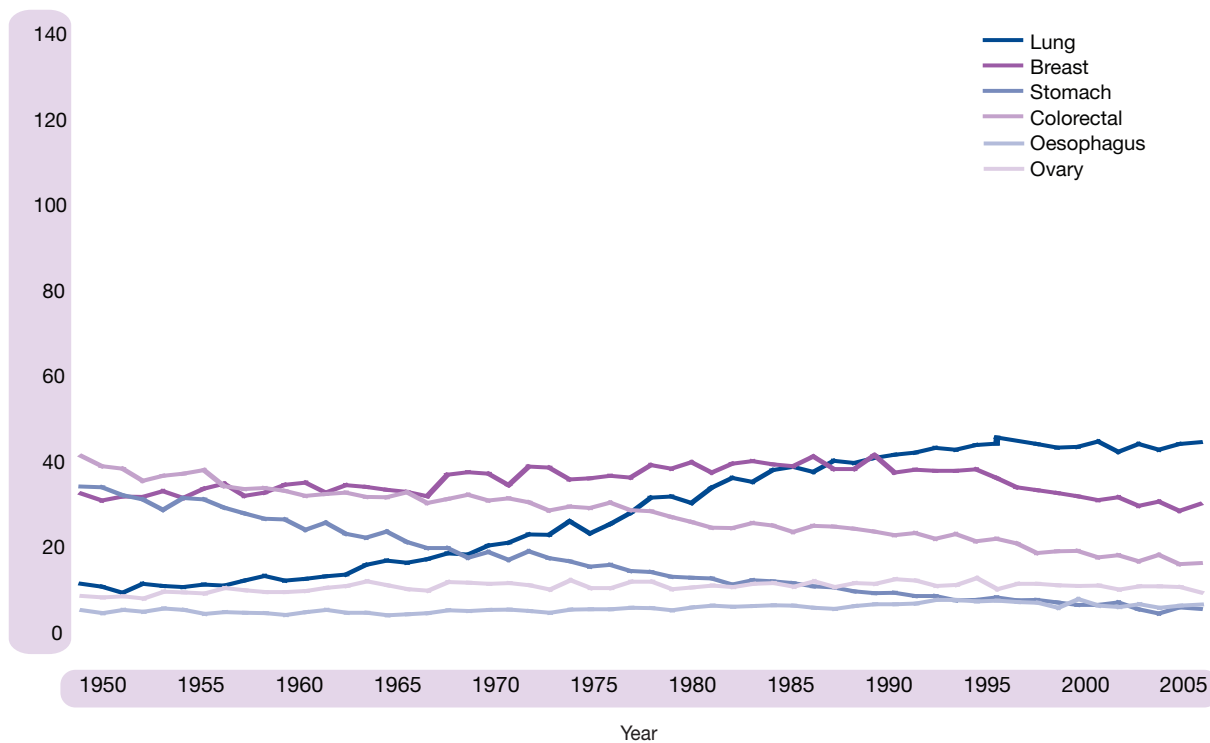


Figure 2.5b Cancers – females – Age standardised mortality rate (per 100,000), 1950-2005



Figures 2.5a and **2.5b** show that, for both sexes, mortality from cancer of the trachea, bronchus and lung (collectively referred to as 'lung') is currently dominant. Though lung cancer was a relatively rare disease at the beginning of the twentieth century, it is now the most common cause of cancer death in the world. In Scotland in 2005 it accounted for 2,195 (8.3 per cent) of all male deaths and 1,814 (6.2 per cent) of all female deaths.

Perhaps the most striking feature revealed by the charts is the differing trends in lung cancer rates for men and women over the last 50 years. Whilst that for men rose rapidly to a peak in the 1970s before falling rapidly since, that for women increased more slowly up to the mid-1990s before levelling off at its current level. The links between cigarette smoking and lung cancer are well established and it is believed that these different patterns can be explained by the differing timing of take-up and cessation of smoking by men and women during the twentieth century.

Figures 2.5a and **2.5b** show that, for both men and women, the rates for stomach cancer, and to a lesser extent colorectal cancer, have declined steadily over the past fifty years. However, those for oesophageal cancer are increasing, particularly for men. Cancer of the oesophagus is known to be associated with smoking, but a more powerful link with alcohol consumption is believed to be the reason for its recent increase amongst men.

For men, the last fifty years have also seen a steady increase in mortality from prostate cancer, though the majority of the deaths are of men aged 75 and over. For women, the rate for breast cancer, having risen slowly for several decades, was overtaken by that for lung cancer around the mid-1980s and has since shown a gentle decline. **Figure 2.5b** also shows that the rate for ovarian cancer increased slightly between 1950 and 1970 but has remained broadly stable since then.

Diseases of the circulatory system

Figure 2.6 Circulatory diseases – Age standardised mortality rate (per 100,000), 1911-2005

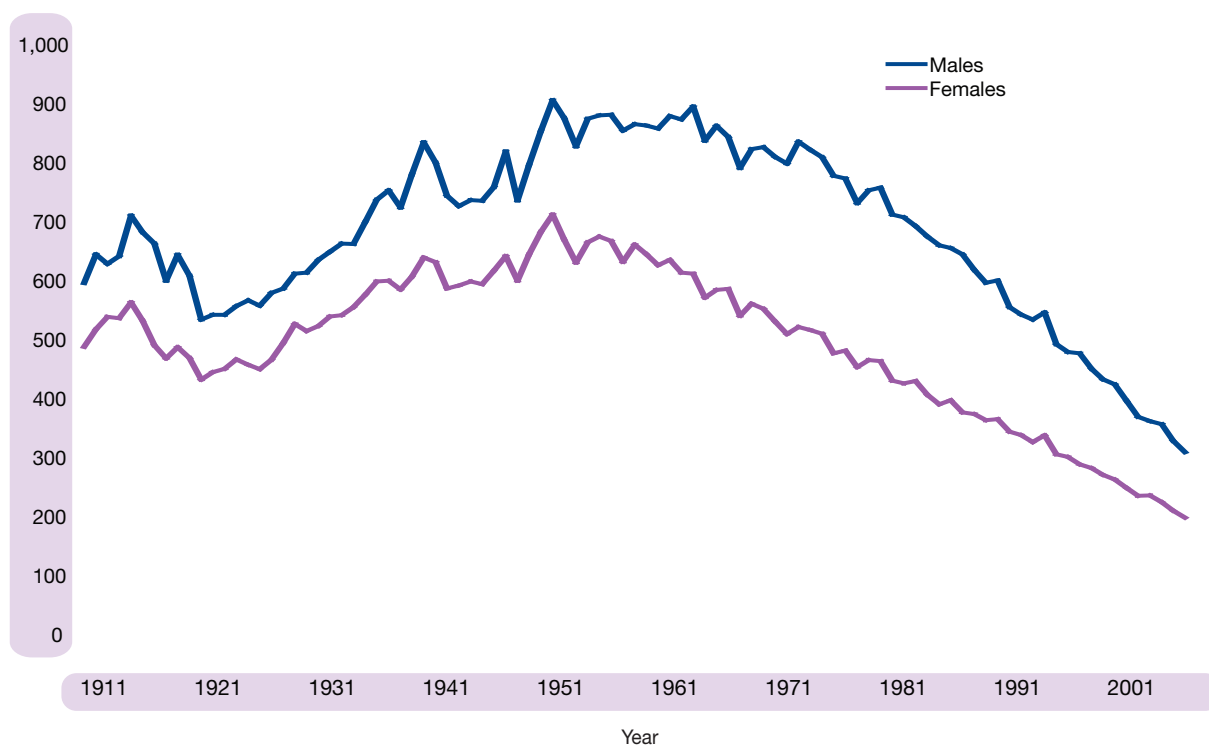


Figure 2.6 shows how, for both sexes, death rates from circulatory diseases first rose and then fell during the twentieth century. Having peaked around the 1950s, the rates for men have fallen steadily for the last forty years. Those for women followed a similar pattern, though the decline in the rates started a few years earlier.

In 2005, diseases of the circulatory system accounted for some 36 per cent of all deaths in Scotland, a significant fall from the period 1950-1985 when they accounted for over 50 per cent of deaths. These high levels are believed to have been partly due to smoking.

Currently, some 80 per cent of the deaths classified to this grouping belong to two specific disease categories – ischaemic (or coronary) heart disease and cerebrovascular disease (or stroke). In 2005 these two categories accounted for 52 per cent and 29 per cent respectively of the relevant ICD Chapter (Diseases of the Circulatory System). **Figures 2.7** and **2.8** display how the mortality rates for ischaemic heart disease and stroke have improved substantially over the last 50 years. Whilst the male rate for stroke is only slightly higher than that for females, it can be seen that a substantial differential still exists for deaths from ischaemic heart disease.

CHAPTER 2 – CAUSES OF DEATH

Figure 2.7 Ischaemic heart disease – Age standardised mortality rate (per 100,000), 1950-2005

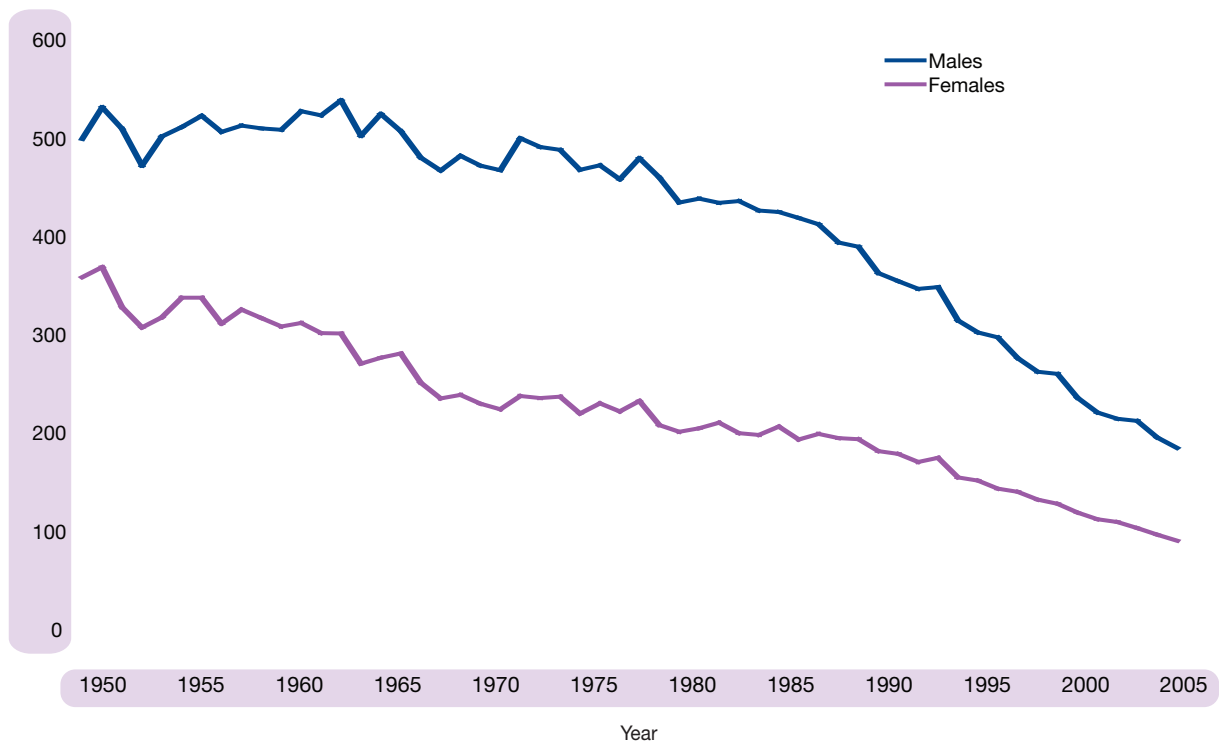
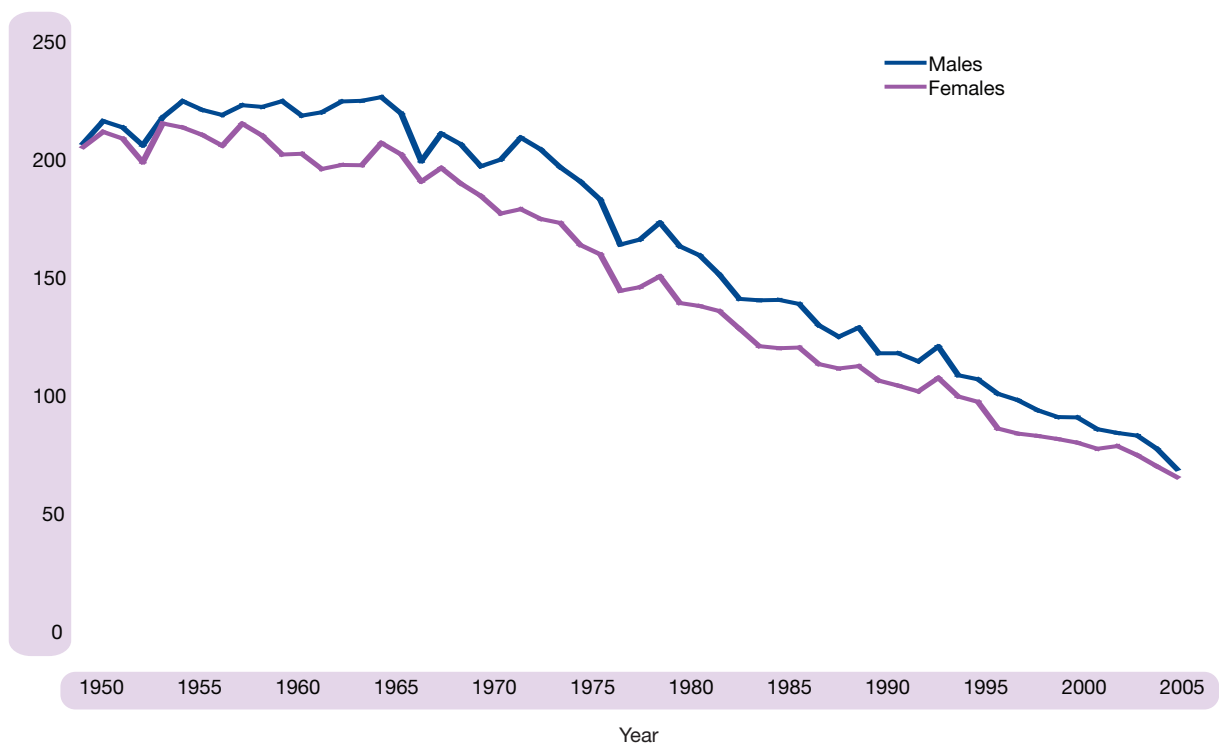


Figure 2.8 Stroke – Age standardised mortality rate (per 100,000), 1950-2005



After cancer (all types), coronary heart disease (CHD) and stroke are now the biggest causes of death in Scotland. In 2005, they accounted for 18.5 per cent and 10.4 per cent of all deaths. However, in recent years, there has been a dramatic fall in the level of premature deaths from these diseases. To ensure that these improvements continued, the Scottish Executive, in the 1999 public health White Paper *Towards a Healthier Scotland*, set targets to halve the death rates between 1995 and 2010 from CHD and stroke in those aged under 75. And in 2004 the target for CHD was increased to a 60 per cent improvement. The improvements between 1995 and 2005 shown in **Figures 2.9a** and **2.9b** suggest that both targets will be met.

Figure 2.9a Ischaemic (coronary) heart disease, age under 75
Standardised death rates per 100,000 population, Scotland, 1995-2005

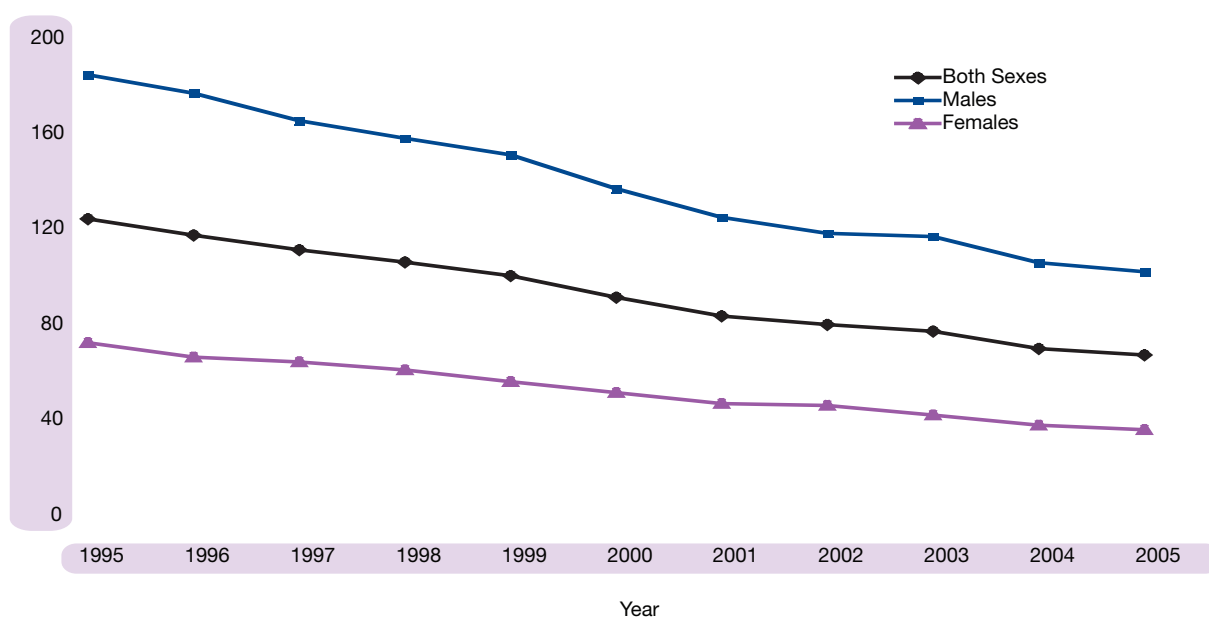
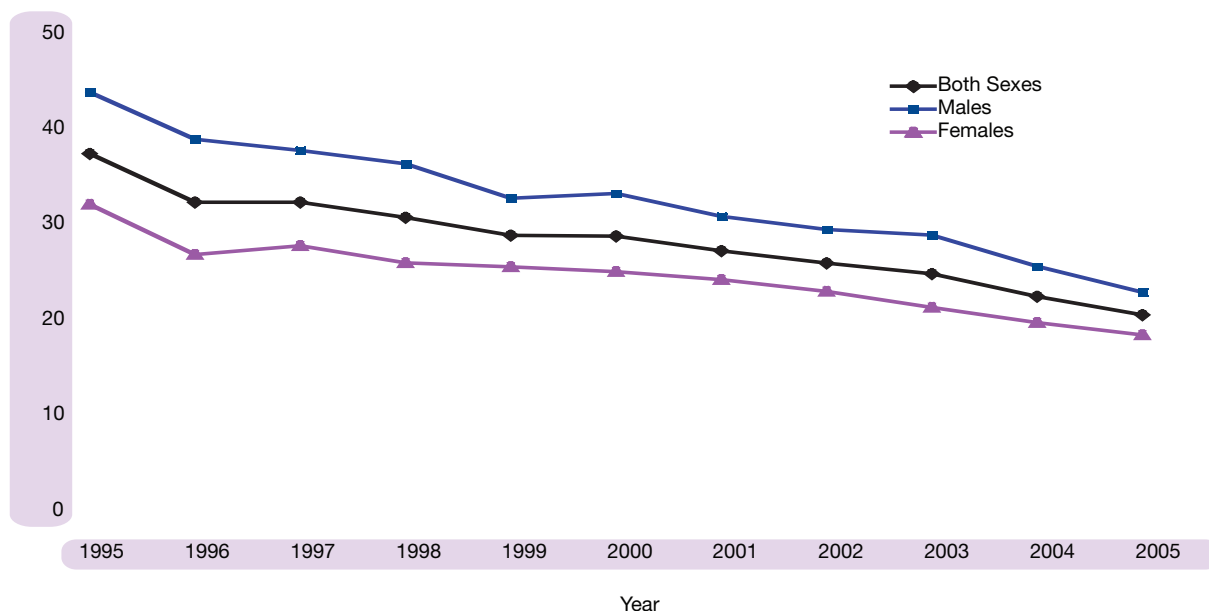
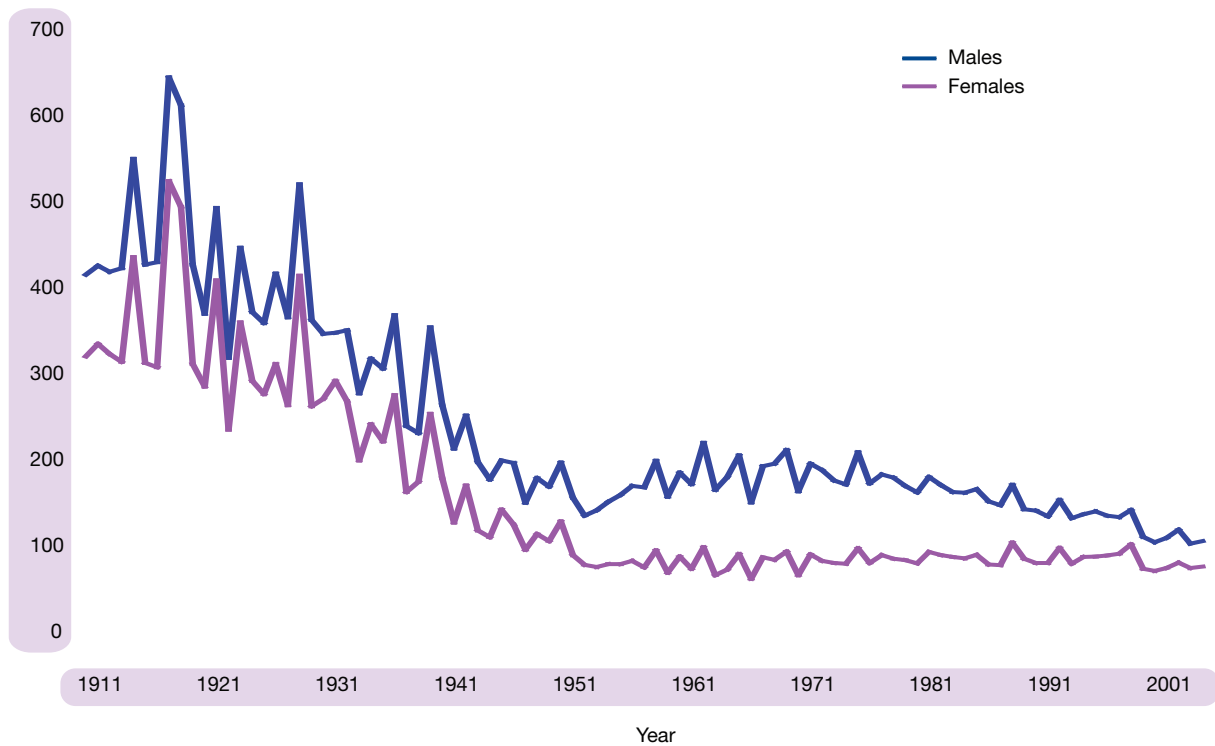


Figure 2.9b Cerebrovascular disease (stroke), age under 75
Standardised death rates per 100,000 population, Scotland, 1995-2005



Diseases of the respiratory system

Figure 2.10 Respiratory diseases – Age standardised mortality rate (per 100,000), 1911-2005



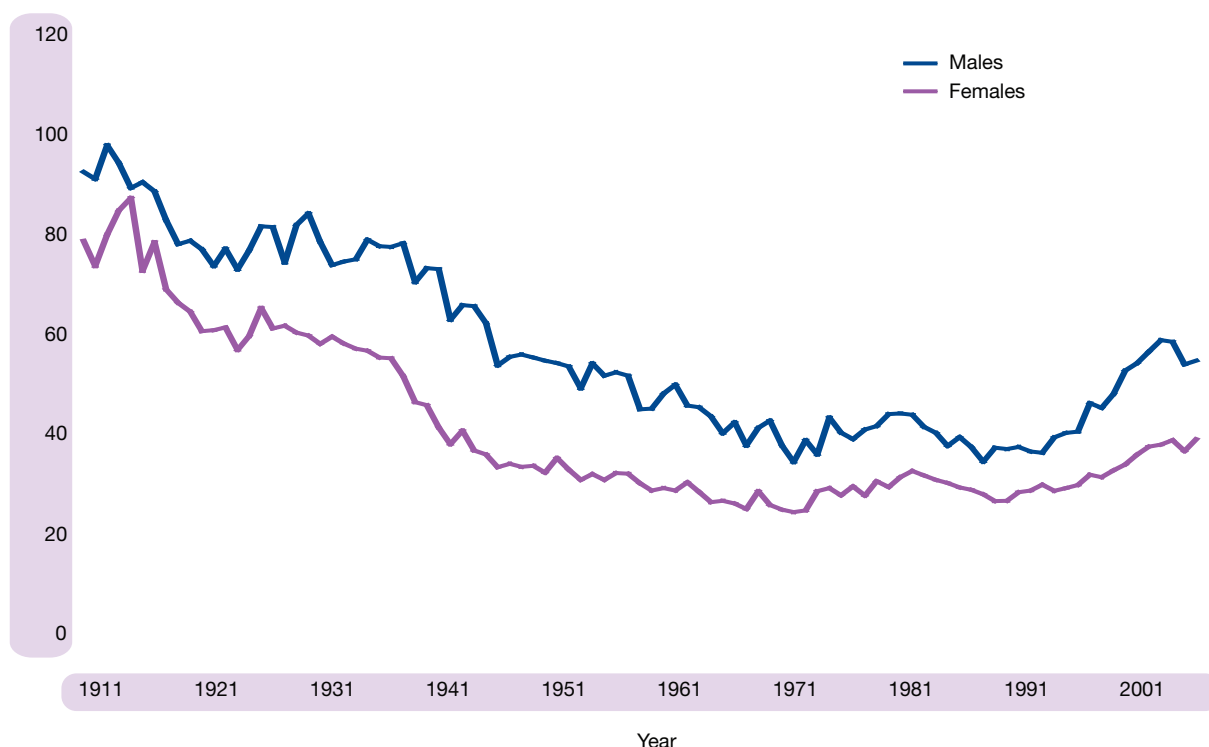
For the first half of the twentieth century, mortality rates from respiratory diseases fell significantly for both sexes, thereafter remaining broadly constant for women but rising slightly for men during the 1950s before falling again by the end of the century. This rise in the male rates is thought to be mainly due to smoking related diseases, such as bronchitis and emphysema, and occupational diseases, such as pneumoconiosis. A minor fall in the rates for both sexes from 2000 is associated with a change in the coding rules that were implemented when ICD10 was introduced. (Further information on this aspect may be found in Appendix 2 of the Registrar General's Annual Report for 2000.)

A particular feature of **Figure 2.10** is the significant year-to-year fluctuation seen within the overall trend. This generally reflects the different levels of influenza activity in different years, with high levels leading to a marked increase in deaths from various respiratory diseases. The most striking example of this was the influenza epidemic of 1918-19. It has been estimated that between 20 and 50 million people died worldwide as a result of the 'Spanish 'flu' pandemic. Scotland did not escape its share of this toll. The Registrar General's Annual Report for 1919 contained a special supplement entitled 'The mortality in Scotland resulting from the influenza epidemic of 1918-19'. Some of the key points to emerge were:

- a) Over the 10-month period July 1918 – April 1919, 17,575 deaths were recorded as due to influenza, either solely (2,876) or in conjunction with some other named cause (14,699).
- b) Of those where another cause was recorded, 11,236 mentioned pneumonia and 1,249 mentioned bronchitis.
- c) Taking account of increases in other causes with no mention of influenza, it was estimated that the true total of deaths caused by the epidemic was probably around 22,000, though it may have been even higher.
- d) Unusually, 50 per cent of the deaths involved people aged 15-44 (it was more usual for influenza epidemics to increase mortality among the elderly and, to some extent, the very young).
- e) The mortality exceeded that of any previous epidemic of any infectious disease (the next highest total being for a scarlet fever epidemic in 1874-75 which claimed some 11,000 lives).

Diseases of the digestive system

Figure 2.11 Digestive diseases – Age standardised mortality rate (per 100,000), 1911-2005



The main categories covered by this broad grouping (Figure 2.11) are liver disease, ulcers, and intestinal diseases. Until the last thirty years or so, mortality rates from these diseases showed a steady decline. Having levelled off during the 1970s and 1980s, there have recently been significant rises for both sexes, particularly men. These recent increases are essentially due to increasing mortality from cirrhosis of the liver, related to excessive alcohol consumption.

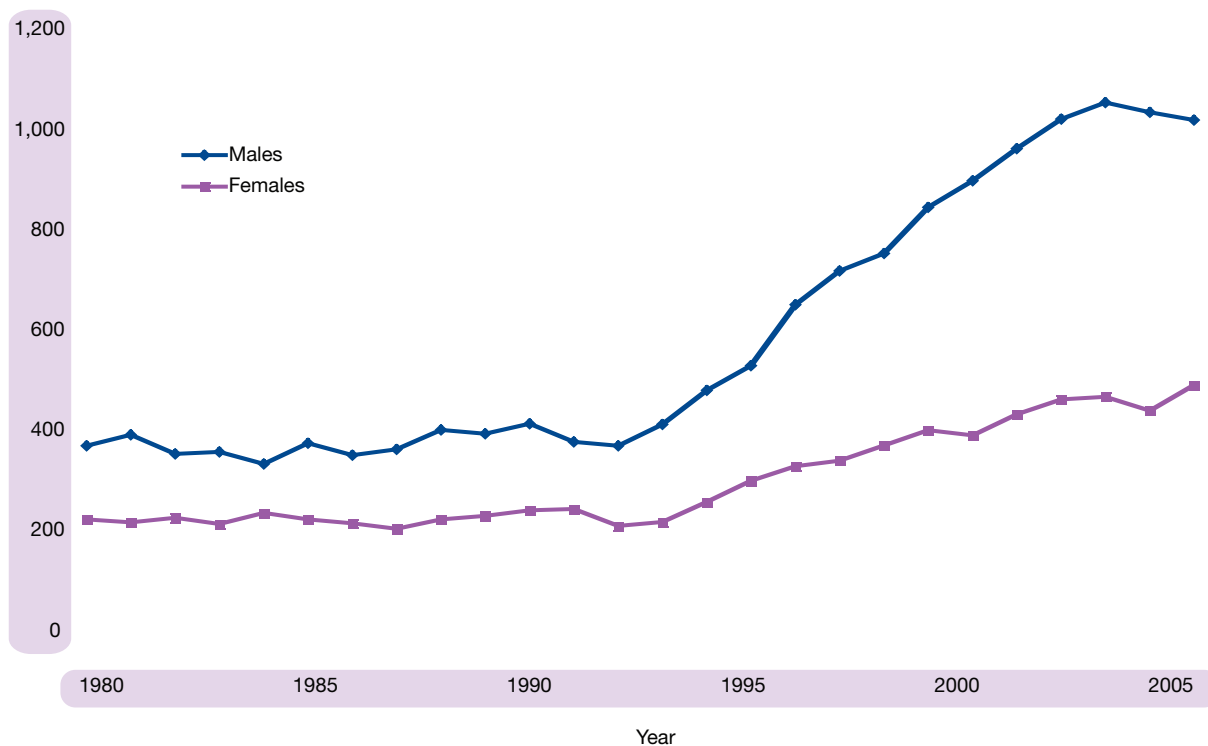
Alcohol-related deaths

As well as alcoholic liver disease, there are numerous causes of death that are considered to be 'alcohol-related'. The main additional category is 'mental and behavioural disorders due to use of alcohol'. There are several other causes that are specifically alcohol related (e.g. alcoholic pancreatitis) as well as some (e.g. oesophageal cancer) where alcohol consumption is only responsible for a proportion of deaths. Following wide consultation, the Office for National Statistics (ONS) recently proposed a new selection of diseases to be used for high-level public health monitoring of alcohol-related deaths (see **Appendix 2**, Notes and Definitions).

Figure 2.12 shows the number of deaths in Scotland since 1980 using this new definition. The trends for both sexes were relatively stable during the 1980s, but there have been significant increases, particularly for men, since the early 1990s. Further analysis of the data shows that deaths have generally been rising in all age groups, with the largest increases being among those aged 45-59.

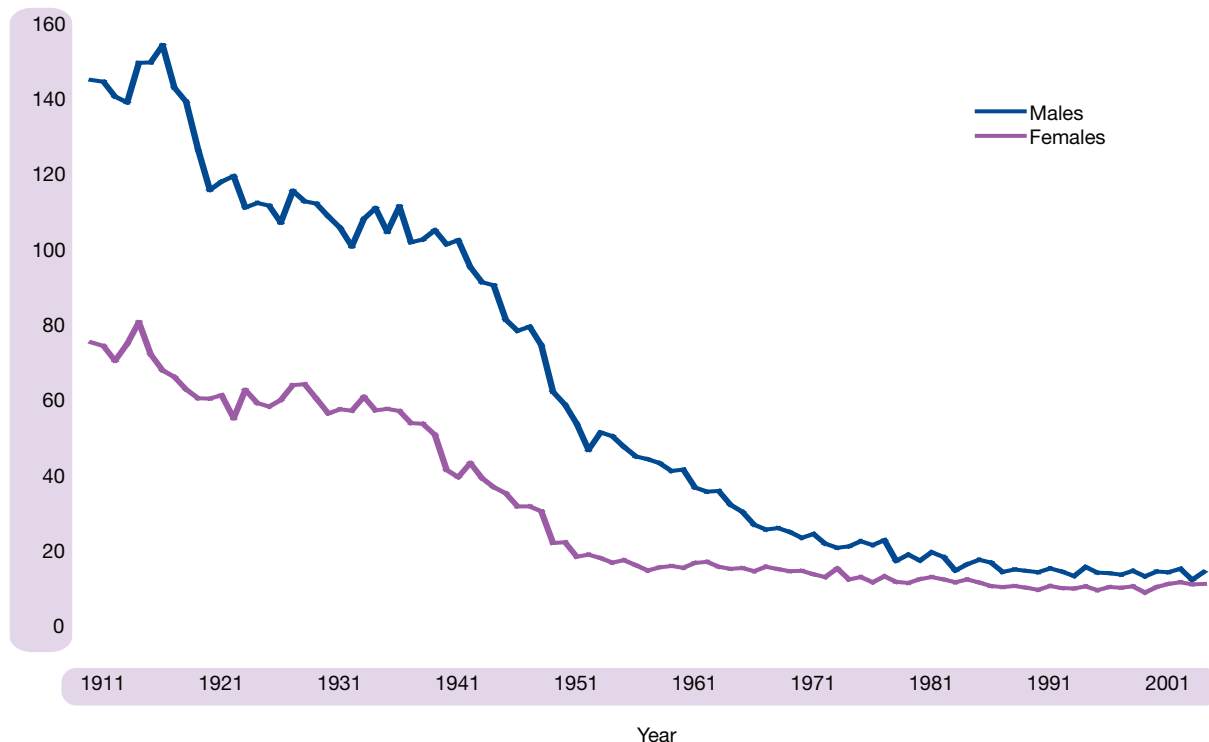
The reasons underlying these changes are not fully understood, but changing social attitudes, increased affluence and relative price levels, and licensing changes are all thought to have contributed to increased alcohol consumption.

Figure 2.12 Deaths from alcohol-related diseases, Scotland, 1980-2005



Diseases of the genitourinary system

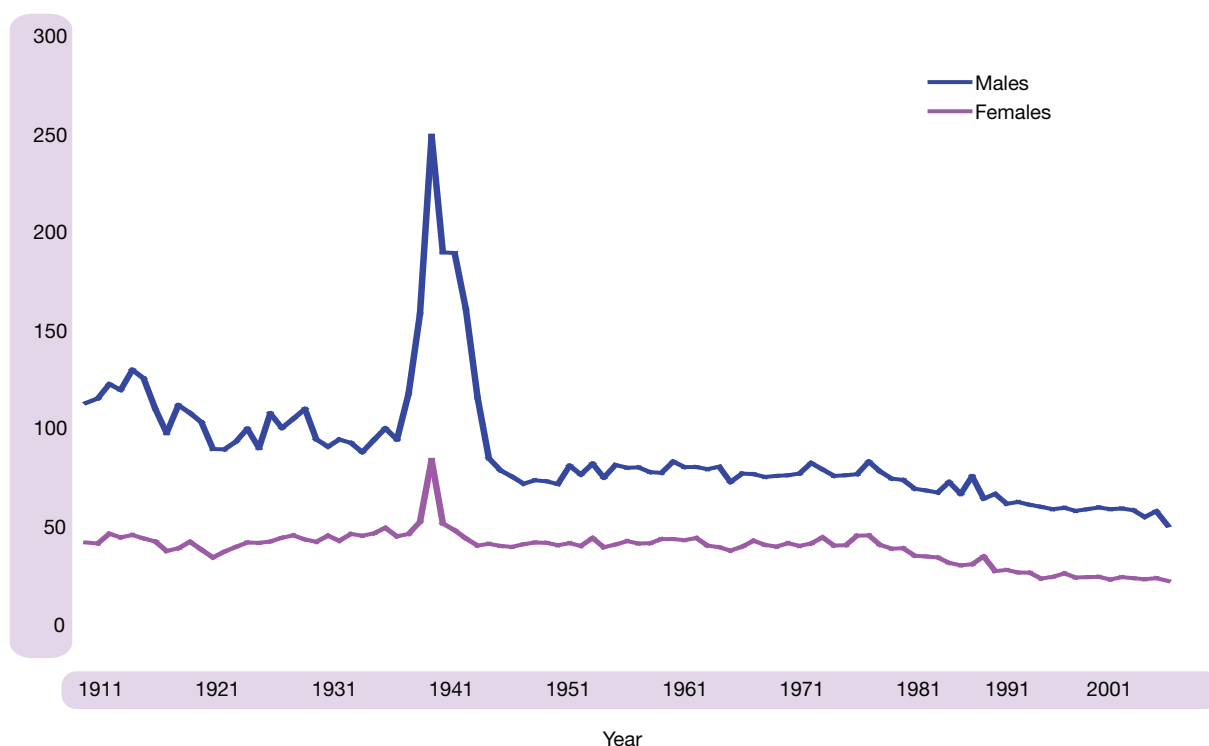
Figure 2.13 Genitourinary diseases – Age standardised mortality rate (per 100,000), 1911-2005



The main category associated with this grouping is renal failure. **Figure 2.13** reveals a significant fall over the twentieth century, particularly for men, with a significant narrowing of male/female differential. Since 1911 the proportion of deaths allocated to this grouping has fallen from 4 per cent to under 2 per cent. This is mainly due to fewer deaths from kidney infection and nephritis.

Injury and poisoning (external causes of mortality)

Figure 2.14 Injury and poisoning – Age standardised mortality rate (per 100,000), 1911-2005



As well as accidents, this Chapter (External Causes of Mortality) includes suicides and homicides (and, more recently, deaths where the intent could not be determined). **Figure 2.14** shows that, apart from the period of the Second World War, there has been a slow but steady decline in the standardised death rates from injury and poisoning mentioned in this Chapter. With the exception of the war years, this grouping has generally accounted for between 4 and 5 per cent of all deaths.

As with all other groupings, only deaths occurring in Scotland were included in these analyses. The increase in the rates during the Second World War reflects a combination of factors including deaths amongst returning wounded, deaths associated with air raids and military activities in Scotland, and a significant increase in road accident deaths (particularly those involving pedestrians) caused by the imposition of blackout regulations.

Road traffic accidents have always been an important part of this grouping, though recently they have declined substantially. In fact, despite increased vehicle ownership and use of cars, they are at a historically low level. In 2005 they numbered 294, less than half the number 50 years ago and slightly less than the 315 deaths from horse or vehicle accidents recorded in 1905.

Other changes over the last hundred years or so include significant decreases in the number of drownings and also deaths from scalds and burns. However, there have been increases in deaths from accidental falls (mainly among the elderly), and from suicides and homicides. It should be emphasised that definitional and reporting issues make long-term comparisons difficult for all three of these categories.

Suicides

The Registrar General's Annual Report for 1856 was the first to report a figure for suicides. The total given was 103, though it was recognised that this was almost certainly an under-estimate of the true figure. Since then the recorded totals have increased substantially, to 305 in 1905, 394 in 1955 and 547 in 2005 (see **Table 2.1**). Throughout, conclusive proof was required for a death to be classified as a suicide.

The Eighth Revision of the ICD, introduced in Scotland in 1968, included a new category of 'Injury undetermined whether accidentally or purposely inflicted'. As it is believed that the overwhelming majority of deaths classified to this category are probable suicides it is now conventional to include these 'undetermined' deaths when considering data on suicides. Before 1968, most such deaths would have been classified as accidents.

Figure 2.15 Suicides and undetermined deaths, Scotland, 1980-2005

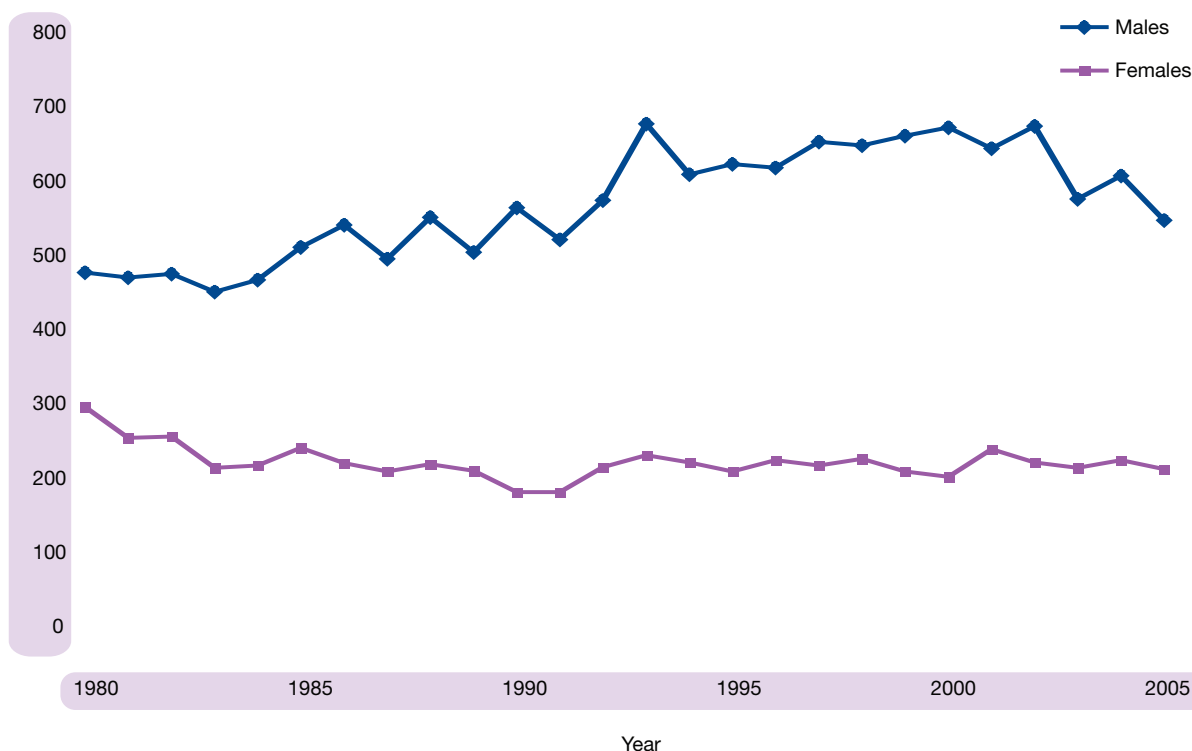


Figure 2.15 shows the number of deaths from the combined categories since 1980. Following a modest initial decline, the number of suicides among women has remained relatively constant at just over 200 a year. However, the totals for men rose to a peak of almost 700 in 1993, and remained over 600 until 2002. Since then, there has been a sharp fall to around 550 in 2005. Of particular concern has been the fact that for men, the highest rates have been amongst those aged 15-44.

In December 2002, the Scottish Executive launched 'Choose Life', a national strategy and action plan to prevent suicide in Scotland. Further information about Choose Life and more detailed statistical analyses may be found on the Choose Life website (www.chooselife.net).

Other ICD Chapters not shown in graphs

Because of problematic coding and classification issues, or the small numbers of deaths involved, a number of the current ICD Chapters have been omitted from the more detailed presentations in this Chapter. Some brief comments on the larger of these other ICD Chapters are given below.

Mental and behavioural disorders: there were 2,454 deaths in this grouping in 2005, 4.4 per cent of all deaths. The bulk of the deaths fall into three categories – dementia (1,835), alcohol dependence (343) and drug dependence (217). All three are particularly difficult to compare over time. Some comments about recent trends in alcohol-related diseases were included in an earlier section of this Chapter, following the comments on diseases of the digestive system. More information about drug-related deaths may be found in the annual papers prepared by GROS on this subject (<http://www.gro-scotland.gov.uk/statistics/library/drug-related-deaths/index.html>).

Diseases of the nervous system: this Chapter accounted for 1,300 (or 2.3 per cent) of the deaths in 2005. Alzheimer's disease (415 deaths) and Parkinson's disease (250 deaths) were the two largest categories. Once again, because of changing certification practices and classifications, the analysis of long-term trends for these conditions is problematic.

Endocrine, nutritional and metabolic diseases: this group accounted for 988 (1.8 per cent) of the deaths in 2005. Approximately three-quarters of these deaths were caused by diabetes.

The remaining Chapters all had less than 1 per cent of the deaths in 2005. In fact, some had very small numbers, for example the 4 deaths classified to 'Pregnancy, childbirth and the puerperium'. This contrasts with the 43 maternal deaths recorded in 1955 and the 450 recorded in 1905 (see **Table 2.1**).

Note on availability of further data:

This short Chapter could only present a limited overview of the cause of death information available from GROS. As well as the published annual reports, GROS has a detailed mortality database covering the period from 1974 onwards. This database can be used to provide analyses by a wide range of demographic variables and geographical breakdowns. Additionally, GROS is building up a set of electronic tabulations covering earlier mortality data. Initially these will cover the period 1900-1973, though it is planned to add information covering the nineteenth century in due course. Most of this older information will cover the whole of Scotland, with no geographical breakdowns. Further information on data availability may be found on our website (<http://www.gro-scotland.gov.uk>) or by contacting Statistics Customer Services (<http://www.gro-scotland.gov.uk/contacts/contact-form.html>).

ANNEX: CODING AND CLASSIFYING CAUSE OF DEATH IN SCOTLAND

International Classifications

The first 'International Classification of Causes of Death' was developed at the end of the nineteenth century. During the twentieth century, periodic revisions, latterly co-ordinated by the World Health Organisation (WHO), were produced almost every decade. These revisions were required to stay abreast of medical advances, both in terms of disease identification and aetiology, and changes in medical terminology. The latest classification, the Tenth Revision, was developed by WHO together with nine international collaborating centres for the classification of diseases. Its use enhances international comparability in the collection, classification, analysis and presentation of mortality and morbidity statistics.

The full title of the classification changed a number of times over the years, the Tenth Revision being renamed as the 'International Statistical Classification of Diseases and Related Health Problems'. However, it is universally known as the 'ICD' with the latest revision being known as ICD10.

History of use in Scotland

The Second Revision was the first to be used in Scotland, in the Registrar General's Annual Report for 1911. The revisions used since then are summarised in the table below. This shows that the Ninth Revision was used for a rather longer period, 1979-1999, than any of the earlier revisions. WHO plans that ICD10 will remain current for some years to come and has established procedures for the agreement of minor updates.

Use of International Classification of Diseases in Scotland:

1911-1920	2nd Revision
1921-1930	3rd Revision
1931-1940	4th Revision
1941-1949	5th Revision
1950-1957	6th Revision
1958-1967	7th Revision
1968-1978	8th Revision
1979-1999	9th Revision
2000-	10th Revision

Selecting the underlying cause of death

Traditionally, tabulations of mortality statistics have presented information based on a single cause for each death and the early international classifications were devised to categorise the single cause normally reported on death certificates. However, as doctors began to report more than one condition on certificates, it became necessary to develop rules to select a principal or 'underlying' cause. The underlying cause is defined by the ICD as:

- (a) *the disease or injury which initiated the train of morbid events leading directly to death, or*
- (b) *the circumstances of the accident or violence which produced the fatal injury.*

For over fifty years WHO has recommended a specific format for collecting information on cause of death. The key part of the current Scottish medical certificate of cause of death (Form 11) is shown below. This conforms to the latest format recommended by WHO in that it includes a fourth line in Part I where the sequence of causes directly leading to death is listed. In a correctly completed certificate, the underlying cause should appear on the last completed line of Part I. In Part II, the doctor may record other conditions that contributed to the death, but did not directly cause it.

Extract from the Scottish medical certificate of cause of death (Form 11)

Cause of death		Approximate interval between onset and death				
		Years	Months	Days		
I hereby certify that to the best of my knowledge and belief, the cause of death was as stated below:						
I	Disease or condition directly leading to death*	(a).....	due to (or as a consequence of)	<input type="text"/>	<input type="text"/>	<input type="text"/>
	Antecedent causes	(b).....	due to (or as a consequence of)	<input type="text"/>	<input type="text"/>	<input type="text"/>
	Morbid conditions, if any, giving rise to the above cause, stating the underlying condition last	(c).....	due to (or as a consequence of)	<input type="text"/>	<input type="text"/>	<input type="text"/>
		(d).....	due to (or as a consequence of)	<input type="text"/>	<input type="text"/>	<input type="text"/>
II	Other significant conditions contributing to the death, but not related to the disease or condition causing it		<input type="text"/>	<input type="text"/>	<input type="text"/>

* This does not mean mode of dying, such as heart or respiratory failure; it means the disease, injury or complication that caused death.

The information originally recorded on the medical certificate of cause of death may be amended or enhanced in two key ways. First, GROS may receive additional information on the cause of death from procurators fiscal, who are responsible for conducting investigations into selected types of death. Second, GROS may contact the certifying doctor to obtain clarification of the stated causes.

If the certificate has not been completed properly, for example if the reported sequence of causes is illogical, it is necessary to have rules that, whenever possible, ensure the selection of an appropriate underlying cause of death. These selection rules are an integral part of the ICD. There are also a number of modification rules which apply to particular conditions, combinations or circumstances even when the certificate has been completed properly. For example two or more mentioned conditions may be linked to derive a composite underlying cause, or a trivial condition unlikely to cause death may be rejected in favour of a more serious condition.

Changes to the selection and modification rules can have significant effects on the underlying causes chosen. Indeed, changes to the selection rules may have as great an effect as changes to the classification itself.

Automated coding

Over 30 years ago, the National Center for Health Statistics (NCHS) in the United States began to develop software that would assign ICD codes to the causes reported on death certificates and consistently apply the rules for choosing the underlying cause. The aim of automated coding is the correct and consistent application of the complex coding rules set out in the ICD. The system uses a set of detailed decision tables developed by coding, classification and medical experts.

The suite of programs developed by NCHS is now used by an increasing number of countries around the world including Scotland, where it was introduced (for ICD9 coding) in 1996. A short report on the introduction of automated coding appeared in Appendix 2 of the Registrar General's 1996 Annual Report. An ICD10 version of the software has been used since 2000.

The introduction of automated coding was another step in the direction of greater accuracy, consistency and international comparability. However, though automated coding works well, trained staff are still required to check and edit the input data and to resolve uncertainties and ambiguities.