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Trends in Cancer Mortality in Young Adults in Europe, 1955–1989

S. Franceschi, F. Levi, F. Lucchini, E. Negri, P. Boyle and C. La Vecchia

Trends in mortality in the age group 20–44 years for the 16 most common cancers or groups of cancer in young adults are presented for 24 European countries (i.e. those with ≥1 000 000 inhabitants). The largest (up to 9-fold) and most frequent increases were recorded for cancer of the mouth and pharynx (≥2-fold increase from 1955–1959 to 1985–1989 in 10 countries), and oesophagus (in eight countries) in males, and for cancer of the skin, chiefly of melanomatous type, in males and females (in nine and eight countries, respectively). Consistent declines were observed for cancer of the stomach and uterus (chiefly, cervix), and for Hodgkin's disease, most notably in northern European countries. Little change emerged in the last 30 years or so in young adult mortality rates for cancer of the colon–rectum, pancreas, non-Hodgkin's lymphoma, leukaemias and cancers of the breast and ovaries in women. More than 2-fold elevations in lung cancer mortality rates in men aged 20–44 years were found only in a few previously non-market economy countries, and in Spain and Portugal. In some northern European countries, favourable downward trends in young males were accompanied by more than 2-fold increases in lung cancer mortality rates in young women. Overall, total cancer mortality rates in women at aged 20–44 years have declined over the last 35 years by more than 20% in 12 countries, and have not increased anywhere. Total cancer mortality rates in young males showed similar decreases in nine northern European countries, but increases of the same magnitude were also observed in most formerly non-market economy countries, and in Spain and Portugal.
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INTRODUCTION

THE OBSERVATION of cancer trends in different populations and age groups is of great value in order to detect the eventual effect of different factors, such as changes in exposure to risk factors, measures for prevention and treatment improvements [1, 2]. Whereas both mortality and incidence data play an important role in determining the general situation, mortality data have been favoured by several researchers for various reasons, particularly because of their widespread availability at a national level [2–10]. Death certification data have been available for longer time periods than incidence rates (i.e. in most European countries for at least four decades), and apply to larger, unselected populations, thus allowing more representative comparisons. More importantly, in contrast to incidence data, they are not greatly distorted by the efficiency of cancer registration, and the implementation and prevalence of screening [1, 3]. However, they are open to distortion due to the effects of treatment.

In this context, the study of mortality trends in young adults (20–44 years of age) is of particular interest in the assessment of cancer trends. In fact, for mortality of all age groups, recent changes may be outweighted by the effects of modifications in behaviour and prevalence of carcinogenic agents in the distant past [1, 11].

The present report will, therefore, focus on mortality trends from approximately 1955 to 1989 in all cancers and in specific cancer sites in European countries. It thus represents the continuation of the approach first proposed by Doll [1] for a few selected countries and cancer sites for the evaluation of progress in the fight against cancer.

MATERIALS AND METHODS

Official death certification numbers for 24 European countries, excluding the former Soviet Union, Albania and a few countries with a population of <1 million (i.e. Andorra, Iceland, Liechtenstein, Luxembourg and Malta) were derived from the World Health Organization (WHO) database. During the calendar period considered (1955–1989), four different revisions

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of the *International Classification of Diseases* (ICD) were used [12–15]. Classification of cancer deaths were thus re-coded, for all calendar periods and countries, according to the ninth revision (ICD-9) [15]. Table 1 gives the cancers or groups of cancers considered, together with the corresponding ICD codes under subsequent revisions. To improve comparability of data throughout different countries and calendar periods, we pooled together all intestinal sites including rectum, all uterine cancers (cervix and endometrium), all skin neoplasms (melanoma and non-melanomatous), all malignant neoplasms of the brain or nerves and all non-Hodgkin's lymphomas. Neoplasms whose occurrence is very rare below the age of 45 (i.e. <1/100 000 for most examined countries in the most recent quinquennium), e.g. prostatic cancer, and/or whose classification changed substantially in the examined period, e.g. liver cancer, are not considered in the present analysis.

Estimates of the resident population, generally based on official censuses, were obtained from the same WHO databank. From the matrices of certified deaths and resident populations, age-specific rates for each 5-year age group considered (20–24, 25–29, 30–34, 35–39, 40–44) and calendar period were computed. Age-standardised rates, truncated at 20–44 years, were based on the world standard population [16].

In a few countries, data were missing for part of one or more calendar periods, e.g. the former German Democratic Republic, Portugal, etc. When a single year was missing within a quinquennium, numerators and denominators were interpolated linearly from the previous and subsequent calendar year. No extrapolation was made for missing data at the beginning or the end of the calendar period considered, or when data on one or more quinquennia were not available. Figures for selected cancer sites/types are shown in the Appendix, and provide an indication of the time period for which data were available for each country. For the purpose of assessing percent changes in cancer mortality rates (Tables 2, 3), only countries with at least 20 years of mortality data were considered, thus making the number of examined countries somewhat lower for certain cancer sites (Appendix).

RESULTS

Table 2 considers the number of European countries where 20–44 truncated rates for various cancer sites changed substantially across the examined period, in most instances from 1955–1959 to 1985–1989. Because of the relative rarity of most neoplasms in young adults, only 2-fold or greater variations in the sex-specific rates were considered noteworthy.

In males, the highest number of 2-fold or greater increases of mortality rates was seen for cancer of the mouth or pharynx (in 10 countries). In three countries (Hungary, Denmark and the German Federal Republic) more than 7-fold increases in 20–44 years mortality rates were recorded. In addition, cancer of the oesophagus showed marked elevations in eight countries, frequently of the same order of magnitude of cancer of the mouth or pharynx (Table 2). Increases in mortality rates from cancer of the upper digestive tract comparable to those recorded in young males were not seen in women in the age group 20–44 years, among whom oesophageal cancer approximately halved in Finland, Poland, Sweden and Scotland.

Cancer of the stomach tended to decrease consistently in the examined period in most European countries, and more than halved among young males in 14 countries and among young females in 12 countries (Table 2). No modification over a factor of two was recorded in European young males for cancer of the colon–rectum (Table 2). Moderate upward trends were, however, found in young men in Czechoslovakia, Hungary and Spain. A hint of a lowering of mortality rates was, however, observed in some northern European countries, more markedly among women. The only 2-fold raise of colorectal cancer rates was observed in women in Bulgaria.

The situation for cancer of the lung differed between the two sexes. More than 2-fold increases in young men were restricted to formerly non-market economy countries (most notably Hungary) and Spain and Portugal, but improvements were observed in England, Wales and Scotland. Conversely, more than a doubling in the rate of lung cancer in young women between 1955–1959 and 1985–1989 was recorded in four northern European countries (Denmark, Netherlands, Norway and Sweden), in addition to Hungary (Table 2).

Table 1. *Cancers or groups of cancers considered**

Type of cancer	6 I.C.D.†	7 I.C.D.	8 I.C.D.	9 I.C.D.
Mouth or pharynx	140–148	140–148	140–149	140–149
Oesophagus	150	150	150	150
Stomach	151	151	151	151
Intestines, chiefly colon and rectum	152–154	152–154	152–154	152–154 + 159.0
Pancreas	157	157	157	157
Trachea, bronchus and lung	162	(162 + 163) − 162.2	162	162
Skin including melanoma	190 + 191	190 + 191	172 + 173	172 + 173
Breast	170	170	174	174(M)/175(F)
Uterus (cervix and corpus)	171–174	171–174	180–182	179–182
Ovary	175	175	183	183
Testis	178	178	186	186
Brain and nerves	193	193	191 + 192	191 + 192
Thyroid	194	194	193	193
Hodgkin's disease	201	201	201	201
All other lymphomas	200 + 202 + 205	200 + 202 + 205	200 + 202 + 208 + 209	200 + 202
Leukaemias	204	204	204–207	204–208
Total, all sites, all histologies	140–239	140–239	140–239	140–239

* Data on 1955–1970 not available for a few countries. † ICD, International Classification of Diseases.

Table 2. European countries where age-standardised mortality rates (world population) from specific cancers in 1985–1989 *were less than half or two or more times those in* 1955–1959†

	Number of Countries					
	Males			Females		
	< Half	≥ 2-fold		< Half	≥ 2-fold	
Cancer site	Number	Number	Country	Number	Number	Country
Mouth or pharynx	0	10	Austria, Belgium, Bulgaria, Czechoslovakia, Germany FR, Hungary (816)*, Poland, Spain, Yugoslavia	0	3	Germany FR (207)*, Hungary, Spain
Oesophagus	1	8	Austria, Belgium, Bulgaria, Czechoslovakia, France, Germany FR, Hungary (913)* Spain	4	1	Germany FR (200)*
Stomach	14	0		12	0	
Colon–rectum	0	0		2	1	Bulgaria (207)*
Pancreas	0	2	Czechoslovakia, Spain (286)*	0	0	
Lung	2	6	Czechoslovakia, Hungary (357)*, Poland, Romania, Spain	0	5	Denmark (290)*, Hungary, Netherlands, Norway, Sweden
Skin (all)	0	9	Czechoslovakia, France, Hungary, Italy, Norway, Poland, Portugal, Romania (420)*, Spain	0	8	Czechoslovakia, France (300)*, Italy, Poland, Romania, Spain, Sweden, Yugoslavia
Testis	4	2	Czechoslovakia (312)*, Spain	—	—	
Breast				0	1	Spain (209)*
Uterus (total)				12	0	
Ovaries				0	1	Spain (232)*
Brain and nerves	0	1	Yugoslavia (316)*			
Non-Hodgkin's lymphomas	1	1	Spain (306)*	1	2	Ireland, Spain (294)*
Hodgkin's disease	9	0	—	12	0	
Leukaemias	0	0	—	0	0	

* Highest percentage increase. † Or the earliest available quinquennium before 1975.

Table 3. European countries where age-standardised (world population) 20–44 years total cancer mortality rates in 1985–1989 *were* <80% *or* ≥1.25 *times those in* 1955–1959†

Countries			
Males		Females	
<80%	≥1.25-fold	<80%	≥1.25-fold
Denmark	Czechoslovakia	Austria (62)*	
Finland (66)*	Hungary (163)*	Belgium	
Ireland	Portugal	Denmark	
Netherlands	Romania	Finland	
Norway	Spain	France	
U.K., England & Wales		Germany FR	
		Italy	
Scotland (66)*		Netherlands	
Sweden		Norway	
Switzerland		Sweden	
		Switzerland	
		Scotland	—

* Highest percentage increase or decrease. † Or the earliest available quinquennium before 1975.

Death rates for cancer of the skin, virtually exclusively from melanoma in the age group 20–44 years, increased substantially both in men (nine countries) and in women (eight countries), with especially marked elevations in southern European countries and in formerly non-market economy countries (Table 2).

Although mortality rates from cancer of the testis improved in young men in Denmark, the Netherlands, Norway and Scotland, they increased by approximately 3-fold in Czechoslovakia and Spain.

With respect to female cancers, along with a substantial stability of mortality rates from cancer of the breast and ovaries (with the only exception of marked upward trends in Spain), improvements of the magnitude and extension of those recorded for cancer of the stomach were observed for cancer of the uterus (chiefly cervix, at age 20–44 years). While there has been a ubiquitous tendency for cancer of the uterus to decline among young women in the last three decades or so, a reversal of this favourable trend can, however, be observed in England and Wales and Scotland since the 1970s.

With regard to the haemopoietic system, consistent decreases in mortality rates in young adults were recorded for Hodgkin's disease (whose rates declined by over 50% in males for nine countries and in females for 12 countries) and, to a lesser extent, for leukaemias, in most European countries, most markedly in northern European countries. Conversely, 20–44 years truncated mortality rates for non-Hodgkin's lymphomas and leukaemias did not show large modifications in the examined decades in Europe. An approximately 3-fold elevation of mortality rates for non-Hodgkin's lymphoma was, however, observed in Spain in both sexes.

The impact of these modifications on the overall cancer mortality rates in young adults in Europe can be assessed in Table 3 in which, because of the larger number of events

considered, changes of only one-fifth were displayed. The emerging pattern suggests that cancer mortality rates in women aged 20–44 years have increased in no European country for the last four decades. In 12 countries, all from market economy countries, substantial improvements took place. In young males improvements were apparent in nine countries, all from northern Europe. These are, however, accompanied by ≥25% increases of total cancer mortality in three formerly non-market economy countries (Czechoslovakia, Hungary and Romania) and in Spain and Portugal (Table 3).

For total cancer and a few selected sites/types, figures, showing world standardised rates truncated at age 20–44 for each 5-year calendar period in both sexes (if appropriate) for each country, are presented in the Appendix. Figures for other examined cancer sites/types are available on request.

DISCUSSION

Mortality in young adults accounts for a small proportion of all cancer deaths, but is of special interest since it reflects more recent changes in the pattern of exposure to carcinogens. It may thus be a useful indication of future trends in the same generations when they grow older and experience higher cancer rates [3]. Whereas accuracy in death certification (or recent modifications in accuracy) is not a major source of concern in the analysis of cancer trends in young adults, an important drawback is the necessity to base conclusions on relatively few deaths, even at a national level. In fact, we were obliged to restrict our analysis to cancer sites which were relatively common, thus overlooking a few other potentially interesting, but less informative trends, e.g. cancer of the thyroid, larynx, soft-tissue sarcomas, etc. We also chose, for classification purposes, certain thresholds of per cent change. They must obviously be regarded as simply indicative and do not substitute for the careful examination of the figures (Appendix).

Nevertheless, it is clear that trends in young adults in Europe show interesting variations with geographical location and also with sex. The greatest falls in 20–44 years truncated mortality rates in the last three decades or so have occurred in both sexes for cancers of the stomach, and Hodgkin's disease, and for females, cancer of the cervix uteri where more than 50% decreases of death rates were recorded in the majority of countries, and opposite tendencies were not observed anywhere.

Similar extensive modifications, but, unfortunately, with increasing trends, were observed for cancers of the upper digestive tract, most notably cancer of the mouth and pharynx, in males and in cancer of the skin (virtually equivalent in the present age group to melanomatous skin cancer) [17] in both sexes.

While, for most other neoplasms, e.g. cancer of the breast and colon–rectum, mortality rates seem to have been in the last three decades or so relatively stable, elevations in 20–44 years mortality rates from breast cancer are, however, apparent in some formerly non-market economy countries, especially Poland, and in Spain and Portugal. The distribution of lung cancer mortality rates in young European adults highlights two rather distinctive issues. Firstly, a lung cancer epidemic, of perhaps unprecedented severity [7, 18], is mounting among young males in formerly non-market economy countries and, to a somewhat lower extent, in southern European countries. Paradoxically, a substantial increase is also emerging among young women of those countries where lung cancer mortality rates have been declining in young men in the last three decades. In fact, the male-to-female sex ratios have been steadily approaching unity in many northern European countries, and already indicate an equality of lung cancer risk in the two sexes in Denmark and Sweden (Appendix) [19].

In terms of general cancer mortality, the picture which emerges from the present analysis is largely reassuring in respect to young European women, in spite of the aforementioned increase of lung cancer mortality rates, which identifies women as a priority target for smoking control interventions. With regard to young males, mortality rates show upward trends in all formerly non-market economy countries and in a few southern European countries (Spain, Portugal and France). In the light of the cancer sites responsible of this modification, it thus seems that the unhalted spread of cigarette smoking chiefly underlies these "losses" in the battle against cancer [20] among young European men. There is also an important influence of alcohol consumption, which acts multiplicatively with cigarette smoking in increasing risk of cancer of the upper aerodigestive tract [21]. In formerly non-market economy countries, the final balance is made worse, in men but also in women in the age group 20–44 years, by the fact that, in addition to more marked increases in certain tobacco- and alcohol-related cancer sites than in the rest of Europe, improvements in the cancer sites which elsewhere have tended to decline are slower or absent. This holds particularly true for those cancer sites which have benefitted substantially from dietary improvements, e.g. cancer of the digestive tract, [22] or from advances in treatment (testis, Hodgkin's disease) [23, 24] or in screening (cancer of the cervix uteri) [25]. No country from the former eastern European block can be included among those where the most encouraging declines in 20–44 years truncated mortality rates for the aforementioned, partly preventable or curable, cancer sites occurred. A similar systematic gap between European countries, according to the former type of economy, has also been observed, starting from the mid-1960s, for other partly preventable or curable diseases, e.g. tuberculosis, cardio- and cerebro-vascular diseases, and, by and large, for life expectancy [26].

In the light of the persisting debate on the value of the different age-specific analysis of mortality trends [27], a final word should be said on the consistency of the situation in cancer trends in Europe as they emerge from the study of young adult mortality rates and all age mortality rates [6–10]. In many common (e.g. cancer of the mouth and pharynx, stomach and uterus) and less common neoplasms (e.g. Hodgkin's disease and leukaemias), trends in mortality in European young adults are qualitatively, if not quantitatively, comparable to those which are seen at all ages and, particularly, to the now widely used 35–64 years truncated mortality rates. However, a few interesting findings of the present analysis of cancer in young adults would have probably been missed or, at least, overlooked in the examination of populations of all ages. This particularly applies to the recent epidemic of lung cancer in young women in a few northern countries and, to a lesser extent, to the size and extension of the present increase in mortality rates from cancer of the skin, and to the possible recent reversal of the favourable tendency of mortality rates for cancer of the uterus in British women.

Conversely, the analysis of the age group 20–44 years probably allows a more reassuring message to emerge as concerns a few important neoplasms which showed moderate or large increases in mortality rates at all ages in the last four decades or so, especially in formerly low-risk European countries. Trends in mortality rates from cancer of the colon–rectum, pancreas and, in females, breast and ovaries show, in most recent years, a

certain tendency to level off in Europe, albeit towards rather high values. This feature emerges more clearly from the observation of younger cohorts than from total age mortality. Similarly, the suggestion of a moderate increase in neoplasms of the brain and nerves and non-Hodgkin's lymphomas in all ages in some countries was attenuated by the observation of 35–64 years truncated mortality rates and, even more, by 20–44 years truncated rates.

In conclusion, the changing pattern of cancer mortality in Europe has its genesis mainly in terms of changes in distribution of risk factors rather than changes brought about by therapy.

A few favourable trends in cancer mortality in young adults, particularly in women, in addition to the existing knowledge of the reasons of certain increases or lack of decline (i.e. inadequate tobacco control, delay in the introduction of effective therapies and screening methods) provide important indications of future priorities in the fight against cancer. Formerly non-market economy countries and, to a somewhat lesser extent, southern European countries, provide the greatest challenge for the future of cancer prevention in Europe.

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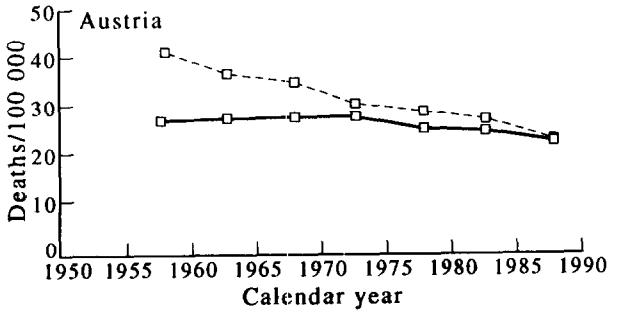
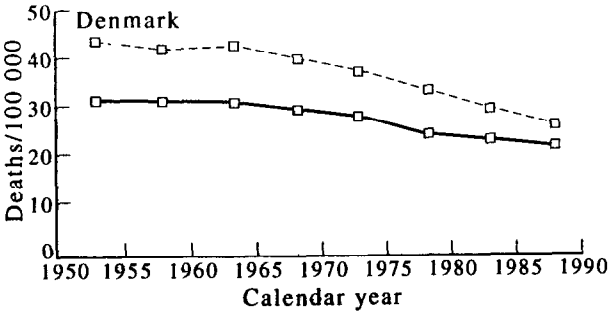
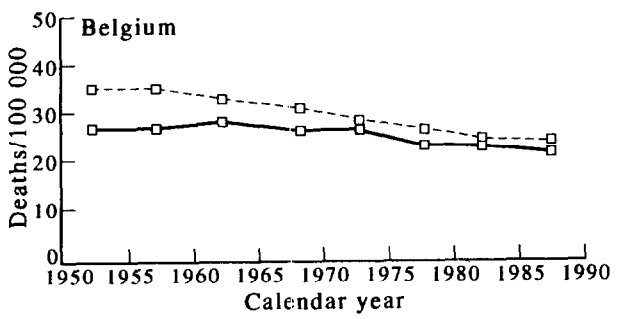
APPENDIX

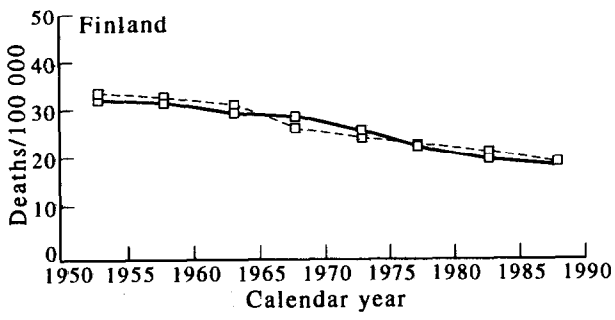
Total all neoplasms, benign and malignant

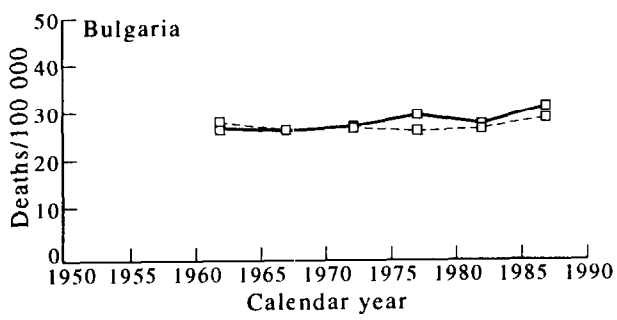
Males 20 – 44 years
Females 20 – 44 years

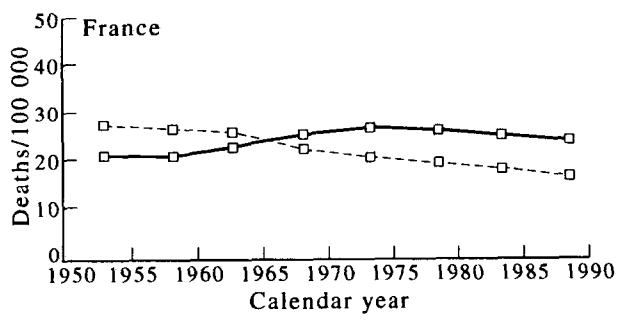


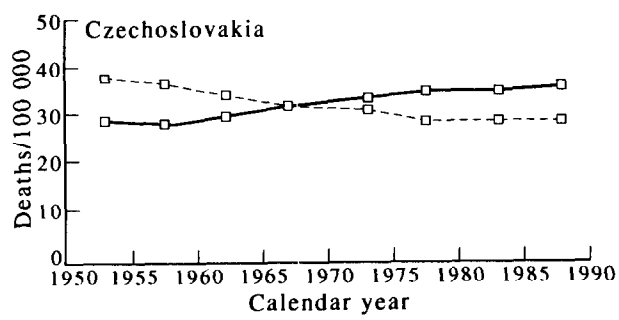


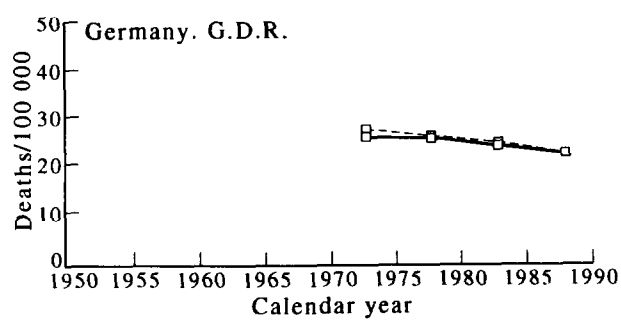


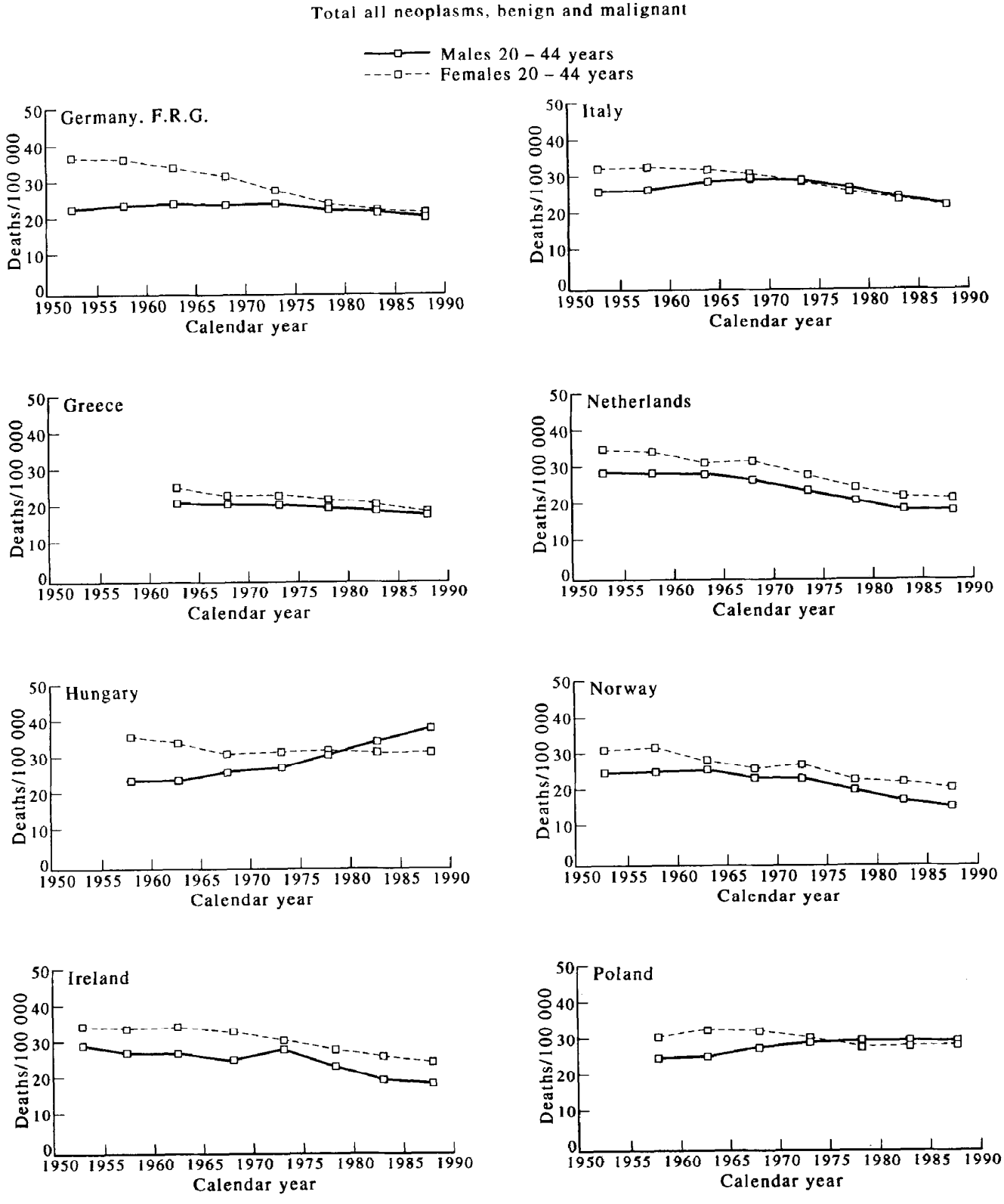






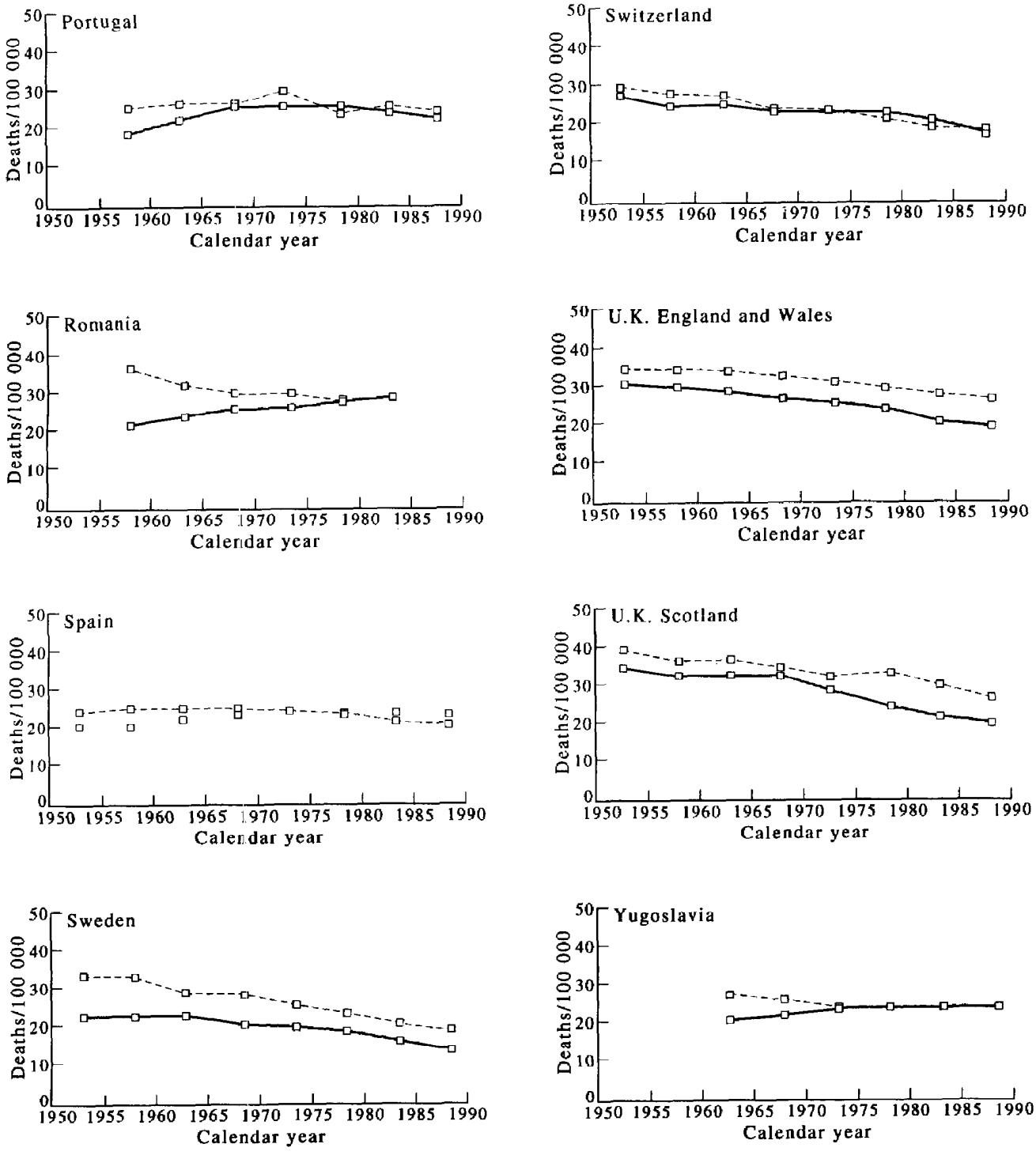


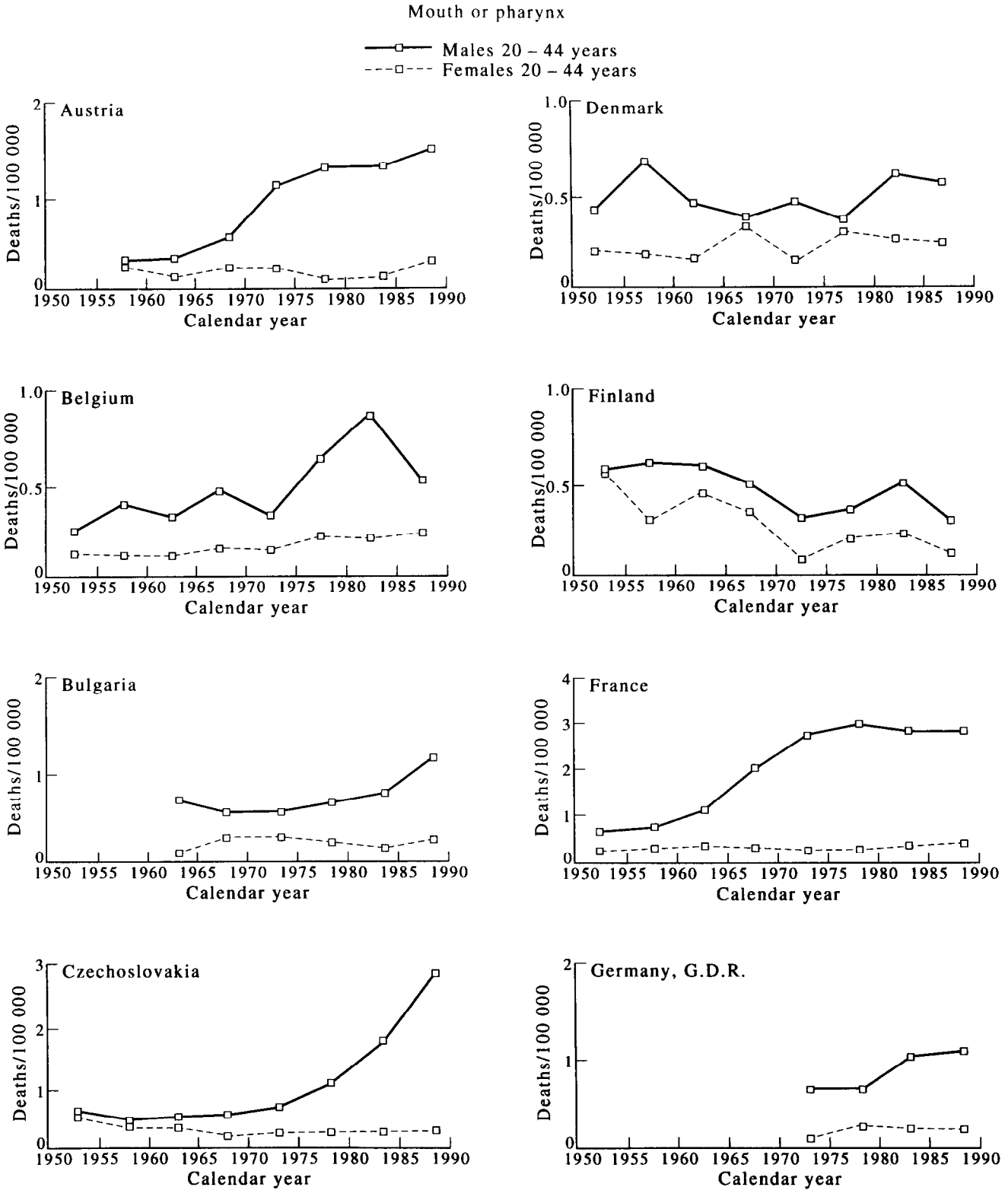


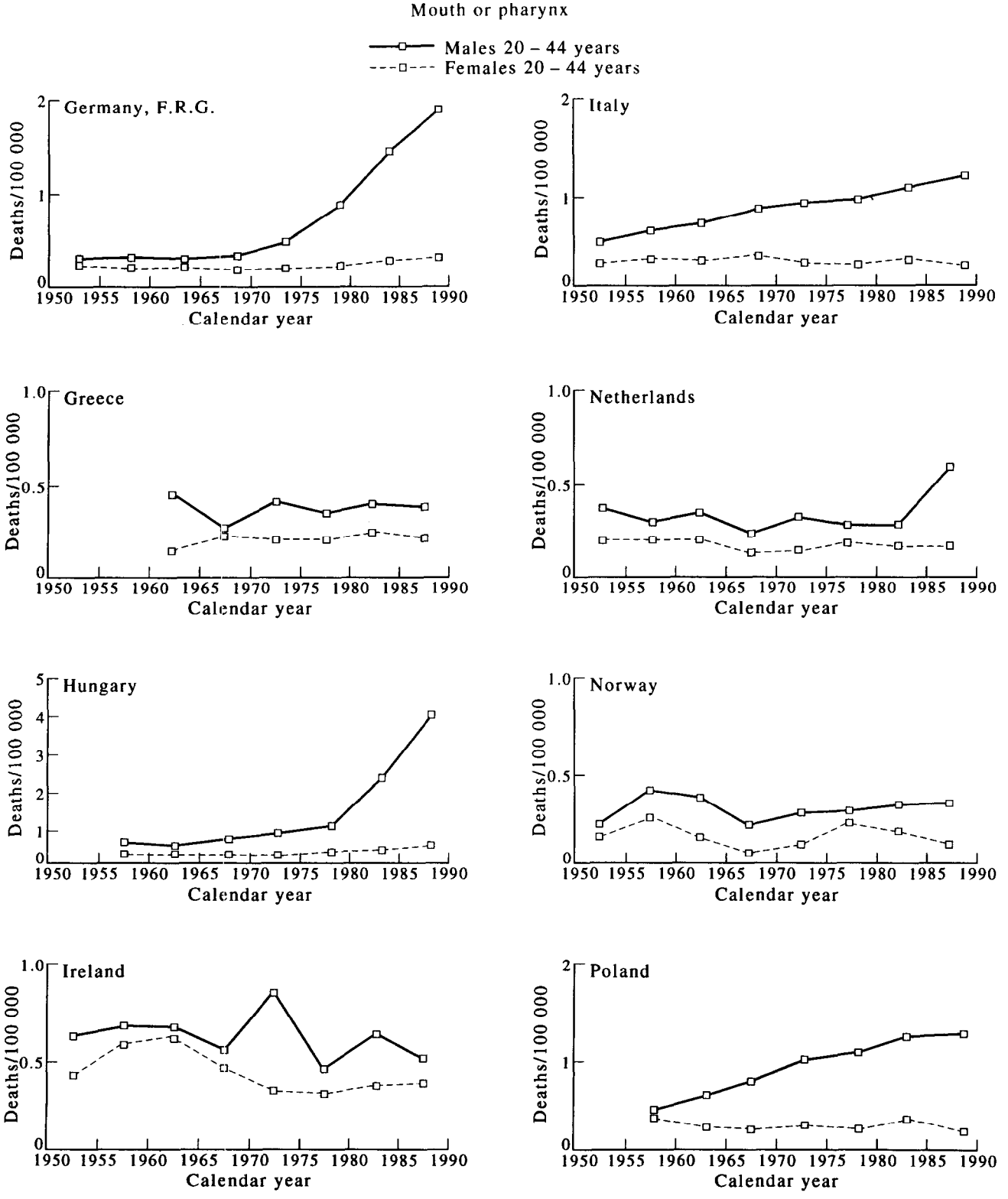

Total all neoplasms, benign and malignant
Males 20 – 44 years
Females 20 – 44 years
Germany. F.R.G.
Italy
Greece
Netherlands
Hungary
Norway
Ireland
Poland
Deaths/100 000
Calendar year
0
10
20
30
40
50
1950 1955 1960 1965 1970 1975 1980 1985 1990

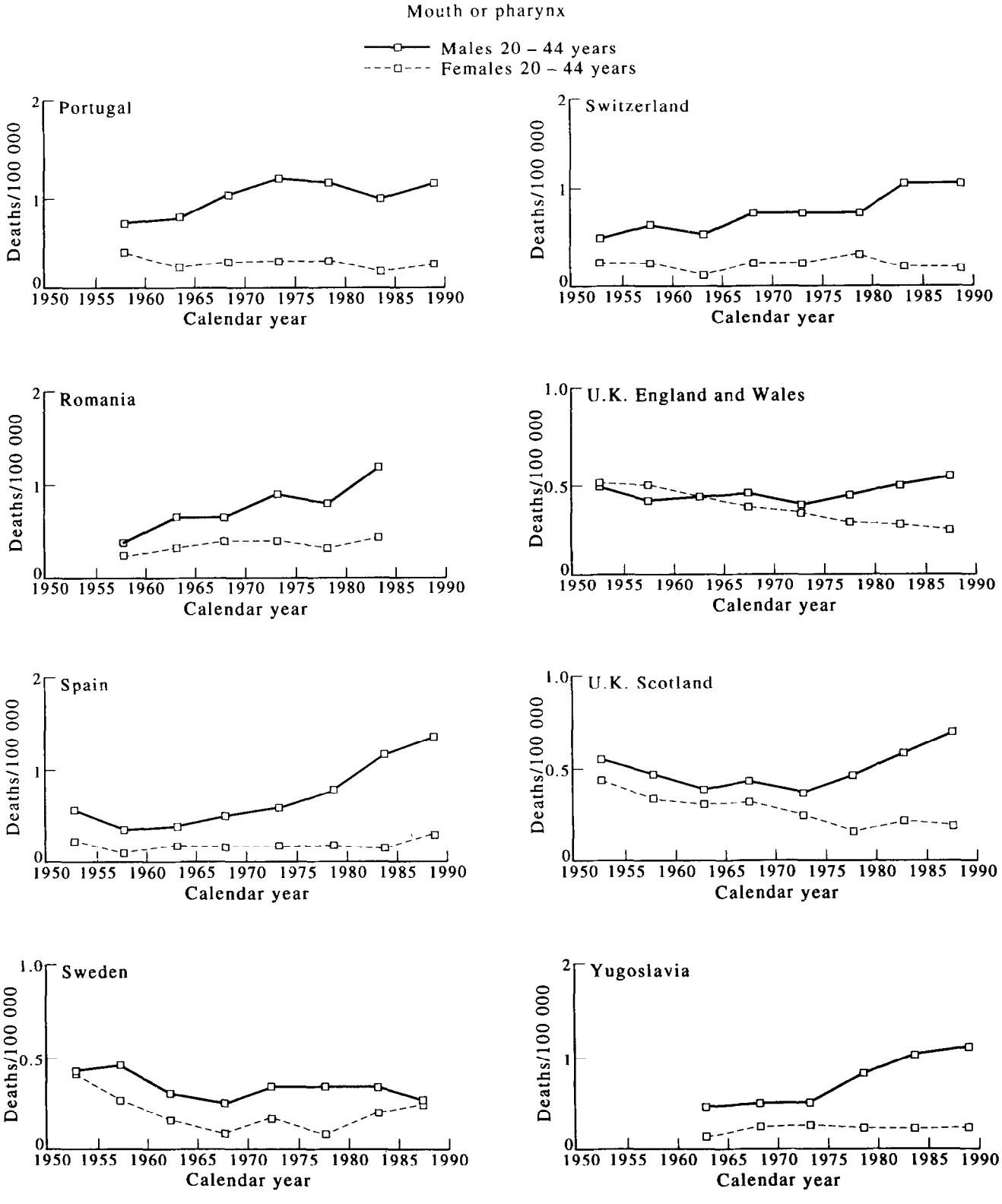
Total all neoplasms, benign and malignant

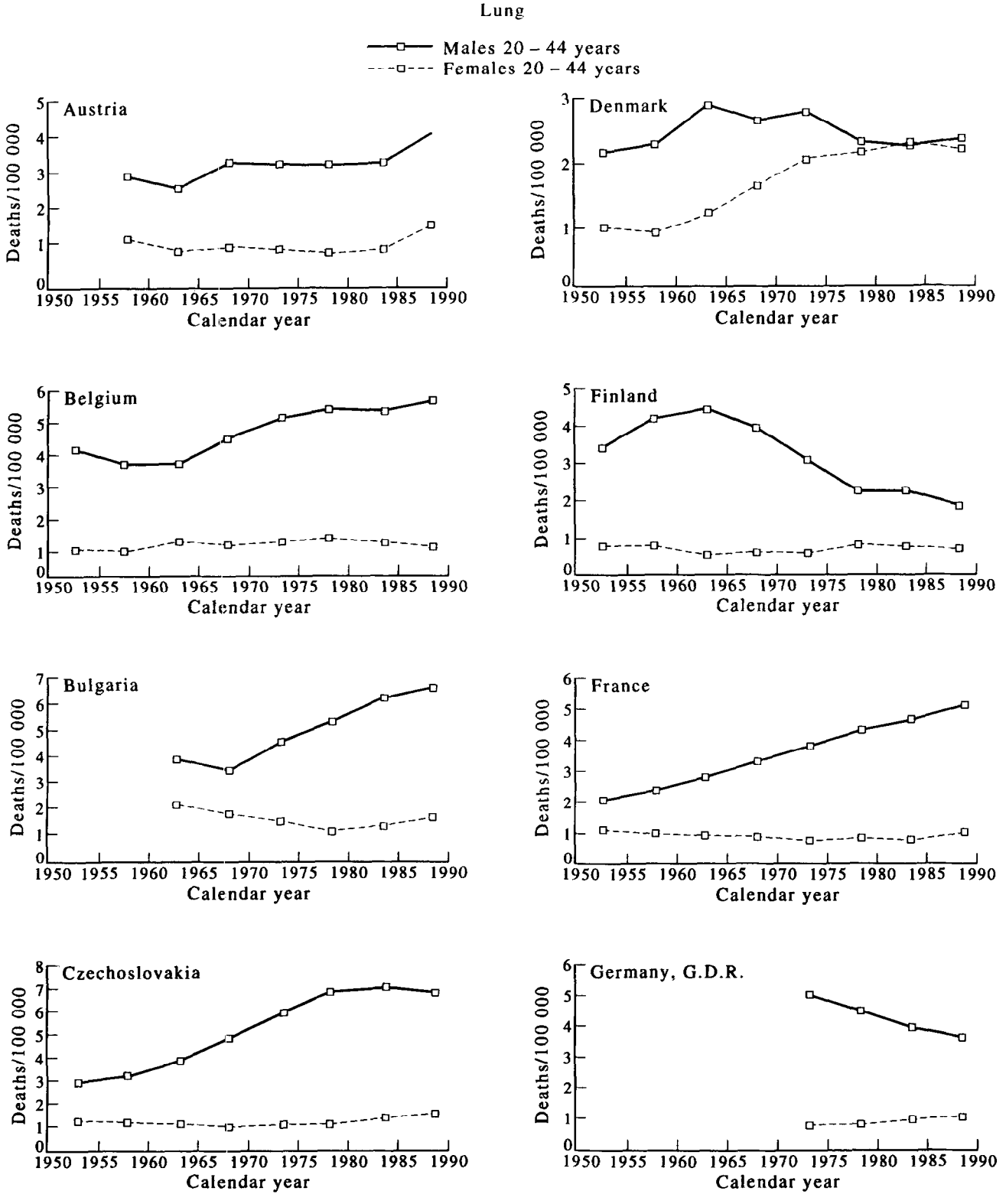
Males 20 – 44 years
Females 20 – 44 years

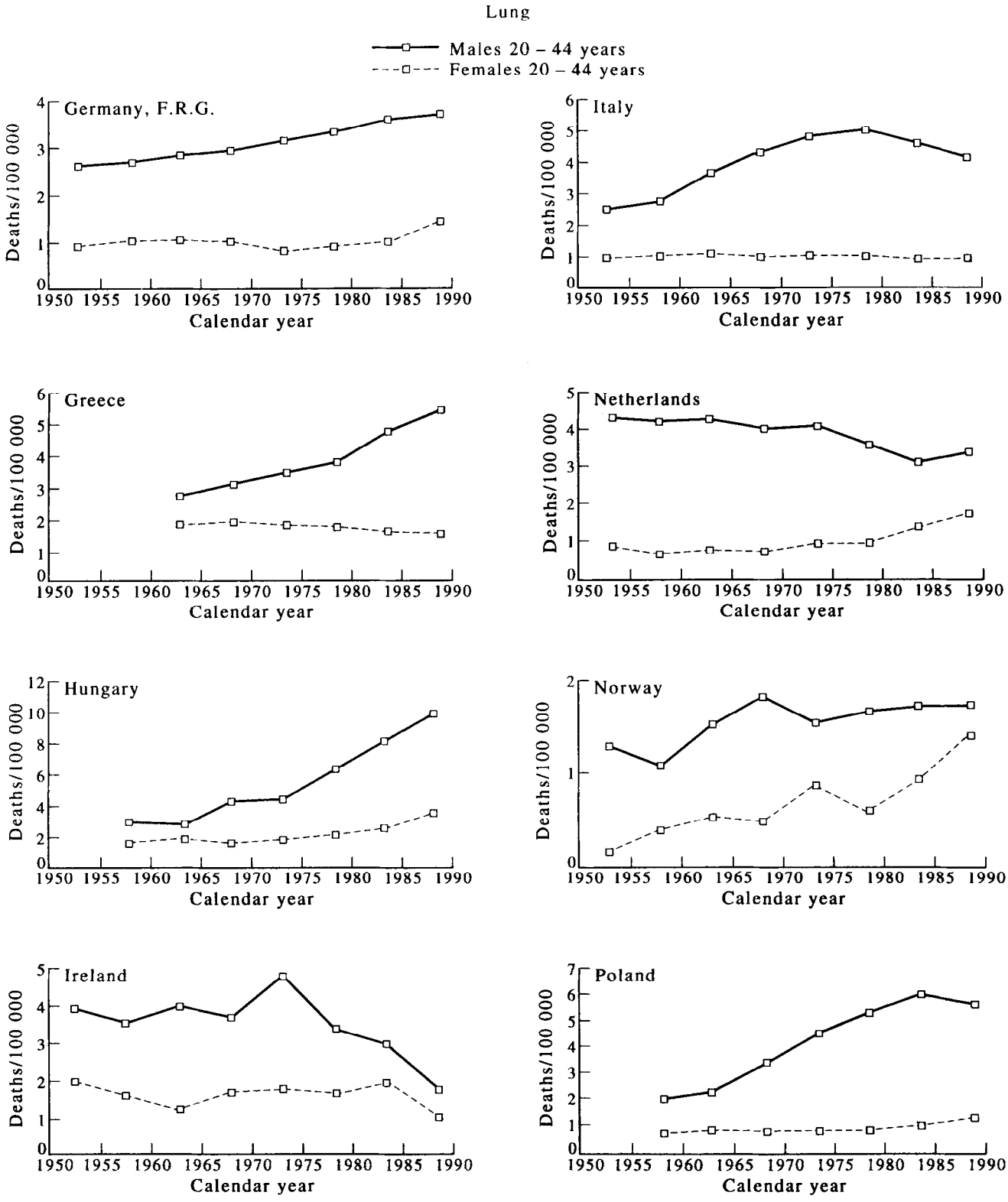


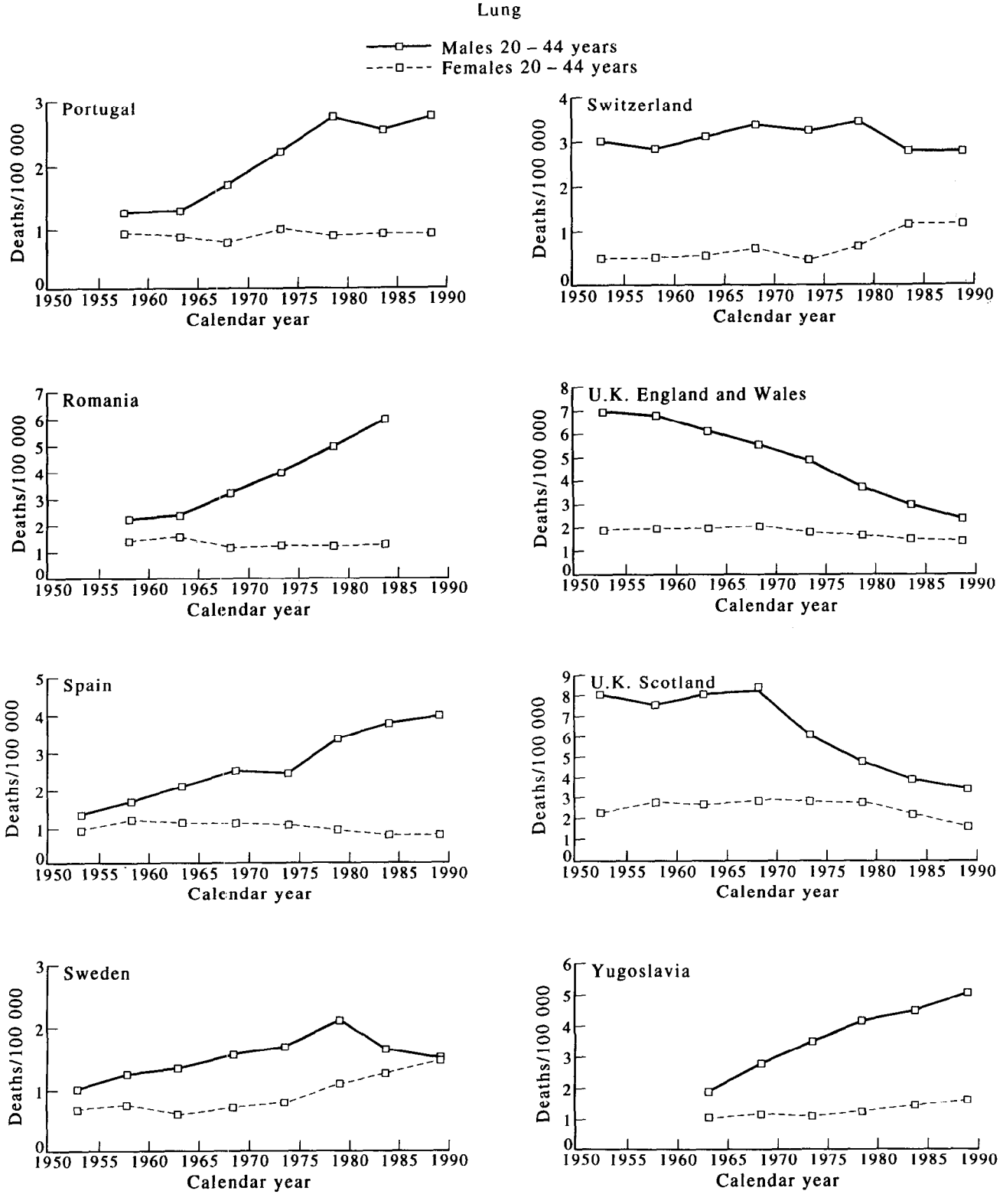

Mouth or pharynx
Males 20 – 44 years
Females 20 – 44 years
Austria
Denmark
Belgium
Finland
Bulgaria
France
Czechoslovakia
Germany, G.D.R.
Deaths/100 000
Calendar year
1950 1955 1960 1965 1970 1975 1980 1985 1990

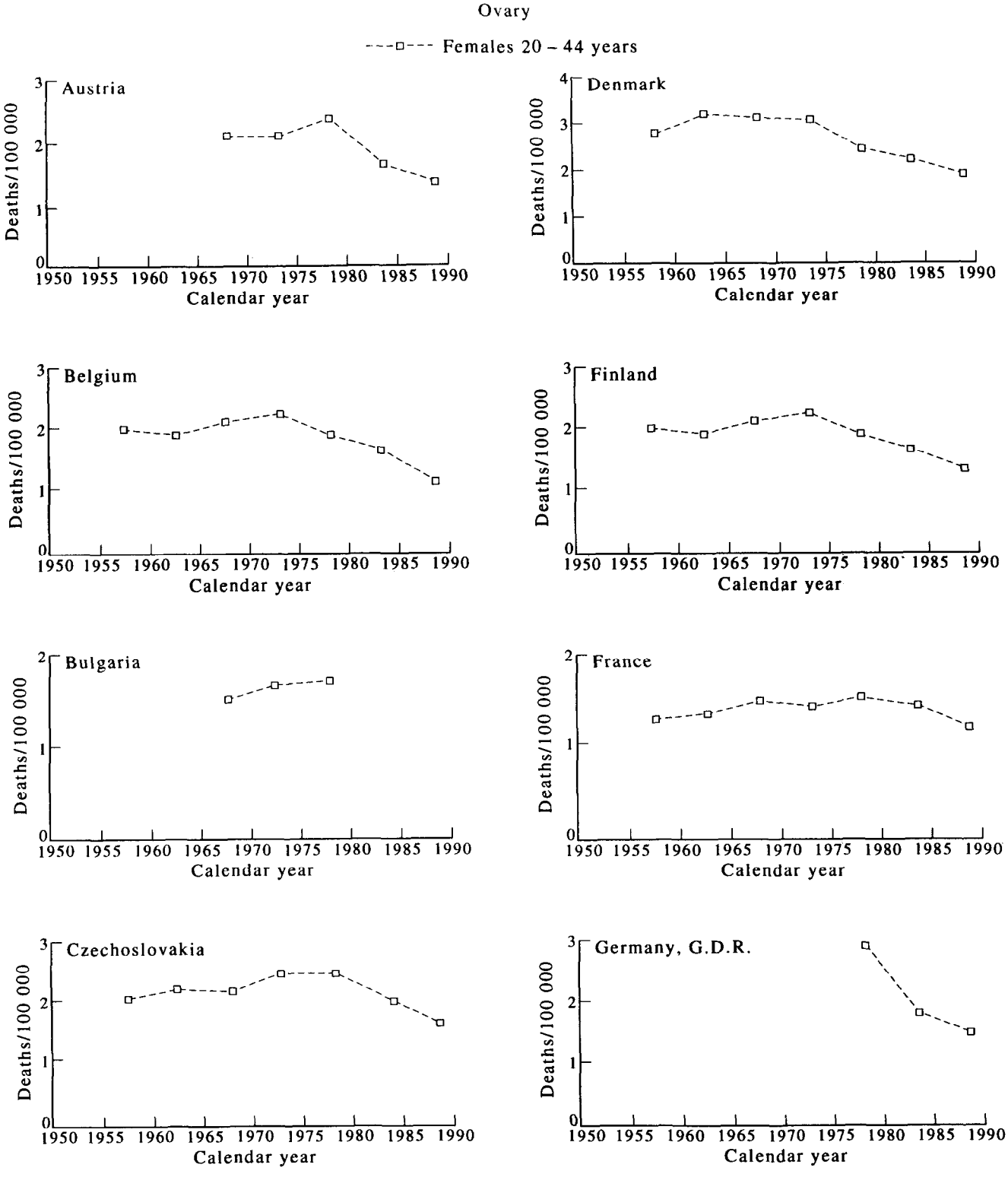

Mouth or pharynx
Males 20 – 44 years
Females 20 – 44 years
Germany, F.R.G.
Italy
Greece
Netherlands
Hungary
Norway
Ireland
Poland
Deaths/100 000
Calendar year
1950 1955 1960 1965 1970 1975 1980 1985 1990

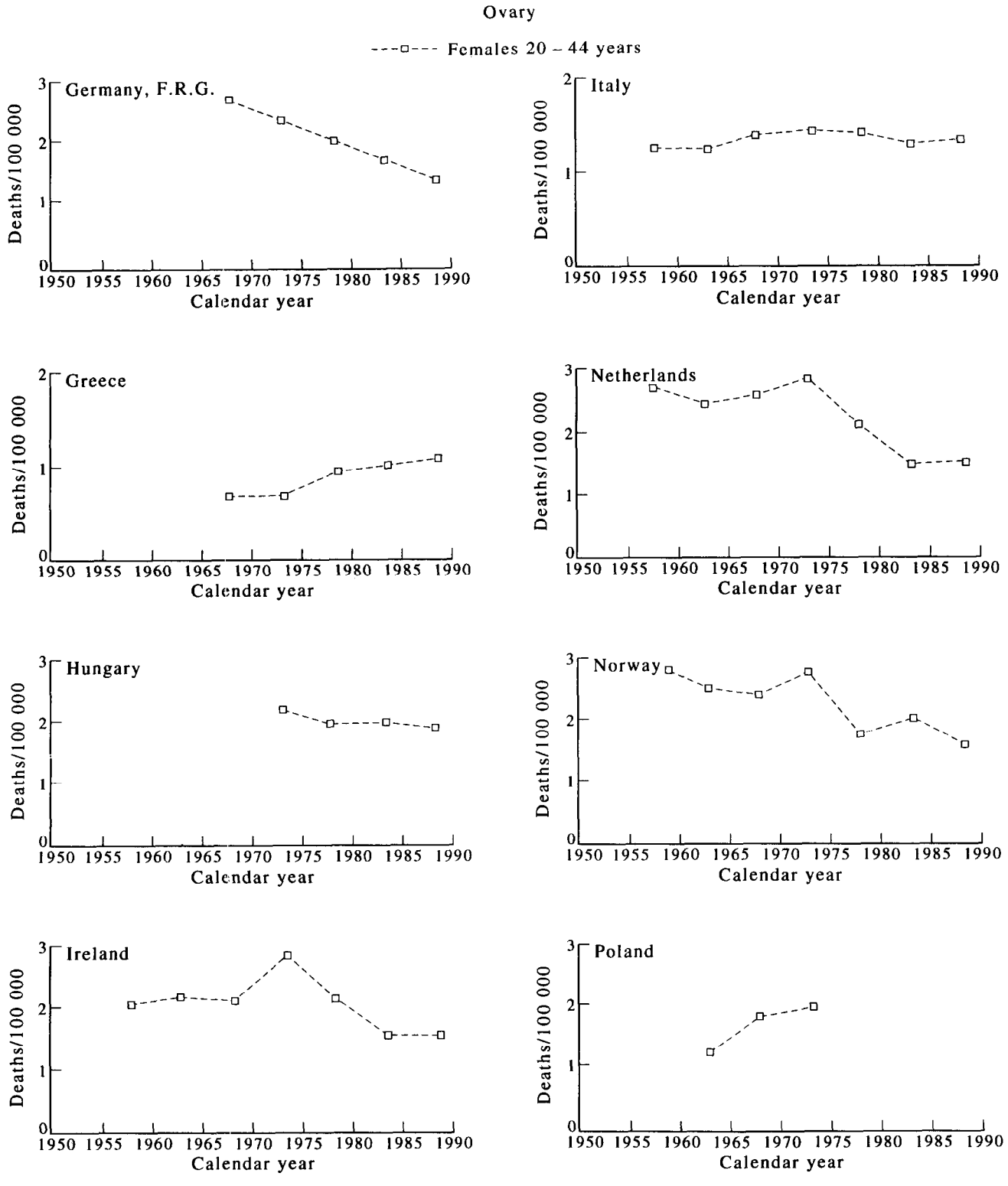

Mouth or pharynx
Males 20 – 44 years
Females 20 – 44 years
Portugal
Switzerland
Romania
U.K. England and Wales
Spain
U.K. Scotland
Sweden
Yugoslavia
Deaths/100 000
Calendar year
1950 1955 1960 1965 1970 1975 1980 1985 1990

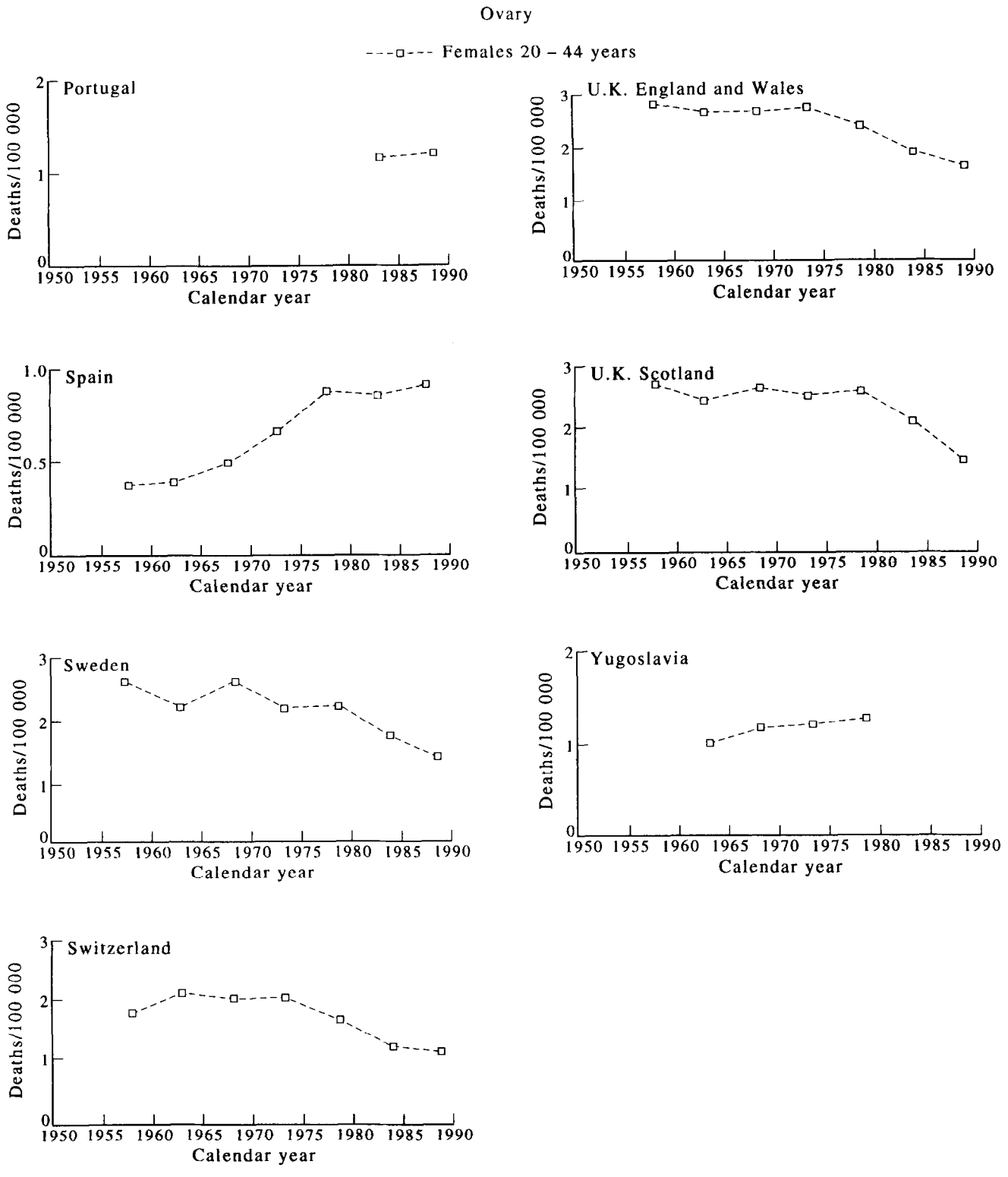

Lung
Males 20 – 44 years
Females 20 – 44 years
Austria
Denmark
Belgium
Finland
Bulgaria
France
Czechoslovakia
Germany, G.D.R.
Deaths/100 000
Calendar year
1950 1955 1960 1965 1970 1975 1980 1985 1990


Lung
Males 20 – 44 years
Females 20 – 44 years
Germany, F.R.G.
Italy
Greece
Netherlands
Hungary
Norway
Ireland
Poland
Deaths/100 000
Calendar year
1950 1955 1960 1965 1970 1975 1980 1985 1990


Lung
Males 20 – 44 years
Females 20 – 44 years
Portugal
Switzerland
Romania
U.K. England and Wales
Spain
U.K. Scotland
Sweden
Yugoslavia
Deaths/100 000
Calendar year
1950 1955 1960 1965 1970 1975 1980 1985 1990

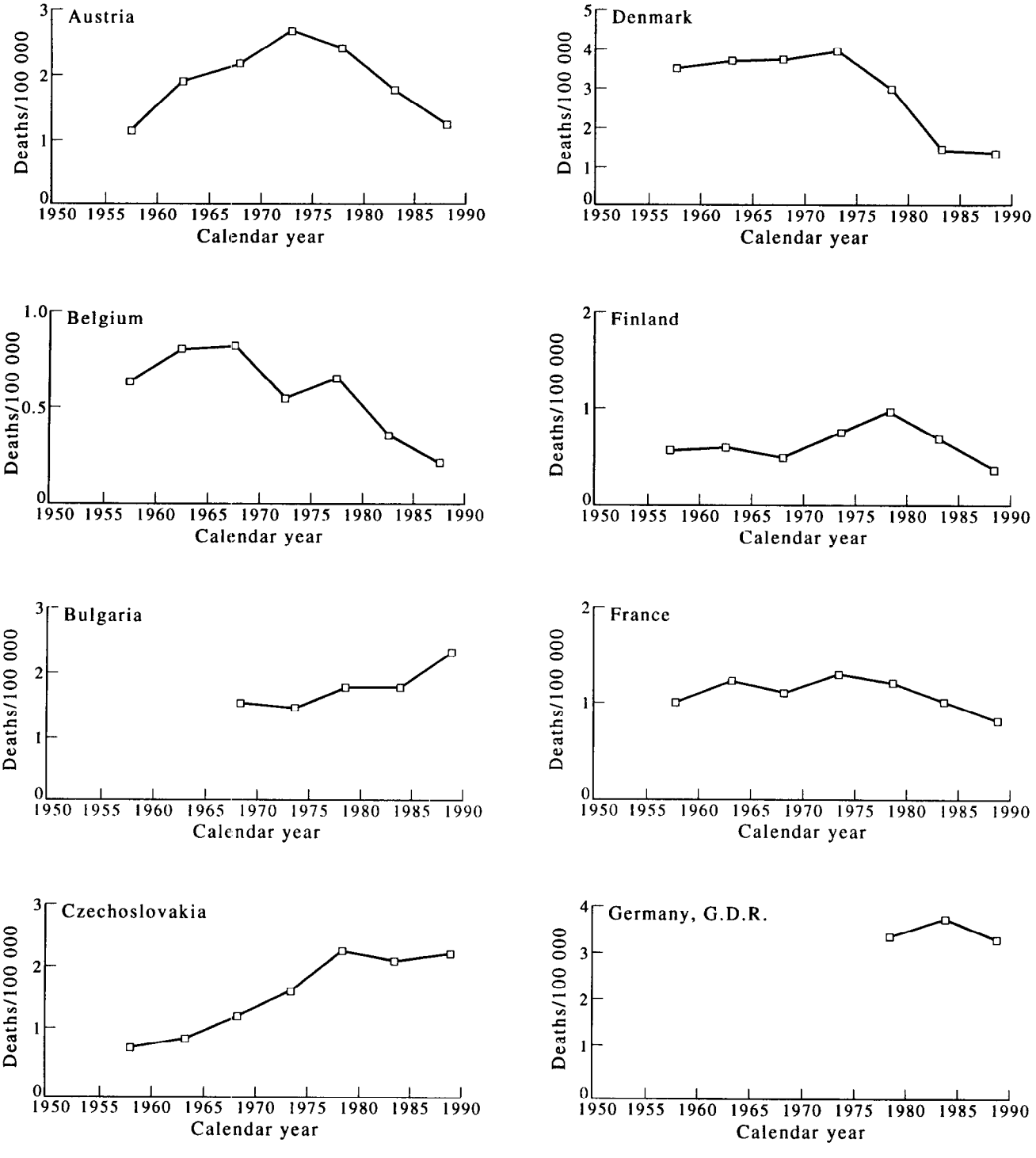

Ovary
Females 20 – 44 years
Austria
Denmark
Belgium
Finland
Bulgaria
France
Czechoslovakia
Germany, G.D.R.
Deaths/100 000
Calendar year
1950 1955 1960 1965 1970 1975 1980 1985 1990

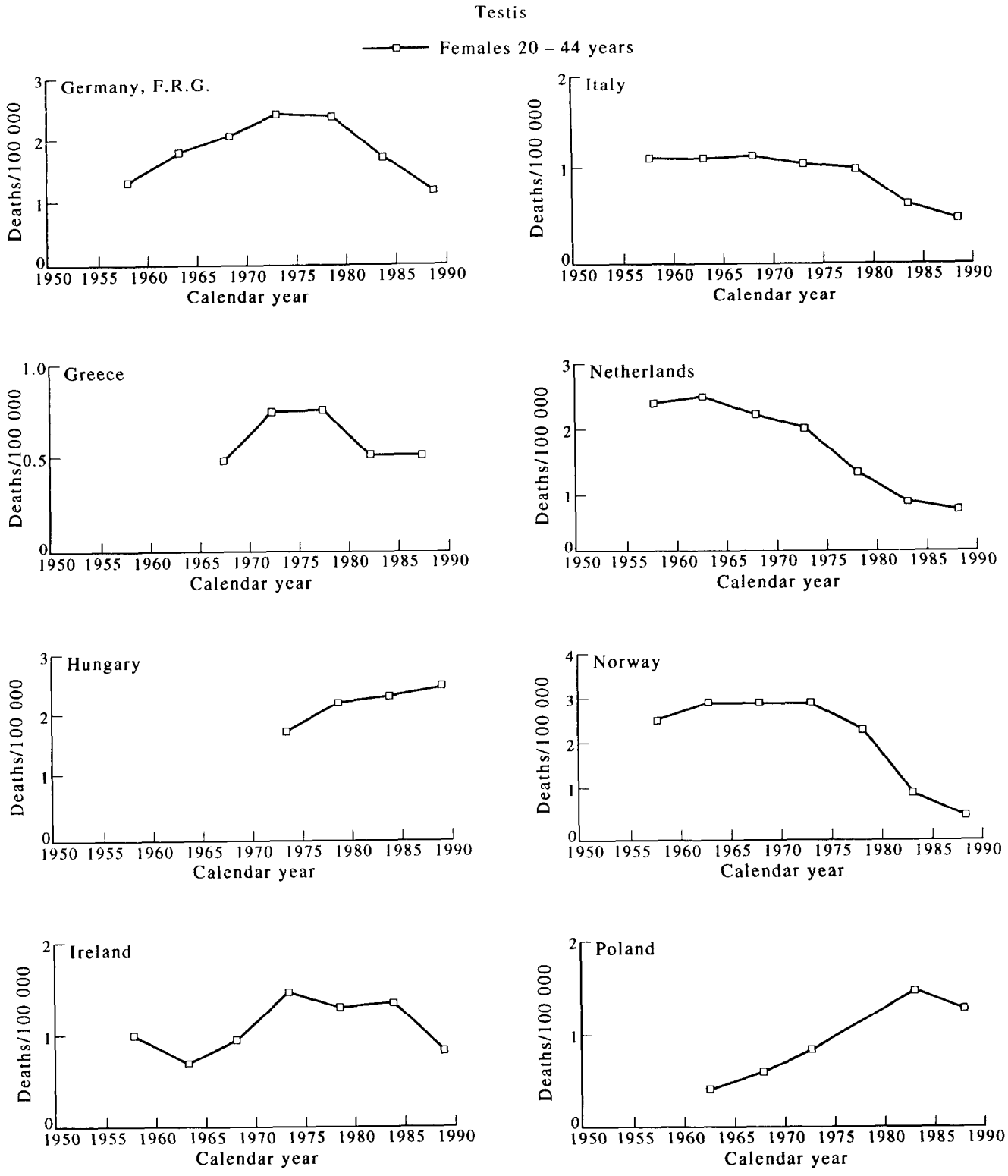

Ovary
Females 20 – 44 years
Germany, F.R.G.
Italy
Greece
Netherlands
Hungary
Norway
Ireland
Poland
Deaths/100 000
Calendar year
1950 1955 1960 1965 1970 1975 1980 1985 1990


Ovary
Females 20 – 44 years
Portugal
U.K. England and Wales
Spain
U.K. Scotland
Sweden
Yugoslavia
Switzerland
Deaths/100 000
Calendar year
1950 1955 1960 1965 1970 1975 1980 1985 1990

Testis

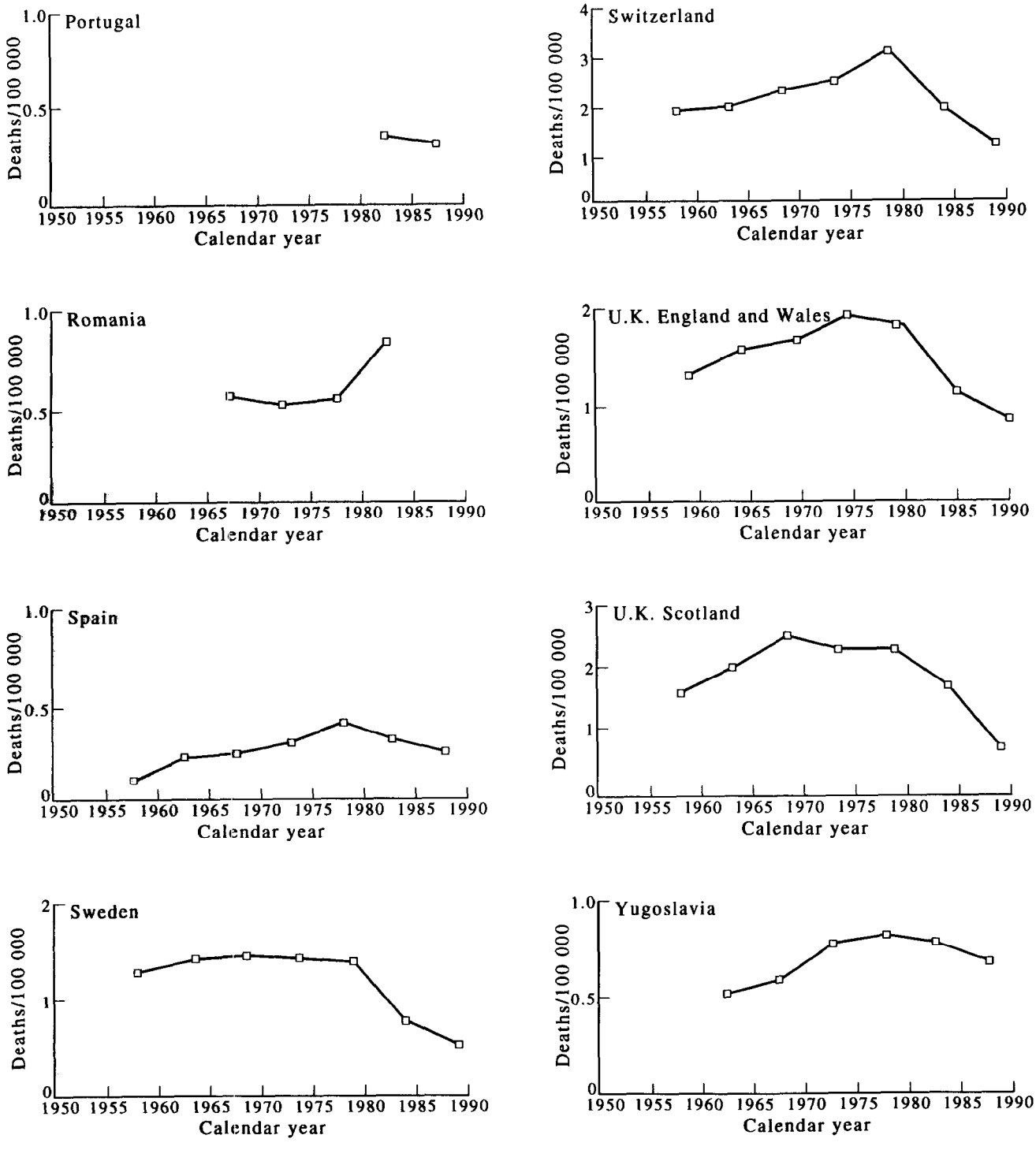
Males 20 – 44 years

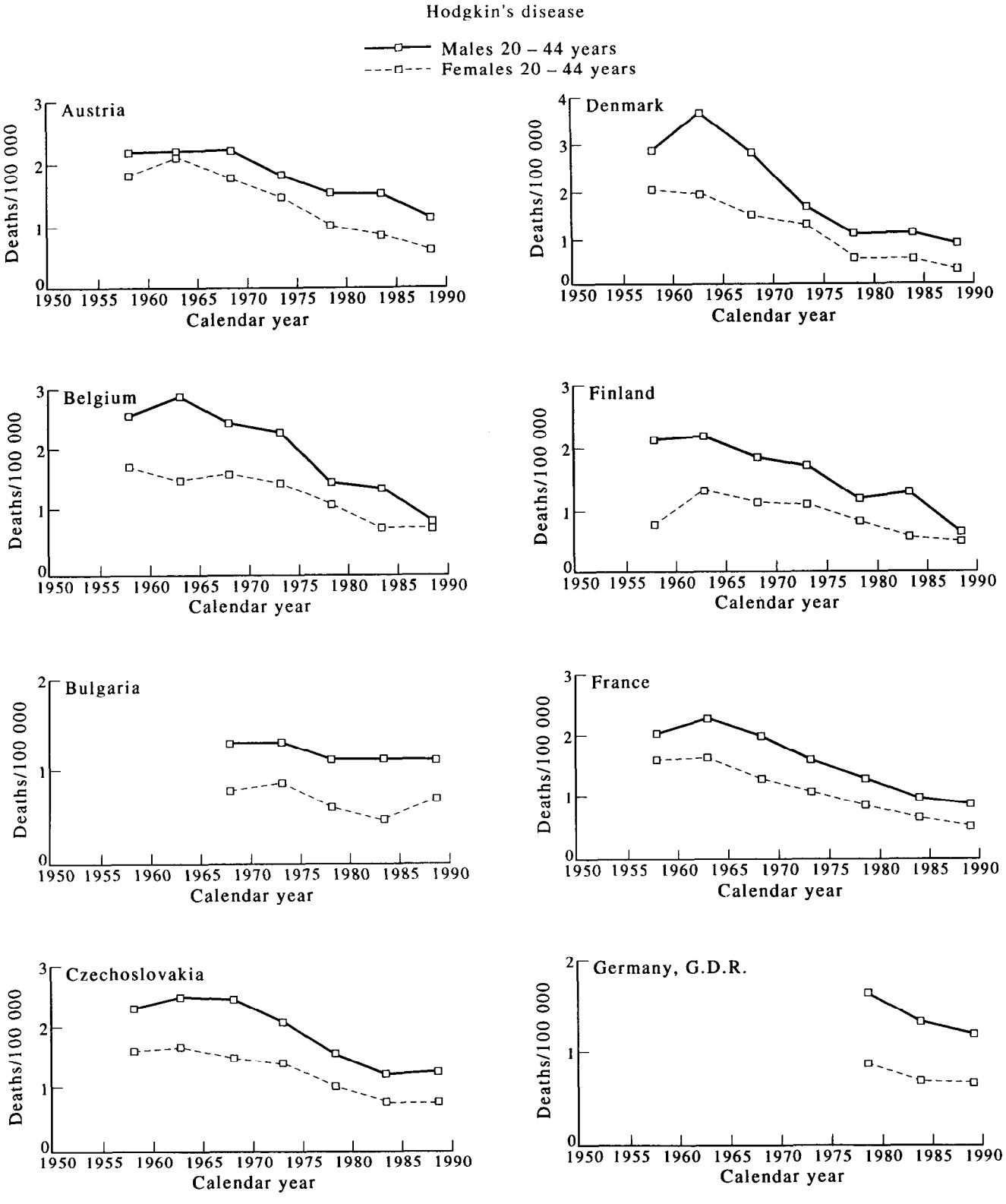


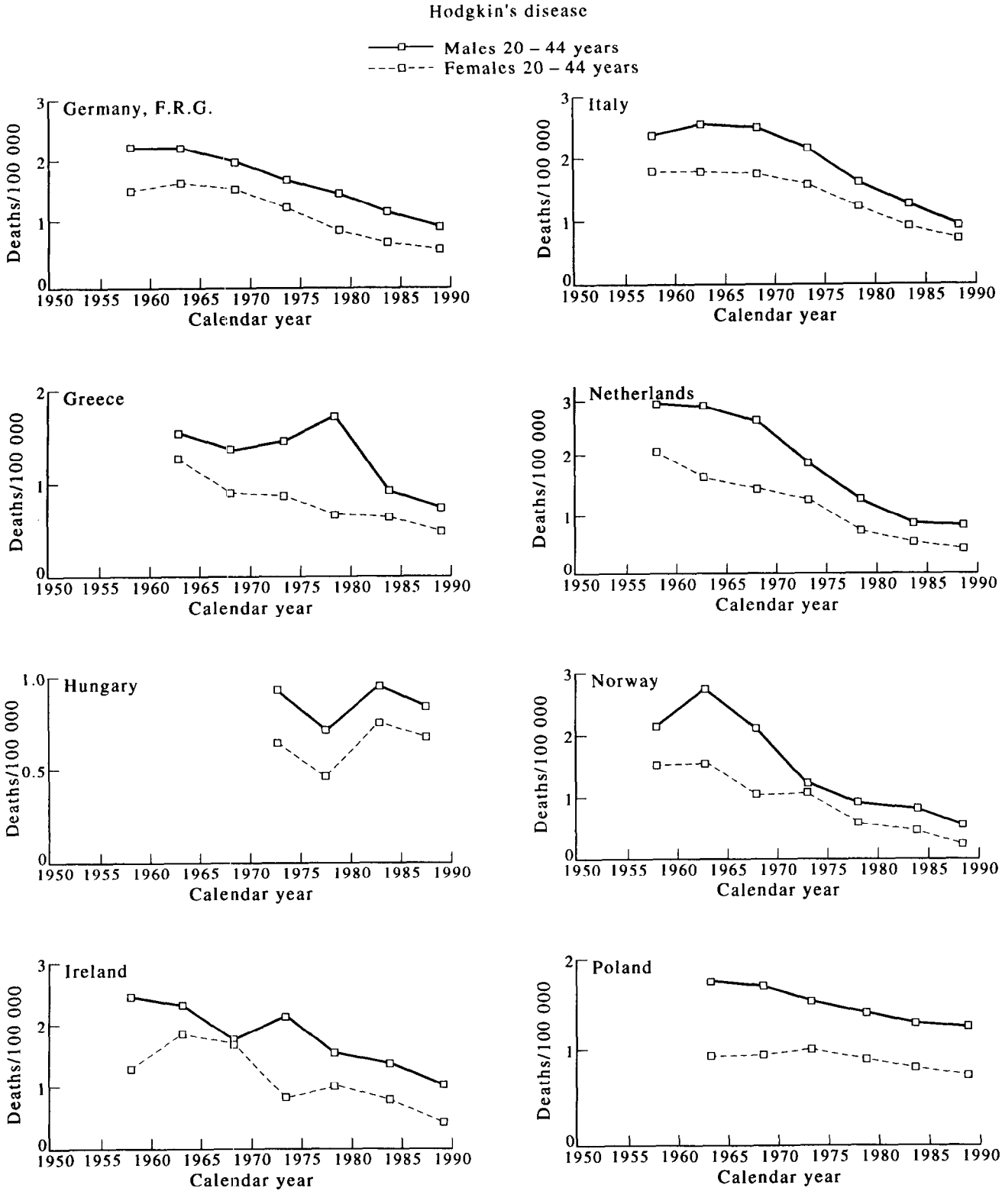

Testis
Females 20 – 44 years
Germany, F.R.G.
Italy
Greece
Netherlands
Hungary
Norway
Ireland
Poland
Deaths/100 000
Calendar year
1950 1955 1960 1965 1970 1975 1980 1985 1990

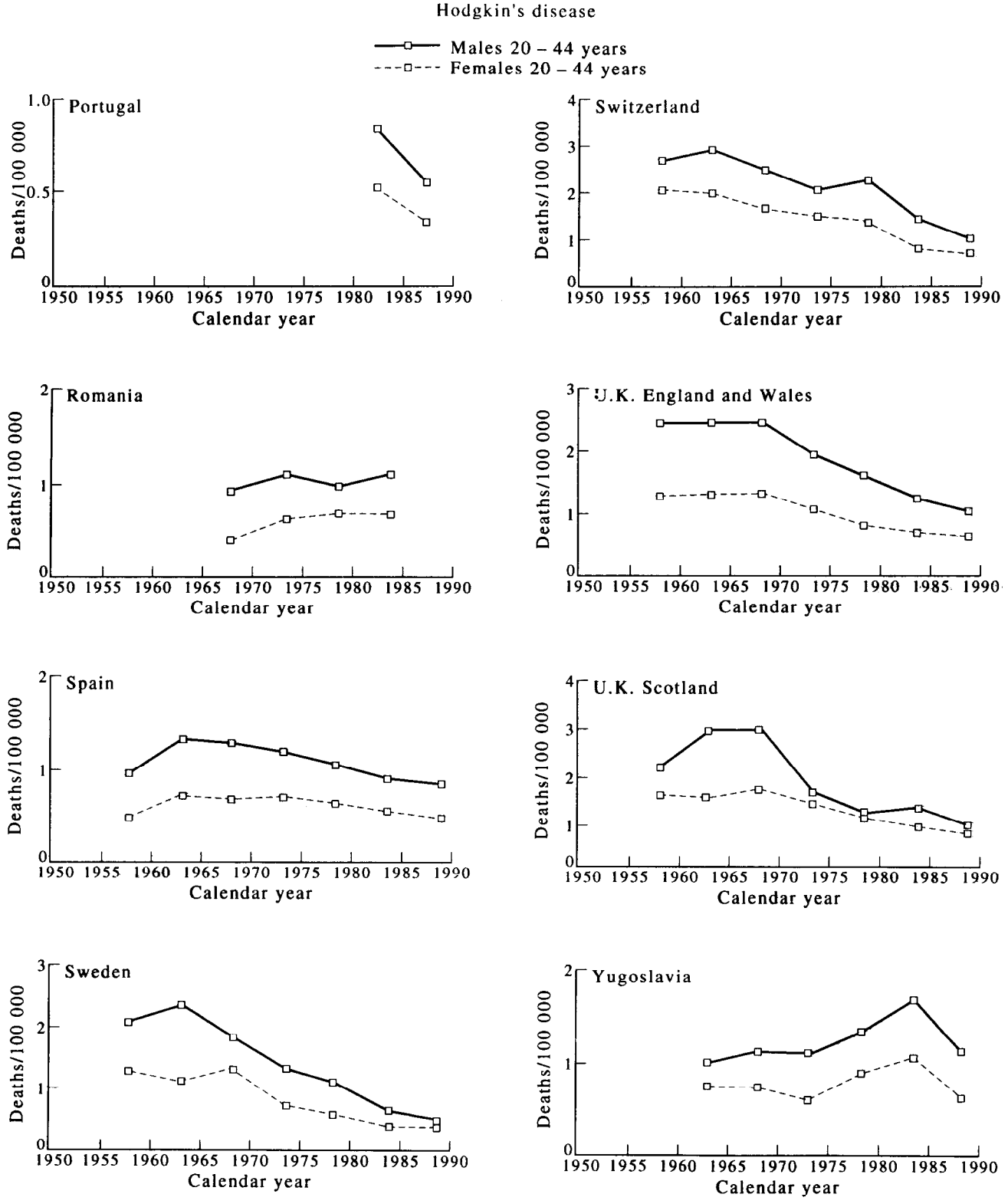
Testis

Males 20 – 44 years




Hodgkin's disease
Males 20 – 44 years
Females 20 – 44 years
Austria
Denmark
Belgium
Finland
Bulgaria
France
Czechoslovakia
Germany, G.D.R.
Deaths/100 000
Calendar year
1950 1955 1960 1965 1970 1975 1980 1985 1990


Hodgkin's disease
Males 20 – 44 years
Females 20 – 44 years
Germany, F.R.G.
Italy
Greece
Netherlands
Hungary
Norway
Ireland
Poland
Deaths/100 000
Calendar year
1950 1955 1960 1965 1970 1975 1980 1985 1990


Hodgkin's disease
Males 20 – 44 years
Females 20 – 44 years
Portugal
Switzerland
Romania
U.K. England and Wales
Spain
U.K. Scotland
Sweden
Yugoslavia
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