

Cancer epidemiology

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Introduction

Cancer epidemiology studies the distribution of cancer in populations and its changes over time and looks at characteristics of different population groups, not only those who get the disease but also those who do not, to find out how these groups differ.

It evaluates the associations between different exposures and diseases to decide whether the observed relationships are likely to be causal. Its ultimate goal is to identify risk factors that may lead to the introduction of effective preventive measures.

Although cancer epidemiology is not a new science, it has matured only in the last half of the 20th century, when communicable diseases underwent a sharp and sustained fall. The development and growth in the field of vital statistics made it possible to study the patterns of cancer mortality. Unfortunately, mortality data published nowadays by the World Health Organization (WHO) are of different quality and may have several biases:

- coverage of the population is incomplete as mortality rates are implausibly low in some countries
- validity of the cause of death information is low in some countries.

The need for more accurate data on cancer patients and the relatively clear-cut pathological case confirmation led to the development of hospital- and population-based cancer registries.

- Hospital-based registries are concerned with recording of information on cancer patients seen in a particular hospital. The main purpose of such registries is to contribute to patient care by providing readily accessible information on all cancer patients, seen in this hospital, the treatment they had

received, and its result. These registries cannot provide measures of the occurrence of cancer in a defined population, because their catchments population, i.e. the population from which all cases arise, is unknown.

- Population-based registries collect data on all new cases of cancer occurring in a well-defined population over a given period of time. The first population-based cancer registry was established in Connecticut in the United States in 1940 with cases registered retrospectively back to 1935. In Europe, the first registry started to operate in Denmark in 1942; others were set up in subsequent decades, so that by 1955, almost 20 existed in various regions and countries (England and Wales, Slovenia, Finland and other Nordic countries, and few others). In some countries cancer registration is nationwide; in others, cancer registries cover only a proportion of the population. The main role of these registries is the provision of data on cancer incidence and prevalence – for some, also survival and mortality. This activity has placed the population-based cancer registry at the center of monitoring programs for cancer and there are few chronic diseases that are as intensively surveyed and characterized across multiple populations as cancer. Since 1964, the data from all the registries have been brought together in the publication ‘Cancer Incidence in Five Continents’. The 2002 volume was published by the International Agency for Research on Cancer (IARC) in conjunction with the International Association of Cancer Registries and records data for up to 50 types of cancer in 215 populations in 55 countries. Many cancer registries are also able to provide follow-up on patients and thereby generate information on survival. This had led to research that assesses comparative survival outcomes within and between populations, e.g. in the EUROCARE studies.

The observation that cancer incidence is different around the world, that it changes over time, and that migrants from low-risk countries attain the risk of their new country contributed to the idea that cancer is a consequence of several environmental risk factors in the broad sense, including physical, chemical, and biological factors in living and occupational environment as well as behavioral and sociocultural factors (e.g. diet, smoking, alcohol consumption, fertility).

Analytical cancer epidemiology with case-control and cohort studies contributed to current knowledge on several factors implicated in the etiology of cancer. Although several studies were conducted before the 20th century, the growth of these studies began after the Second World War. In 1950, three case-control studies, two from the USA and one from Britain, were published, clearly showing the association (probably causal in nature) between

tobacco smoking and lung cancer. Since then, several studies have confirmed this association and a lot of other agents have been identified as being potentially carcinogenic.

Several studies, published in different parts of the world on various potential cancer risk factors are reviewed by interdisciplinary working groups of expert scientists, gathered by the IARC in the IARC Monographs Program. These groups evaluate the weight of the evidence that an agent (including chemicals, complex mixtures, occupational exposures, physical and biological agents, and lifestyle factors) can increase the risk of cancer. Special scientific criteria have been developed that guide the evaluations and are described in the Preamble to the IARC Monographs. Since 1971, more than 900 agents have been evaluated, of which approximately 400 have been identified as carcinogenic or potentially carcinogenic to humans. The complete list of agents evaluated and their classification is regularly updated and available at <http://monographs.iarc.fr/index.php>. This list is a valuable source of information on carcinogenicity for public health and other scientists and national health agencies to use as scientific support for their actions to prevent exposure to potential carcinogens.

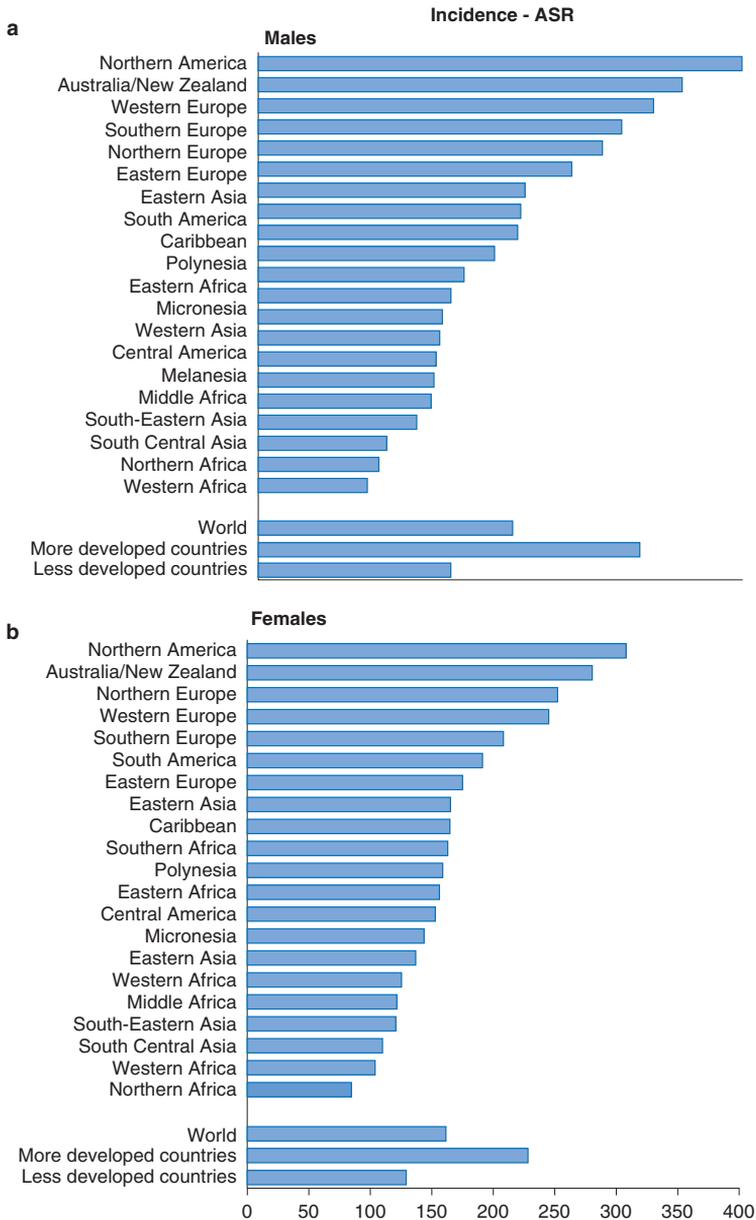
The burden of cancer worldwide and in Europe

There are great regional differences in cancer incidence and mortality overall and at specific organ sites in the world. A valuable tool to analyze these differences is *CANCER Mondial* at <http://www-dep.iarc.fr/>. This website provides access to information on the occurrence of cancer worldwide held by the Descriptive Epidemiology Group of IARC in four databases: original and updated data from volumes I to VIII of *Cancer Incidence in Five Continents*; the WHO Mortality database; and GLOBOCAN 2002. The GLOBOCAN 2002 database presents estimates of the incidence and prevalence of and mortality from 27 cancers for all countries in the world in 2002.

In 2002, there were an estimated 10.9 million new cases (53% among males and 47% among females), 5.1 million in more-developed and 5.8 million in less-developed regions.

Of 6.7 million cancer deaths (57% among males and 43% among females), 2.7 million were in more-developed regions and 4.0 million in less-developed regions. There were an estimated 24.5 million persons living (within 5 years of diagnosis) with all forms of cancer (except non-melanoma skin cancer).

Incidence and mortality rates, standardized to the standard world population in different world regions are presented in Figure 1.1. As age standardization



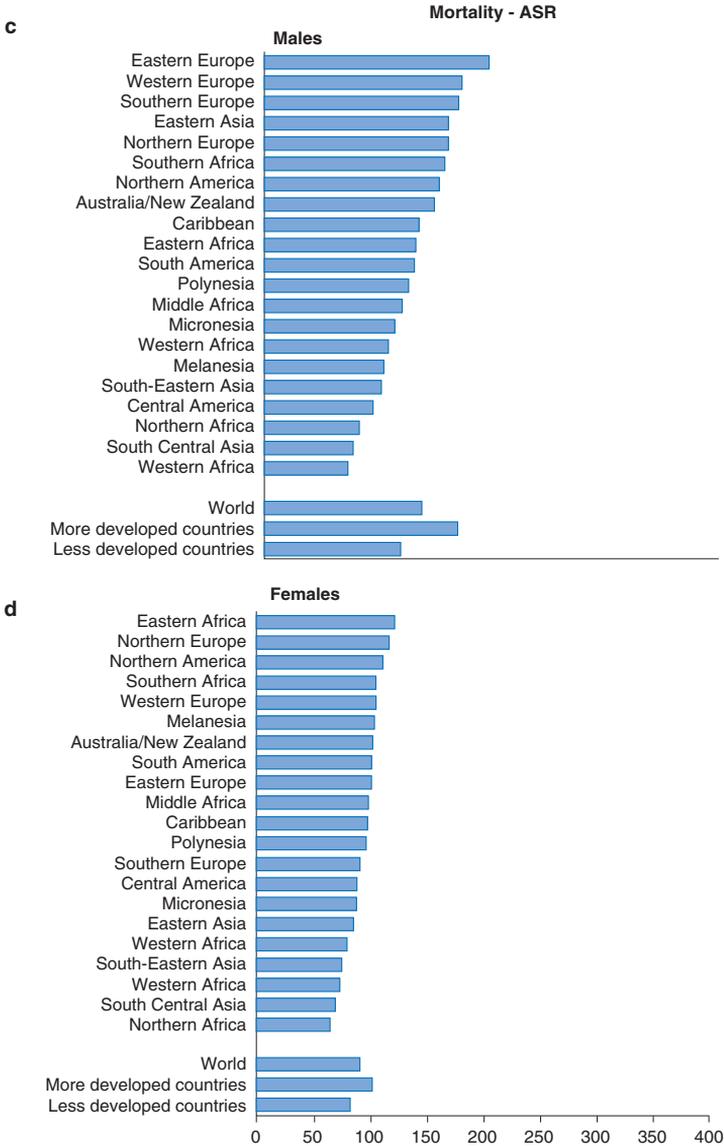


Figure 1.1 Estimated age-standardized cancer incidence and mortality rates (ASR) in different world regions in 2002.

eliminates the effect of different age structures in several populations, so the differences in incidence and mortality rates represent differences in risk due to all other risk determinants.

Nearly a third of the world's new cancer cases (excluding non-melanoma cancer) and a quarter of cancer deaths appear in Europe, for which the estimates of incidence and mortality data are available for the year 2006.

Similarly to the whole world, there are regional differences within Europe in terms of incidence and mortality:

- The overall estimated incidence rates in males ranged from nearly 600/100 000 persons in Hungary to 300/100 000 persons in some South and Eastern European countries and from about 400/100 000 persons in Denmark to less than 250/100 000 in Hungary for females after adjusting for the different age structures to a European standard population.
- Mortality rates show variation from nearly 400/100 000 persons to less than 200/100 000 in males and from nearly 200/100 000 to about 100/100 000 in females.

High all-cancer mortality rates for a number of Central and Eastern European countries despite lower incidence reflect the distribution of most frequent cancers and poor survival of these patients. While several published analyses of trends in cancer mortality in Europe over the past 30 years show, that in the majority of countries of the former European Union (EU), the age-standardized mortality from most common cancer sites has fallen since the late 1980s, the situation is less favorable in the majority of Eastern European countries.

Most frequent cancer types in Europe

Breast, colon and rectum, lung, and prostate were among the most common cancer sites in both sexes in Europe in 2006.

- In the last few years prostate cancer has replaced lung cancer at first place in males, followed by colorectal cancer at third place.
- In females, breast cancer was the most common cancer site, followed by colorectal and uterine cancer.

In terms of mortality, lung cancer was still the most common cause of cancer death in both sexes combined, followed by colorectal, breast, and stomach cancer.

Lung cancer

Lung cancer is still one of the biggest public health problems in Europe, accounting for one-fifth of all cancer deaths. As the most important risk factor for lung cancer is tobacco smoking, trends in lung cancer incidence and mortality reflect the stage of the smoking epidemics in different countries. While in some Western European countries the mortality from lung cancer, especially among younger men has started to decline, due to the modification in the smoking habit from generation to generation, there is an increasing trend in females, especially in Northern Europe.

Colon cancer

Excess calorie intake and insufficient levels of physical activity leading to obesity clearly increase the risk of colon cancer, and its constant rise in incidence have been observed within populations undergoing economic development. The incidence is high in many Western, but also Central–Eastern European countries, e.g the Czech Republic, Hungary, and Slovakia.

While mortality trends tended to decrease in some of the North-Western countries from the 1990s onwards, they were still in the upward direction in many Central and Eastern European countries.

Besides different lifestyles, these differences may be due also to earlier diagnosis, new treatment modalities and hence better survival in some Western, but not to such an extent in Eastern countries.

As screening for colorectal cancer has been shown to be effective, there is a need for organized programs throughout Europe.

Breast cancer

Breast cancer was the leading cause of death from cancer in women in Europe.

Genetic factors, including the major susceptibility genes (*BRCA1*, *BRCA2*), may account for up to 10% of breast cancer cases in developed countries, but their prevalence in the population is too low to explain much of the international variation in risk.

The majority must therefore be a consequence of different environmental exposures. This is evident from studies of migrants, which show quite clearly that incidence rises following migration from low to high incidence countries, particularly if this takes place at young ages.

Besides age and sex, the established breast cancer risk factors include previous breast cancer in one breast, family history of breast cancer, fibrocystic disease, and ionizing radiation (the reported range of relative risk estimates of breast cancer is 2.1 to more than 4).

For others, the reported range of relative risk estimates is low, ranging from 1.1 to 2.0. These include hormonal and reproductive factors, such as early age at menarche, late age at menopause, late age at first birth, late age at any birth, nulliparity, current use of oral contraceptives, and hormone replacement therapy.

All these risk determinants are difficult to change, while lifestyle-related factors, such as body mass index, physical activity, diet, and alcohol consumption should be the goal of primary prevention.

The introduction of organized mammography screening programs throughout Europe will lead to a reduction in breast cancer mortality, where the maximum effect is expected from programs with effective quality control.

Prostate cancer

Prostate cancer is a disease predominantly affecting elderly men. In many European countries, the number of deaths is increasing due to aging of the European male population.

Cervical cancer

Mortality from cervical cancer in Europe is much lower than in the developing world, where 80% of all deaths occur. There are great differences in its incidence and mortality between Eastern and Baltic European countries and other European countries, mostly due to different availability of organized screening programs. They reflect the fact that opportunistic screening, as currently present in the majority of these countries, is not effective.

Sexually transmitted infection with some human papillomavirus (HPV) strains is fundamental to the development of cervical cancer and HPV vaccine already available on the market is hoped to reduce incidence in the years to come; however, screening programs will have to remain, as the vaccine does not protect against all HPV strains. Unfortunately, the current high price of the vaccine, especially for the countries with the highest risk, besides some other scientific questions (e.g. most appropriate age for vaccination) are obstacles to its wider use as a public health measure in all selected target age groups.

Conclusion

Cancer epidemiology has contributed to our knowledge on regional differences in cancer burden and time trends across the world and in Europe. It has helped to identify cancer risk factors, lifestyle-related and environmental, including tobacco, alcohol, dietary habits, and pollution of the working and general living environment, that can partially explain these differences and are important for cancer prevention.

The results from the EURO CARE and other studies have revealed great variations in cancer survival among countries in Europe and worldwide that are mostly due to differences in screening, timing of diagnosis, and quality of treatment. All these findings support the need for comprehensive national cancer control programs that extend from primary prevention and screening to management of disease, rehabilitation, and palliative care.

Further reading

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