Update: Is There a Cancer Epidemic in the United States?

This report was originally written by Alan C. Fisher, Dr.P.H.,
and Wendy Worth, Ph.D. It was revised by Debra A. Mayer, M.P.H., a Research
Associate in Epidemiology at the American Council on Science and Health.

AMERICAN COUNCIL ON SCIENCE AND HEALTH
1995 Broadway, 2nd Floor
New York, NY 10023-5860
Phone (212) 362-7044
fax (212) 362-4919

ACSH accepts unrestricted grants on the condition that it is
solely responsible for the conduct of its research and the dissemination
of its work to the public.

The organization does not perform proprietary research,
nor does it accept support from individual corporations for
specific research projects.

All contributions to ACSH — a publicly funded organization under Section
501(c)(3) of the Internal Revenue Code — are tax deductible.

Individual copies of this report are available at a cost of $5.00.
Reduced prices for 10 or more copies are available upon request.

Research Director: Andrea Golaine Case, M.S.
Art Director: Friederike Paetzold

February 1995-06500
Entire contents © American Council on Science and Health, Inc.

ACSH gratefully acknowledges the comments and contributions of the following individuals who reviewed this report:

Joseph Francis Borzelleca, Ph.D.
Medical College of Virginia

William G. Cahan, M.D.
Cornell University Medical College

Ralph Dittman, M.D., M.P.H.
Houston, Texas

F.J. Francis, Ph.D.
University of Massachusetts

LaNelle E. Geddes, Ph.D., R.N.
Purdue University

K.H. Ginzel, M.D.
University of Arkansas

Ronald E. Gots, M.D., Ph.D.
National Medical Advisory Service

David Kritchevsky, Ph.D.
The Wistar Institute

Lillian Langseth, Dr.P.H.
Lyda Associates

Howard D. Maccabee, M.D., Ph.D.
University of California at San Francisco

Kathleen Meister, M.S.
Nutrition Research Newsletter

A. Alan Moghissi, Ph.D.
Temple University

John S. Neuberger, Dr.P.H.
University of Kansas School of Medicine

Gordon W. Newell, Ph.D., M.S.
Palo Alto, California

R.T. Ravenholt, M.D., M.P.H.
World Health Surveys, Inc.

Edward G. Remmers, Sc.D.
American Council on Science and Health

Robert A. Squire, D.V.M., Ph.D.
Johns Hopkins University School of Medicine

Fredrick J. Stare, M.D., Ph.D.
Harvard School of Public Health

Elizabeth M. Whelan, Sc.D., M.P.H.
American Council on Science and Health

Table of Contents

EDITOR'S NOTE:

Just as this ACSH report was going to press, *The Journal of the National Cancer Institute* published a study that echoed the underlying themes of *Update: Is There a Cancer Epidemic in the United States?*

The paper, by Susan S. Devesa et al,* reported rising incidence rates for certain cancers, stating that: "Much of the recent increase in cancer incidence can be explained by known factors. Improved detection appears to account for most of the increases in breast cancer among women and prostate cancer among men. On the other hand, cigarette smoking is the major determinant of the rise in lung cancer among women, AIDS has led to increases in non-Hodgkin's lymphoma and Kaposi's sarcoma among young and middle-age men, while sunlight exposure patterns have affected the trends in melanoma."

But while incidence rates for some cancers have risen, mortality rates are holding steady or dropping, with the exception of lung cancer attributable to smoking. The paper states: "Mortality rates for total cancer declined by 10 to 32% among males and females in all age groups under age 55 years, while increasing by 3 to 12% at older ages." This pattern would result from the effect of therapies that prolonged the life of individuals with cancer.

An editorial accompanying the article** made some initially troubling but ultimately optimistic predictions. "At about the turn of the century, cancer will become the number one cause of death in American even as its overall mortality rate declines." This will come about because the rate of the current number- one killer, coronary artery disease, is declining even more rapidly than the cancer rate. However, the tide is turning. Treatments continue to improve and prevention will continue to play a "major role in controlling cancer as it has for many of mankind's plagues." The editorial's authors, Dr. Philip Cole and Warren Sateren, predict that "over the next thirty to fifty years [cancer] will recede into the background. This pattern of waxing and waning has occurred for virtually all the great scourges of mankind and it will occur for cancer. The information presented by Devesa and her colleagues and recent national statistics tell us that we are at the turning point."

* Devesa, S.S., Blot, W.J., Stone, B.J., Miller, B.A., Tarone, R.E., Fraumeni, J.F. Recent cancer trends in the United States. *Journal of the National Cancer Institute.* 1994;87(3):175-182.

** Cole, P., Sateren, W. The evolving picture of cancer in America. *Journal of the National Cancer Institute*. 1994;87(3):159-160.

EXECUTIVE SUMMARY

The media and many advocacy groups would have the American public believe that the U.S. is in the midst of a cancer "epidemic." These groups perpetuate the myth that there has been a sudden surge in new cancer cases and deaths and that unknown environmental agents are the cause. The purpose of this American Council on Science and Health report is to provide current cancer statistics and detail the proven causes of cancer. A careful review of the facts reveals:

- With a few exceptions, primarily lung and AIDS-related cancers, there has been little overall increase in the number of new cases of cancer reported or the number of cancer deaths over the last 40 years.
- The number of deaths caused by many forms of cancer has actually decreased, including deaths from Hodgkin's disease and cancers of the cervix, uterus (endometrium), stomach, rectum, testis, bladder and thyroid.
- Modern screening methods, such as mammography for breast cancer and the prostate-specific antigen (PSA) test for prostate cancer, create the appearance of a sudden increase in new cancer cases. There is no correspondingly large increase in mortality from these forms of cancer, indicating that we are finding more previously undetected malignancies.
- Most cancers are related to known lifestyle factors. Among the proven causes of cancer are: tobacco, diet, alcohol, radiation, certain sexually transmitted diseases or reproductive patterns and sunlight. Current research indicates that some individuals may also have a genetic predisposition for certain forms of cancer.
- "Chemicals" in food and the environment do not have a significant impact on overall cancer risk in the U.S.

INTRODUCTION

Despite considerable progress made in research to understand its causes and search for effective treatments, cancer remains a major cause of death in the United States. The term "cancer" actually refers to a large group of over 100 diseases. Although their form and symptoms vary, all cancers begin with an alteration in a normal cell. This altered cell then replicates millions of times, resulting in the unregulated growth and spread of abnormal cells. The American Cancer Society estimates that in 1994 there were 538,000 cancer deaths and 1,208,000 new cases of cancer in the U.S.

A commonly held belief is that the U.S. is now experiencing a cancer "epidemic." A longstanding definition of "epidemic" is a significant increase in a disease's frequency (i.e., incidence) and/or mortality. However, with a few exceptions, most notably lung cancer, statistics reveal that, although fluctuations have occurred for certain types of cancers, there has been little overall change in cancer incidence or mortality rates over the last 40 years. What does exist in the United States is a condition of "excessive prevalence," meaning that a large number of individuals are classified as cancer cases. However, in the case of cancer, what is classified as epidemic should be determined by a comparison of cancer rates over time, among different countries and even among different groups within the same country. Such comparisons do not reveal an overall cancer epidemic in the U.S. today.

Part I of this report focuses on these comparisons. Part II focuses on the known causes of human cancer and what can be done to reduce one's risk of developing any of these many diseases. Before reviewing the comparisons, however, it is important to understand how cancer statistics are typically calculated and the limitations of the sources from which they are obtained.

Ways of Looking at Cancer Data: Terminology

Epidemiology is the study of the distribution and determinants of disease frequency within and between human populations, and the application of the findings to the control of health problems.[1] Cancer epidemiology is a subspecialty of this discipline, which uses standard statistical techniques to compare cancer data from place to place, time to time or group to group. This report will focus only on those techniques that are most useful in addressing the issue of a possible cancer epidemic in the United States.

An important concept in cancer epidemiology is incidence — the number of new cases diagnosed in a given geographic area during a specific period of time. To compensate for variations in number of inhabitants in different areas, incidence is divided by the total population to yield the incidence rate. The measure thus formed is not influenced by population size and can be used for comparison.

Another important concept is cancer mortality or death. This number represents how many people in a given geographic place, during a specified period of time, die of cancer. Usually, when comparing cancer deaths, one calculates mortality or death rates by dividing the number of deaths by the total population of the geographic location.

Theoretically, epidemiologists prefer incidence rates to death rates. Incidence rates are more closely associated with the occurrence of a disease and its causes. Incidence may also provide an important measure of the current success in preventing new cancers. However, incidence rates for cancer can be unreliable; for some cancers, recent trends show either sharp increases or substantial incident fluctuations from year to year. This report will detail some of the "biases" (systematic departures from true values) researchers believe to be responsible for these statistical artifacts.

By contrast, mortality data are the end result of the disease and often are removed from its causes. Such data are also influenced by changes and advances in treatment. However, death rates for cancer are more readily available and are more accurate than incidence rates, because the cause of death appears on every death certificate. (Mortality data have other limitations, with only a 70 to 80 percent accuracy in identifying the cause of death. Autopsy increases the accuracy of mortality data up to 99 percent.) In practice, epidemiologists frequently use cancer death rates instead of incidence rates. Death rates most closely resemble incidence rates when the average survival time after diagnosis is short. For example, in lung cancer the incidence and death rates are closer than would be the case for prostate or skin (non-melanoma) cancer.

Often, incidence and death rates are standardized or "adjusted" for an additional factor, namely age. The adjusted rate is composed of a weighted average for specific age groups. The weight given to each age group is determined by reference to a standard population. Since cancer risk increases rapidly with age, and people in the U.S. are living longer today, failure to adjust cancer rates for age can convey the impression that there is an overall increase in cancer when in fact there is none. When one compares cancer rates over time, between places or among racial and ethnic groups where the age distribution varies, one generally adjusts the rates to a standardized age distribution to make them comparable. Thus, changes in cancer frequency over and above those influenced by a changing age distribution become detectable.

Incidence and death rates are often reported per 100,000 persons. It is common to report rates for a one-year period corresponding to a given calendar year.

Sources of Cancer Data in the United States

In the United States there is a primary data source for incidence rates and another for death rates.

The National Cancer Institute (NCI) has conducted surveys of cancer incidence in the past (1937, 1947, 1969-71). It was not until 1973, however, that it began to monitor cancer incidence constantly through the Surveillance, Epidemiology and End Results (SEER) Program. This program involves collection of data from cancer registries in different geographic areas. The areas presently covered are the states of Connecticut, Hawaii, Iowa, New Mexico and Utah. Also included are metropolitan Atlanta, Detroit and the San Francisco-Oakland and Seattle-Puget Sound areas. The areas covered by SEER have changed slightly over the years. The diverse geographic, ethnic and racial groups monitored through the SEER program represent approximately 10 percent of the U.S. population. The quality and completeness of data vary among cancer registries, which often employ different methods of case definition.

Cancer mortality data come from the National Center for Health Statistics (NCHS) and are obtained from death certificates throughout the U.S. Such data have been available since 1933.

Every year the American Cancer Society (ACS) uses data from the NCI and NCHS to compile estimates of both cancer incidence and mortality for the upcoming year. An annual ACS publication presenting this information is called *Cancer Facts and Figures*.[2]

Accuracy

All cancer data sources have limitations; some are inherent in the data and can result in bias during examination of the statistics for a specified period. In other circumstances, biases cause concern when we compare data from different time periods. Different kinds of bias may characterize each period.

The major limitation of the recent NCI data (SEER) is that the geographic areas covered in the survey may not be representative of the United States as a whole but were chosen because they represent epidemiologically diverse populations. Information included for incidence rates by site, age, race and ethnicity allows epidemiologists to monitor changes in incidence over time and make comparisons among groups. Mortality rates by cancer site for the SEER areas and the U.S. as a whole correspond closely for the white population only.

In comparing incidence rates over time for NCI data, a number of important biases become evident:

- There has been a change in the geographic areas covered. There is also a significant difference in the areas covered by the earlier NCI studies compared to those covered by SEER.
- Accuracy of the area population estimates differs for the various time periods.
- Biases can be introduced if cancer patients are listed more than once in a study. Only new cases of cancer should be included for the period under study.
- Changes in the effort and motivation of physicians in registering cases of cancer incidence can also be a source of error.
- Finally, over the years there have been many technical changes in the definition of a cancer, as well as changes in the methods and ability to diagnose the many forms of the disease.

When evaluating current cancer incidence, one must remember that seemingly elevated statistics may merely reflect the development of more sensitive diagnostic procedures. Many experts believe that current cancer incidence rates are also inflated by a preponderance of “over diagnosis” of growths that are biologically malignant but do not spread quickly or immediately threaten the individual’s health. An example of over diagnosis can be seen in the case of prostate cancer. In a previous report,[3] the National Cancer Advisory Board identified this problem as inflating some cancer rates.

Data on death rates from the National Center for Health Statistics (NCHS) are subject to certain problems. Death certificates are the source for these data and have remained constant.

However:

- Rules governing the registration of deaths may vary over time from one state to another, thus introducing a source of inaccuracy and making comparisons more difficult.
- Classification systems used to report deaths have varied over time. Even when the exact type of cancer is detected while the patient is alive, the correct information may not appear on the death certificate.
- Often only one underlying cause of death appears on a death certificate, and therefore some cancer deaths are incorrectly attributed to secondary causes or even missed entirely. Such errors are more likely to occur for elderly patients and have been more of a problem in the past than now. In cases where a patient had widespread cancer, the primary site of the disease may not be known and/or properly recorded, and thus the type of cancer is not specified on the death certificate.
- Sometimes a misdiagnosis of the type of cancer occurs. Such errors can also affect incidence rates.
- The frequency of post-mortem exams has declined from about 60 percent in the 1950-60 period to only about 12 to 14 percent today. As autopsy is the most effective means of diagnosing cancer mortality, this decline indicates a decrease in quality of the data base.

The annual *Cancer Facts and Figures* from the American Cancer Society (ACS) is a major source of cancer information disseminated to the public. It is thus fair to ask if the estimates of cancer death and incidence contained in this publication are accurate.

Because it takes time to compile nationwide information from death certificates, the ACS uses death rates that are three to five years old to project trends for the coming year. In general, their track record has been very good. A comparative study[4] found that when actual data became available and were compared to ACS estimates for specific sites, estimates differed by only two to four percent. The more common the cancer type, the better the estimate. Estimates for sites with rapidly changing mortalities (e.g., lung cancer in women) have been consistently low.

ACS estimates of incidence tend to be less accurate than death estimates, partly because the actual rates from which estimates are made are limited to locations covered by SEER. Yet, estimates for incidence rates are made for the whole country. These estimates also depend upon the accuracy of population and mortality projections, which may contain errors. Incidence estimates for states covered by SEER have been in error by as much as 22.3 percent, though, in fairness, they have also been within one percent of actual figures. It is not uncommon, however, for these figures to be off by 15 to 20 percent.

One problem with all the above sources of data is their comparability. For example, the ACS often reports data in actual numbers rather than rates, while the SEER and NCHS figures are reported as rates. In addition, when rates are age adjusted, they are not necessarily standardized to the same base population. This creates additional error. Thus, comparisons of cancer statistics between publications or over time must be made with caution.

PART I: TIME TRENDS IN THE UNITED STATES

Overall Incidence and Mortality Comparisons

An important way to examine whether there is a U.S. cancer epidemic today is to look at patterns over time for cancers at specific sites. A comparison of the relative changes over time in both incidence and mortality rates can prove useful. Table 1 provides such a comparison. As illustrated in the table, certain forms of cancer have had dramatic increases in incidence in recent years without a corresponding increase in mortality. Such changes may be due largely to increased screening or improved treatment methods for the disease or both.

An examination of Table 1 reveals that deaths since 1973 caused by Hodgkin's disease and cancers of the cervix, uterus (endometrium), stomach, rectum, testis, bladder, thyroid, oral cavity and pharynx have declined by more than 15 percent.

Increases in mortality of greater than 15 percent have occurred since 1973 for lung cancer, melanoma, non-Hodgkin's lymphoma and multiple myeloma. Lung cancer mortality rates support the evidence of an epidemic of lung cancer in the U.S. Smoking has long been implicated as the main cause of these elevated rates. Increases in cigarette smoking from 1900 until the 1960s transformed this once rare disease into the leading cause of cancer death. The increase in melanoma mortality parallels a larger increase in the incidence of the disease. This trend is mainly caused by overexposure to the sun in fair-skinned individuals. The increases in the incidence and mortality of non-Hodgkin's lymphoma and multiple myeloma may be due to improved diagnosis in the detection of the disease. As discussed later in this report, much of the recent increased incidence of these diseases in younger age groups may be attributed to the increasing prevalence of human immunodeficiency virus (HIV) infection, which is associated with these forms of cancer.

Cancer of the breast and prostate have both increased in incidence without a corresponding increase in mortality. Early detection of these diseases, as well as increased utilization of screening procedures such as mammography, the digital rectal exam and the prostate-specific antigen (PSA) test, may largely explain these trends. The 23 percent increase in the incidence of brain and other central nervous system (CNS) tumors may be explained by the increased availability of X-ray computerized tomography in the diagnosis of previously undetected tumors. Some theorize that the increase in CNS tumor incidence may be the result of the exposure to dental X-rays. Specifically, earlier models of X-ray equipment resulted in much higher exposure than experienced today. The increase in kidney cancer incidence and the lesser increase in mortality can be at least partially attributed to cigarette smoking.

Changes in mortality and incidence since 1973 have remained fairly stable for most of the remaining forms of cancer. Increases in esophageal and liver cancer can be largely attributed to the combined effects of alcohol and tobacco.[5]

TABLE 1. Cancer Sites Ranked by Percentage Change in Mortality and Incidence Between 1973 and 1987. Based on Rates per 100,000 Age-adjusted to the 1970 U.S. Standard Population.

	Percentage change, 1973-1987	
Cancer site or type	**Mortality**	**Incidence**
Greater than 15% decrease in mortality and incidence		
Hodgkin's disease	-49.5	-15.9
Cervix	-39.6	-36.4
Stomach	-29.4	-20.5
Uterus (endometrium)	-19.8	-26.1
Greater than 15% decrease in mortality but stable or increasing incidence		
Testis	-60.0	39.0
Rectum	-39.9	-3.3
Bladder	-22.7	12.3
Thyroid	-20.6	14.6
Oral cavity and pharynx	-16.2	-1.3
Greater than 15% increase in mortality with increasing incidence		
Lung	34.1	31.5
Melanoma	29.8	83.3
Multiple myeloma	23.6	10.5
Non-Hodgkin's lymphoma	21.7	50.9
Greater than 15% increase in incidence with smaller change in mortality		
Kidney	12.9	27.0
Brain, other nervous system	9.4	23.0
Prostate	7.2	45.9
Breast	2.2	24.2
Fairly stable mortality and incidence		
Esophagus	11.3	12.3
Ovary	-6.4	-6.8
Larynx	-6.0	0.5
Leukemia	-5.6	-10.2
Liver	-4.7	14.5
Pancreas	-2.0	-5.6
Colon	-1.6	10.4
All sites	5.4	14.6

* Negative numbers indicate a percentage decrease.
Source: B.K. Henderson, et al., *Science* 254: 1131-1137, 1991.

Incidence: Specific Trends

The availability of data on incidence rates over time is limited. As mentioned earlier, before the SEER program, nationwide NCI cancer studies were used. Using two of these points in time (1947-50 and 1969-71) and the SEER results, the trends presented in Figures 1 and 2 emerge.

Changes in incidence rates seen in lung, breast and prostate cancer are of particular interest in Figures 1 and 2. As illustrated in Figure 1, male lung cancer rates have recently declined, from a high of 87 per 100,000 in 1983 to 80 in 1990. This decline in incidence, however, is limited to men under 55 years of age. This is the first such decrease in 50 years and corresponds to a substantial decrease in smoking patterns among men beginning about 20 years ago. Among women the story is different: Lung cancer incidence is still increasing steadily in women. No such decrease is expected for 15 to 20 years because more young women are smoking.

Breast cancer incidence rates may illustrate the effects of increased screening for the disease. The female breast cancer incidence rate increased from 85.2 per 100,000 in 1980 to 112.4 in 1987. In 1988, incidence rates actually decreased to 109.6 and further decreased in 1989 to 104.6. This recent trend appears to indicate a turnaround in breast cancer incidence rates. This trend supports the view that the increase during the 1980s was due to early detection resulting from the increased use of mammography.[6]

Prostate cancer shows a progressive increase in the period covered. Doll and Peto[7] believe this pattern to be the result of a “vigorous search for lumps” resulting in diagnosis of the disease in cases where it is associated with old age and is not life threatening. Frequently, this apparent increase is detected as a result of biopsies for noncancerous conditions. However, the rise in incidence is mainly due to ultrasound examination and the routine use of the prostate-specific antigen (PSA) test. The average age at diagnosis for prostate cancer is about 73.

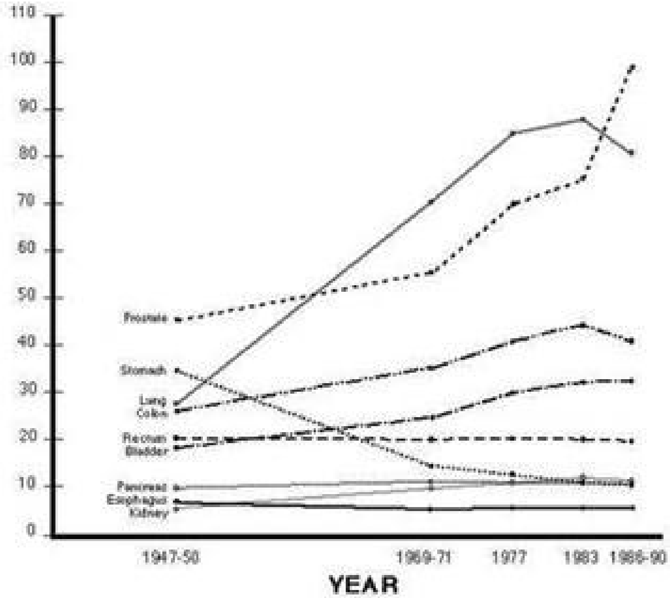
Age-specific Incidence Band

Thus far, we have used age-adjusted comparisons of incidence rates. Although these rates display useful trends, they do not give the full picture. Cancer becomes 30 times more common in women and 100 times more common in men as age increases from 25 to 75 years. Changes in age-adjusted incidence at all ages reflect changes almost entirely in the older age groups. In order to assess the effect of recent changes in treatment and the prevalence of cancer-causing agents, trends in the younger age groups are particularly useful. The trends in young adults reflect only relatively recent changes in the prevalence of carcinogenic agents and are not complicated by exposures in the distant past. Also, young people tend to adopt new health habits and/or risk factors more readily than older individuals.[8]

Cancer incidence in the younger age groups has increased for certain forms of cancer. Examination of the trends for various types of cancer at 20 to 44 years of age reveals that increases in both sexes can be accounted for by the four types of cancer listed in Table 2 (see page 15). The biggest increase is seen in non-melanomatous skin cancer, which includes Kaposi’s sarcoma. The second biggest increase is seen in non-Hodgkin’s lymphoma. In both cases, the increases are far greater in men and can be attributed to the association of these diseases with the acquired immunodeficiency syndrome (AIDS). Thus, the increased incidence rates for cancer in this age group illustrate the introduction of a known cancer promoting agent into the population — HIV.

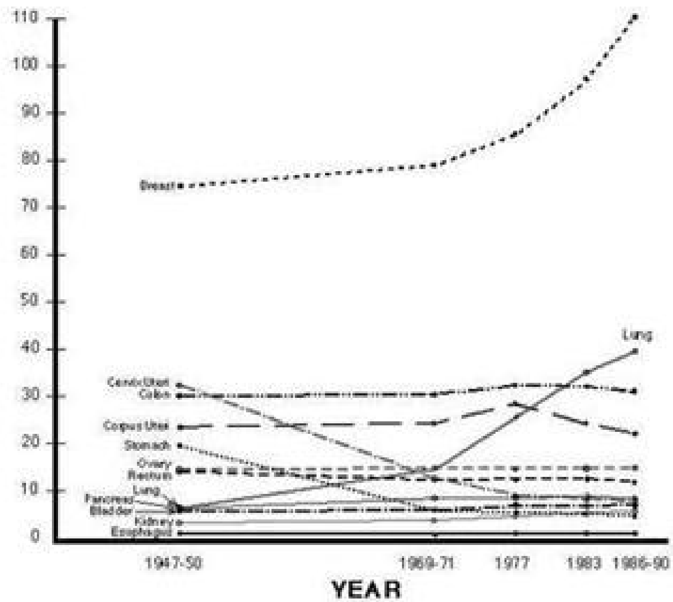
The increases in melanoma are attributable to sun exposure in light-skinned populations. At the present time, there is no explanation for the increase of testicular cancer in this younger age band.[1]

FIGURE 1: AGE-ADJUSTED CANCER INCIDENCE RATES FOR SELECTED SITES. WHITE MALES, UNITED STATES.



Source: Data from the NCI cancer incidence surveys (1947-50 and 1969-71) and SEER (1977,1983, 1986-90) adjusted to the age distribution of the 1970 U.S. census population.

FIGURE 2: AGE-ADJUSTED CANCER INCIDENCE RATES FOR SELECTED SITES. WHITE FEMALES, UNITED STATES.



Source: Data from the NCI cancer incidence surveys (1947-50 and 1969-71) and SEER (1977,1983, 1986-90) adjusted to the age distribution of the 1970 U.S. census population.

TABLE 2. INCREASES IN RECORDED INCIDENCE OF CANCER: SEER PROGRAM, 1973-1977 AND 1983-1987, AGES 20-44 YEARS. (INCIDENCE PER 10,000 PER YEAR)

Type of Cancer	Men		Women	
	1973-77	1983-87 as % of' 1973-77	1973-77	1983-87 as % of' 1973-77
Testis	7.85	139*	—	—
Melanoma	6.65	129*	8.28	131*
Non-Hodgkin's lymphoma	3.67	174*	2.72	116*
Skin, non-melanoma	0.37	2,246*	0.41	161*
Four types	18.54	185*	11.41	128*
Other cancers	42.83	96	96.18	99
All cancers	61.37	123	107.59	102

*p ≤ 0.05

Source: Doll, R. "Progress Against Cancer: An Epidemiologic Assessment." *American Journal of Epidemiology*, 134 (7): 675-688, 1991.

Table 3 illustrates three forms of cancer that have decreased in incidence during the period covered. The reduction in lung cancer incidence is due to the decreasing number of young men taking up smoking. The 22 percent decrease in cancer of the cervix in women may reflect the increased use of the Papanicolaou (Pap) smear as a screening method. This test can detect cervical changes in the precancerous stage. If such changes are diagnosed early, they can usually be treated successfully, and the patient will not develop cancer. The reason for the decrease in stomach cancer may be attributed to improved refrigeration, hygiene and improved food preservation techniques. Again, the trends in this age band illustrate relatively recent changes in the health practices in the United States.[8]

Mortality

Figures 3 and 4 (see page 17) present death rates for males and females respectively from 1930 until 1990 (the latest data available as of this writing). An important advantage of this data set is the availability over time.

The sharp increase in deaths from lung cancer is apparent, as is the sharp decrease in deaths due to stomach cancer. The other forms of cancer tend to show relatively steady death rates, especially in recent years. There is no marked increase in mortality from prostate or breast cancer. This point supports the argument that increases in incidence are due to greater detection of less dangerous cancers and/or are countered by improved treatment. Death rates from uterine cancer also declined over the entire period, and those for colon and rectal cancer show

TABLE 3. REDUCTIONS IN RECORDED INCIDENCE OF CANCER: SEER PROGRAM, 1973-1977 AND 1983-1987, AGES 20-44 YEARS. (INCIDENCE PER 10,000 PER YEAR)

Type of Cancer	**Men**		**Women**	
	1973-77	**1983-87 as % of 1973-77**	**1973-77**	**1983-87 as % of 1973-77**
Stomach	1.10	92	0.64	84
Lung	5.90	81*	4.22	91
Cervix	—	—	12.34	78*
Other cancers	30.69	101	27.13	102
Total	37.69	99	44.33	94

*p ≤ 0.05
Source: Doll, R. "Progress Against Cancer: An Epidemiologic Assessment." *American Journal of Epidemiology*, 134 (7): 675-688, 1991.

a slight downward trend. Deaths from other cancers indicate a relatively steady rate in recent years.

Cancer in Minorities

By comparing racial and ethnic groups at the same point in time, we can identify which groups have high rates for specific cancers as well as possible differences in lifestyles. These comparisons have been examined for men and for women from the 1930s until 1990. Comparing groups at the same point in time allows for the elimination of biases in the data attributable to changes in recording procedures and diagnoses with the passage of time.

In 1994, of the expected 1,208,000 diagnosed cancers in the United States, about 120,000 will be among black Americans and 35,000 among other minority groups.

In general, cancer incidence and mortality rates are higher for black Americans than for white Americans. In 1990, the incidence rates were 423 per 100,000 for blacks as opposed to 393 for whites. The mortality rates for the same year were 230 for blacks and 170 for whites. Black Americans have significantly higher incidence and mortality rates for multiple myeloma and cancer of the esophagus, uterus, cervix, stomach, liver, prostate and larynx.[2]

Incidence and mortality rates for other minority groups, such as Hispanics, are lower than those for white or black Americans. These comparisons confirm that blacks in the U.S. experience many forms of cancer more frequently than do other groups. The specific causes for these increased rates may be the risks associated with various aspects of lifestyle and differences in access to health care.

FIGURE 3. CANCER DEATH RATES BY SITE, MALES, UNITED STATES, 1930-90.
Rates are per 100,000 and are age-adjusted to the 1970 census population.
Data from National Center for Health Statistics and Bureau of the Census, United States.
Source: American Cancer Society, *Cancer Facts and Figures*. New York, 1994.

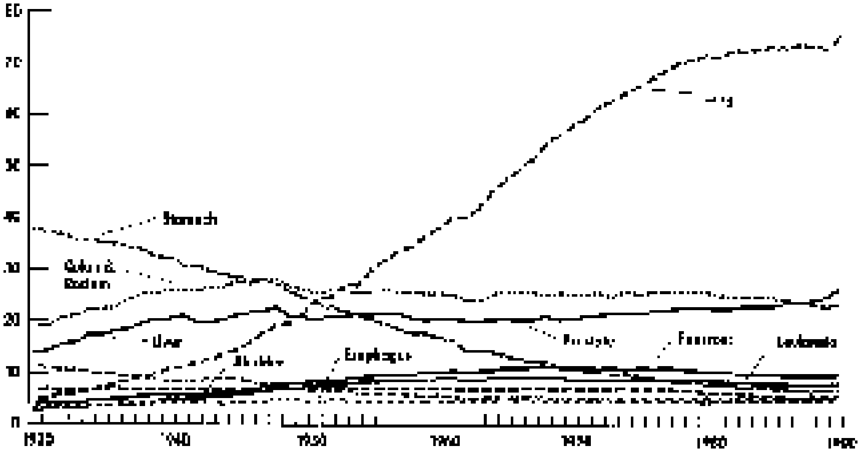
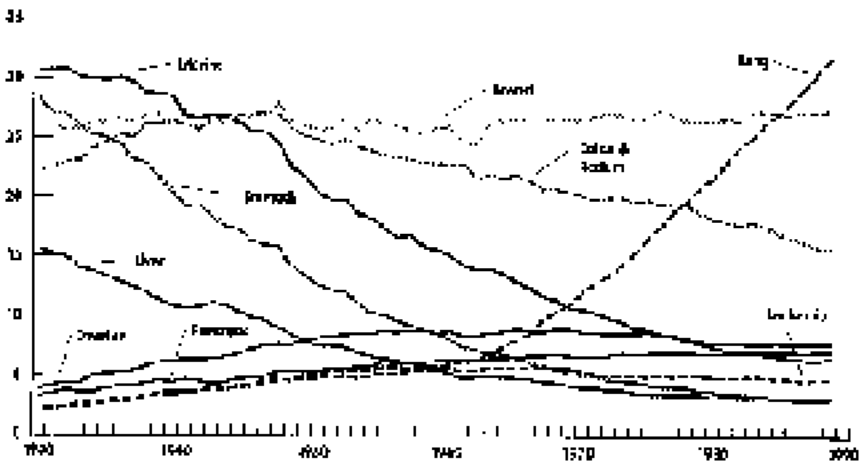


FIGURE 4. CANCER DEATH RATES BY SITE, FEMALES, UNITED STATES, 1930-90.
Rates are per 100,000 and are age-adjusted to the 1970 census population.
Data from National Center for Health Statistics and Bureau of the Census, United States.
Source: American Cancer Society, *Cancer Facts and Figures*. New York, 1994.



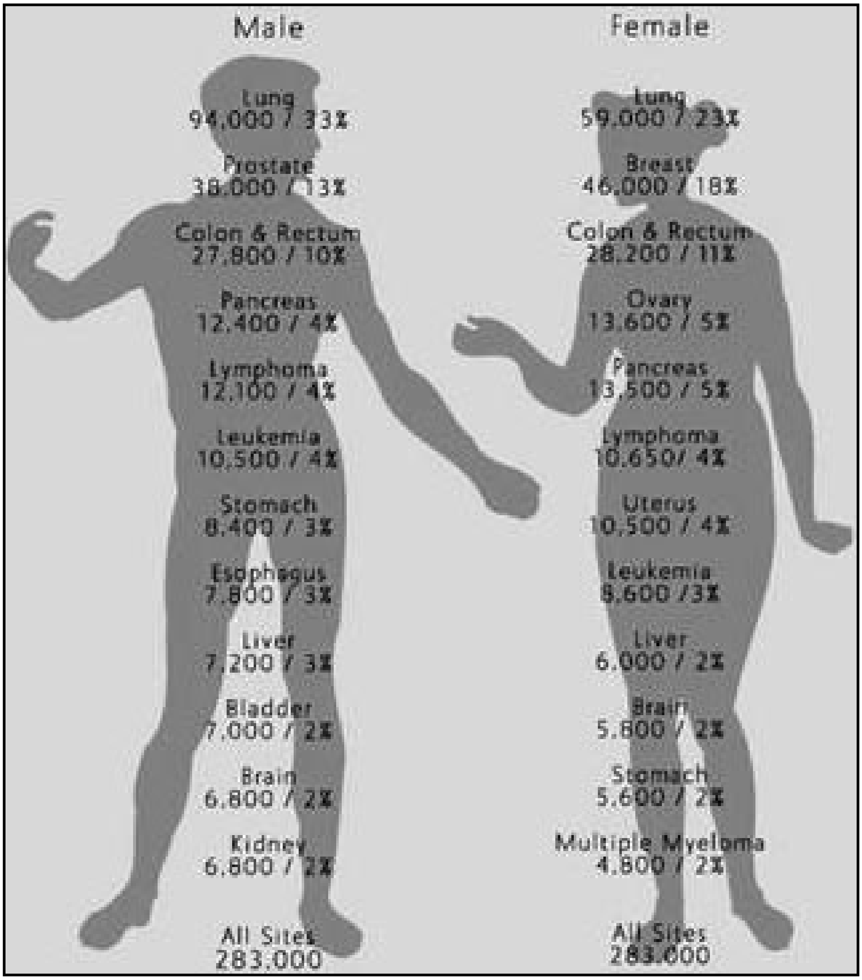
Another Way of Looking at Current Patterns: Gender

Each year, the American Cancer Society (ACS) prepares estimates of the distribution of cancer incidence and death by site and sex for the upcoming year. Since their projections for mortality tend to be much more accurate than those for incidence, only the mortality estimates are presented here in Figure 5.

The ACS projected that 33 percent of all cancer deaths among men in 1994 would be the result of lung cancer. For women, the corresponding figure is 23 percent. The latter figure is of particular significance. In 1987, lung cancer surpassed breast cancer as the major cause of cancer death in American women.

International Comparisons — Sources of Data

The major source of incidence and mortality rates for international disease is the World Health Organization (WHO) and specifically its affiliate the International Agency for Research on Cancer (IARC). Periodically, IARC publishes international incidence data, the latest volume being *Cancer Incidence in Five Continents, Volume V* (1987). This volume contains data from 58 cancer registries, although it does not cover all countries on every continent. WHO also publishes updated data on mortality.[9]



Comparisons of Cancer Statistics

Comparisons of cancer incidence and mortality among countries present many potential sources of error. Data for each country are subject to the kinds of error for incidence and mortality discussed earlier for the U.S. Since the types of errors vary by country and registry, comparisons are of limited value.

Incidence data are usually based on a small number of registries in a particular country. The data come from specific regions, states, counties and metropolitan areas. It is unclear how representative these registries are of the total population of the country. In addition, the extent to which people use medical services (often varying according to age), the availability and affordability of these services, the level of diagnostic ability and the quality of data in the registry — compliance in reporting, careful checks and "cleaning" of the data — may all differ by registry and country. For these reasons, we limit our analysis to a comparison of mortality data.

A major problem with mortality rates is that the level of technology used in diagnosis and the medical treatment given to the patient can affect lifespan. Therefore, a high or low mortality rate may not truly reflect the cancer mortality, but rather the influence of the level of diagnosis and treatment. For example, the mortality rate may reflect the level of medical sophistication within a country or registry area.

Internationally compared cancer mortality data are age-standardized to a world standard population. Sometimes different world standard populations are used for different continents. However, despite this precaution, the influence of age can exert an effect on the data through such processes as differential use of diagnostic procedures and treatment facilities by various age groups.

TABLE 4. U.S. MORTALITY RATE PER 100,000 AND RANK AMONG 46 COUNTRIES FOR CANCER, SELECTED SITES BY SEX, 1988-91*

	Male		Female	
	Rate	Rank	Rate	Rank
All sites 1	64.4	24	110.6	11
Oral	3.72	9	1.31	2
Colon & Rectum	16.7	20	11.4	19
Lung	57.1	10	24.7	2
Breast	—	—	22.4	16
Uterus /Cervix	—	—	2.6	33
Other			2.6	33
Stomach	5.24	6	2.34	6
Prostate	16.8	17	—	—
Leukemia	6.3	8	3.8	9

* Age-adjusted death rates per 100,000 population. Rates are adjusted to the WHO world standard population.

Source: *Cancer Facts and Figures*, American Cancer Society, New York, 1994.

Mortality rates are available for 46 countries. Table 4 presents the U.S. world standardized rate and rank among these countries for eight major cancers. The overall rates and ranks indicate no evidence for a cancer epidemic for either sex in the U.S. To the contrary, the data suggest a relatively stable state, with only minor exceptions.

Recent research has demonstrated a strong genetic component for cancer. However, scientists believe that most cancers in the U.S. are "environmentally related." In particular, many aspects of lifestyle are known to increase an individual's cancer risk.

The importance of environment in cancer causation has been illustrated dramatically by studies of migrants from one part of the world to another. They or their descendants quickly adopt the cancer patterns typical of their new home. It is also significant that dramatic changes in cancer rates sometimes occur in only a few decades. Genetic changes cannot account for this; environmental changes can.

Since 1970, professional and popular articles have frequently cited the estimate that "80 to 90 percent of all cancers are environmentally induced." This estimate was originally calculated by the International Agency for Research on Cancer (IARC), a World Health Organization affiliate. The figure has often been misinterpreted, leading to the mistaken impression that 80 to 90 percent of all cancers are due to known environmental factors such as air and water pollution, industrial chemicals, food additives and contaminants.[10]

In assessing the meaning of this controversial statement, we must emphasize two points. First, saying that 80 to 90 percent of cancer is environmentally caused is not the same as saying that we know what these factors are and that we can control them effectively. The specific causes of most cancers remain unknown. Second, our "environment" is not limited solely to our physical surroundings and man-made chemicals. Many scientists now believe that cultural and personal habits contribute more to cancer causation than environmental pollution or toxic chemicals. In its broadest sense, then, our environment encompasses factors such as tobacco (smoking and smokeless tobacco use), diet, sexual and reproductive patterns, alcohol consumption, sunbathing and other aspects of lifestyle, as well as our purely physical surroundings. This nature/nurture controversy will eventually be laid to rest as evidence for genetic dispositions to a variety of environmental factors accumulates.

Tobacco

Lung cancer is the leading cause of cancer death in American men and has now surpassed breast cancer as the leading cause of cancer death among American women. In 1994 more than 153,000 people in the United States are expected to die of lung cancer. Ninety percent of those deaths are directly attributable to smoking. Male smokers are up to 22 times and female smokers up to 11 times more likely to die of lung cancer than are nonsmokers.

Before 1930, lung cancer was a rare disease. In 1912, a physician commenting on U.S. disease patterns wrote: "There is nearly a complete consensus of opinion that primary malignant neoplasms of the lung are among the rarest forms of disease." However, by 1950, clinical and statistical evidence clearly demonstrated a large increase in lung cancer among men. Numerous clinical, epidemiological and laboratory studies have confirmed that this increase in lung cancer was directly related to cigarette smoking.

Smoking acts to increase cancer risks for other body sites as well. In fact, the Surgeon General has estimated that nearly 40 percent of all cancers are caused by use of tobacco products. Tobacco smokers have greater risks than nonsmokers for cancers of the larynx, trachea, oral cavity, pharynx, esophagus, bladder and pancreas. Smoking is associated with increased risk of developing leukemia and cancers of the cervix, kidney and liver. Most recently, a study published in the *Journal of the National Cancer Institute* linked smoking to colon cancer — a previously unrecognized connection.[11] There is a synergistic effect of smoking and alcohol use that greatly increases the risk of cancer of the larynx, oral cavity and esophagus.

Most research suggests that many chemicals found in tobacco smoke are carcinogenic agents. A few of the carcinogenic agents found in cigarette smoke are:

- methylflouranthrenes
- benzo(a)anthracene
- beta-napthylamine
- dibenzo(c)carbazole
- benzo(a)pyrene
- methylbenzo(a)pyrene
- dimethylnitrosamine

Other factors are also important. These include the length of time a person has smoked, the number of cigarettes smoked per day, the total number of cigarettes consumed and how deeply the smoke is inhaled.

However, there is hope for current smokers. The 1990 Surgeon General's Report cited "major and immediate" health benefits of smoking cessation for men and women of every age group. For example, former smokers live longer than continuing smokers and enjoy reduced risk of lung cancer, other cancers, heart disease, stroke and chronic lung disease.

Diet

Americans have been led to believe that the link between specific dietary factors and cancer is solid and convincing and that dietary modification should be the top priority in cancer prevention. The facts about diet and cancer are as follows:

- An impressive body of scientific evidence shows that low intake of fruits and vegetables is associated with increased risks of cancer. The current recommendation that all Americans should consume at least five servings of fruits and vegetables daily has a sound scientific basis.[12]
- The current scientific evidence does not warrant recommendations for widespread supplementation with antioxidant vitamins (vitamin C, vitamin E, or ß-carotene). Clinical trials scheduled to be completed within the next decade should provide definitive evidence on the value of antioxidant supplementation.
- Dietary fiber has not been convincingly linked with reduced risks of cancer. However, fiber does have other health benefits.
- Reducing dietary fat intake may reduce the risk of colon cancer but not breast cancer. Evidence for other cancer sites is inconsistent. It is possible that effects attributed to dietary fat may actually be due to related factors, such as total caloric intake.
- Reaching and maintaining a reasonable body weight is an important health priority. Obesity increases the risk of hypertension, diabetes and coronary heart disease; and it may also increase the risk of some types of cancer, especially in women.
- Recommendations that Americans should minimize consumption of cured, smoked or pickled foods do not have a sound scientific basis.
- "Chemicals" in food — including naturally occurring substances, intentional additives, and contaminants — do not have a significant impact on cancer risk in the United States.

Alcohol

Heavy alcohol consumption is associated with increased cancer risks. "Heavy" alcohol consumption is defined in most epidemiologic studies as the consumption of roughly three drinks or more per day. Excessive alcohol intake, especially in combination with cigarette smoking, dramatically increases the risks of cancers of the mouth, larynx and esophagus. Alcohol abuse is also associated with an increased risk of liver cancer, but it is unclear whether this is a cause-and-effect relationship. However, alcohol abuse needs to be distinguished from the "moderate" consumption of alcoholic beverages. The term "moderate drinker" generally refers to an individual who consumes an average of approximately one to two drinks per day. This is a level that in most clinical and epidemiologic studies is not associated with the disease conditions that relate to alcohol abuse.

Recent reports that the consumption of even moderate amounts of alcohol might increase a woman's risk of breast cancer have aroused understandable concern. However, the scientific evidence on this issue is far from conclusive at this time. Most epidemiological studies have found an association, usually a weak one, between alcohol and breast cancer, while others have found no association. In some studies, the association was seen only in women with pre-menopausal breast cancer, not in the larger number who develop the disease after menopause. A few reports, including one from a large ongoing cohort study of U.S. nurses, indicate that breast cancer risk is increased even in moderate consumers of alcohol,[13] but others suggest that only heavy drinkers of alcohol have a significant increase in risk. No biological mechanism by which alcohol might influence breast cancer risk has been established, and it is unclear whether the increased risk seen in some epidemiological studies is attributable to alcohol per se or to some other characteristic of women who drink alcohol as opposed to those who abstain.

Some epidemiological studies have associated the drinking of large amounts of beer with an increased risk of rectal cancer; others have not shown the relationship. If the association is real, it may be attributable to carcinogenic substances called nitrosamines that may be produced during brewing. The nitrosamine content of beer sold in the U.S. has decreased in recent years as a result of improvements in brewing methods. Therefore, it is uncertain whether prior epidemiological findings are applicable to the types of beer currently on the market.

Radiation

Radiation is a proven cause of cancer. However, as with many other agents, "the dose makes the poison." Scientists now know that excess radiation will cause certain types of cancers — in particular, leukemia, lung, breast, stomach and bone (but generally not pancreatic, prostate, cervical or uterine) — some 20 to 30 years after exposure.

Americans are exposed to radiation from all sources, including naturally occurring radiation (e.g., exposure to sunlight, cosmic rays), medical X-rays, occupational activities and numerous environmental sources including nuclear power production. By far the largest contributor to this dose is natural background radiation.

Some figures suggest that medical procedures utilizing radiation (X-rays) are responsible for one half of one percent of all cancer cases in this country. Many experts feel that this in a gross overestimate. The actual percentage could be as low as zero. Experts agree that when these medical procedures are used prudently, their diagnostic and therapeutic benefits far outweigh their small cancer risk.

Recently, media attention has focused on the non-ionizing type of radiation emitted by electromagnetic frequencies. Many people fear that they can "get cancer" from their cellular phones, alarm clocks, hair dryers, video display terminals, etc. However, these people do not understand that this type of radiation is at the very low end of the electromagnetic spectrum and is quite different from ionizing radiation. An advisory group to the British National Radiological Protection Board, chaired by Sir Richard Doll, concluded after reviewing the literature on cancer and electromagnetic fields that: ”The epidemiological findings that have been reviewed provide no firm evidence of the existence of a carcinogenic hazard from exposure ... to the extremely low frequency electromagnetic fields that might be associated with residence near major sources of electricity supply, the use of electrical appliances, or work in the electrical, electronic, and telecommunications industries.”[14]

Drugs

In rare cases, certain drugs have contributed to an increase in cancer risk. The most prominent example is diethylstilbestrol (DES), a drug that was widely prescribed to prevent miscarriages. In 1974 an obstetrician noted a rare form of vaginal cancer in women whose mothers had taken large doses of the drug during pregnancy. Recently, further investigation revealed a modest, but statistically significant, increased risk of breast cancer in the women who used DES during pregnancy. Although widely publicized, the actual number of cases of cancer caused by the use of DES as a human drug is small.[15]

There is a marked increase in endometrial cancer risk with prolonged use of postmenopausal estrogen replacement therapy (ERT). The risk can be greatly reduced by adding a second hormone, progestin, to the therapy regimen. Although the scientific data are not entirely conclusive, the best current evidence indicates that a woman who takes combined estrogen/progestin therapy has no greater risk of endometrial cancer than a woman who does not take hormone therapy at all. Prolonged estrogen therapy may also cause a small increase in the risk of breast cancer. Whether the addition of progestin influences the effect of estrogen on breast cancer risk has not been established. The risks associated with the use of postmenopausal estrogens must be weighed against the benefits of this therapy, which include reductions in the risks of coronary heart disease and osteoporotic bone fractures as well as relief from menopausal symptoms.[16,17]

The breast cancer risks associated with the use of oral contraceptives have also been extensively studied. Oral contraceptive use is not generally associated with either an increase or a decrease in breast cancer risk.

Other drugs used to treat tuberculosis and, ironically, to treat some forms of cancer have shown an increased risk potential. Yet for these drugs, the risks of not using them are far more serious than their cancer risk.

Sexual and Reproductive Patterns

Intercourse at an early age and multiple sexual partners have been linked to an increased risk of cervical cancer. It has become increasingly clear that cervical cancer is caused, at least in part, by one or more sexually transmitted agents, most likely the human papillomaviruses (HPVs), especially DNA subtypes 16 and 18. Over the past 20 years, there has also been increasing evidence that the herpes simplex virus type 2 (HSV-2) may also be a causative agent in cervical cancer.

Hepatitis B virus (HBV) infection has been implicated as increasing the risk of developing hepatocellular carcinoma, a dangerous liver cancer. One of the primary routes of transmission for this agent is sexual intercourse. Many scientists state that HBV is “second only to tobacco as a known human carcinogen.”

AIDS, another sexually transmitted disease, is also associated with cancer. In 1994, The Centers for Disease Control and Prevention (CDC) reported that one million Americans, or one of every 250 people, are infected with the human immunodeficiency virus (HIV), the agent responsible for the spread and development of AIDS. From June 1981 through December 31, 1993, there were 361,509 cases of AIDS reported to the CDC. As shown previously in this report, the spread of the AIDS epidemic has caused increases in the forms of cancer associated with this disease. AIDS patients are at increased risk of developing Kaposi’s sarcoma, non-

Hodgkin's lymphoma, primary lymphoma of the brain, cervical cancer, anal cancer and malignant lymphoma of the heart.

Sunlight

The most widespread environmental carcinogen, accounting for the majority of superficial skin cancers and some types of melanoma, is ultraviolet radiation from the sun. Superficial skin cancers are rarely fatal and are not included in most statistical estimates of U.S. cancer patterns. Melanoma is more serious; but, overall, the outcome of treatment of this cancer is good when it is discovered early.

Among light-skinned people, sunlight-related cancers are more common in tropical areas than in colder climates because the sun's rays are most intense near the equator. There are also individual differences in susceptibility to the effects of the sun, with people who tan poorly and sunburn easily being most at risk. For example, individuals with blonde hair and blue eyes are generally at highest risk.

Limiting exposure to the sun and to other sources of ultraviolet light is the simplest and most effective means of reducing this cancer risk. It is best not to cultivate a suntan or to patronize tanning parlors. It is helpful to use sunscreen products and to wear protective clothing, especially when exposed to midday summer sun.

Occupation

High dose, long-term exposure to a number of industrial chemicals and manufacturing processes, including asbestos, vinyl chloride, nickel refining and dye manufacturing, can increase risk for several types of cancer. To date, approximately 20 industrial chemicals have been confirmed as human carcinogens. An additional 200 to 300 are suspected carcinogens on the basis of animal evidence. As with other cancer risks, occupational risks depend on the length and degree of exposure, the potency of the chemical agent, possible interactions with other chemicals and lifestyle factors such as cigarette smoking and alcohol consumption. Most experts estimate that between one and five percent of all cancers in the U.S. are related to occupational exposures.

The role of occupational exposure to pesticides is currently under investigation. The National Cancer Institute (NCI), the Environmental Protection Agency (EPA) and the National Institute of Environmental Health Sciences (NIEHS) recently announced the initiation of a joint study that will be the nation's largest ever epidemiologic study of farmers and their families. The "Agricultural Health Study" will identify and assess cancer rates among about 100,000 farmers, their spouses and pesticide applicators. The $15 million study is planned to last 10 years. At this point, there is not enough evidence to link pesticide use to cancer among farmers or their families.

Air Pollution?

Trace amounts of carcinogens in urban and suburban air samples and the differences in cancer death rates between urban and rural areas have led many to conclude that pollution is a serious cancer risk. The case for air pollution as an important cause of human cancer, however, remains unconvincing.

Numerous reviews of the relationship between air pollution and lung cancer have reported no evidence of an association. Differences in lung cancer death rates between urban and rural people may be explained by differences in smoking habits. A recent study of lung cancer by the American Cancer Society concluded: "General air pollution had little effect in comparison between urban and rural people. Smoking is the key factor."

This is not to suggest that pollution should not be controlled. There may be other health and esthetic reasons to minimize environmental pollution. Some preliminary evidence suggests that certain types of air pollution may exacerbate acute respiratory illnesses such as asthma and bronchitis. Yet, at present, the threat of cancer does not appear to be associated with general pollution.

Cancer and the Environment: An Overview

The media and environmental activists would have the public believe that cancer rates are escalating out of control and that unseen “environmental factors,” such as pesticides and industrial pollution, “play a prominent role” in cancer causation.[18,19] However, the truth is that the age-adjusted death rates for most forms of cancer have decreased or remained constant over the past 50 years. Lung cancer is a notable exception. This disease, caused primarily by cigarette smoking, has increased dramatically in both sexes. Black Americans have higher cancer rates than other ethnic and racial groups; lifestyle factors, particularly smoking, may be responsible. Differences in access to health care may also be a factor. Cancer incidence rates have also remained relatively stable. Increases in incidence have occurred for a few forms of cancer, notably the AIDS-related cancers and lung cancer (most recently in women).

The exact number of cancers that can be eliminated by sound preventive methods is unknown, but the percentage is undoubtedly substantial. Eliminating the effects of cigarette smoking alone would eventually reduce cancer incidence and mortality by approximately 40 percent.

Effective preventive measures can substantially reduce the U.S. cancer burden or at least postpone cancer until later in life. To this end, current scientific knowledge suggests that our preventive efforts should be focused on lifestyle factors, especially smoking, obesity, sunbathing and excessive alcohol consumption.

References

1. MacMahon, B. and T. F. Pugh, *Epidemiology. Principles and Methods*. Boston: Little, Brown & Co., 1970.

2. American Cancer Society, *Cancer Facts and Figures*. New York, 1994.

3. Sondik, E.J., et al, 1985 *Annual Cancer Statistics Review*. NIH Publication No. 86-2789. Bethesda, MD., National Cancer Institute, March 1986.

4. Silverberg, E., and J. Lubera, "A Review of American Cancer Society Estimates of Cancer Cases and Deaths." *Ca-A Cancer Journal for Clinicians* 36 (1), January/February 1983.

5. Henderson, B.E., Ross, R.K., and M.C. Pike, "Toward the Primary Prevention of Cancer." *Science* 254: 1131-1137, 22 November 1991

6. Miller, B.A., Reis, L.A.G., Hankey, B.F., Kosary, C.L. and B.K. Edwards (eds)., *Cancer Statistics Review: 1973-1989.* National Cancer Institute. NIH Pub. No. 92-2789, 1992.

7. Doll, R., and R. Peto, *The Causes of Cancer*. New York: Oxford University Press, 1981.

8. Doll, R., "Progress Against Cancer: An Epidemiologic Assessment." *American Journal of Epidemiology* 314 (7): 675-688, 1 October 1991.

9. Muir, C. et al., World Health Organization, International Agency for Research on Cancer, *Cancer Incidence in Five Continents,* Volume V (1987).

10. Tomatis, L. et al., World Health Organization, International Agency for Research on Cancer, *Cancer: Causes, Occurrence and Control,* IARC Scientific Publication No.100, 1990.

11. Giovvannucci, E. et al., "A Prospective Study of Cigarette Smoking and Risk of Colorectal Adenoma and Colorectal Cancer in U.S. Women." *Journal of the National Cancer Institute* 86(3): 192-199, February 2, 1993.

12. Block, G., Patterson, B. and A. Subar, "Fruit, Vegetables, and Cancer Prevention: A Review of the Epidemiological Evidence." *Nutrition and Cancer* 18(1): 1-29, 1992.

13. Willet, W.C., "Moderate Alcohol Consumption and the Risk of Breast Cancer." *New England Journal of Medicine* 316:1174-1180, 1987.

14. National Radiation Protection Board, *Electromagnetic Fields and the Risk of Cancer: Report of an Advisory Group on Non-Ionizing Radiation.* London, England, 1992;3.

15. Colton, T. et al., "Breast Cancer in Mothers Prescribed Diethylstilbestrol in Pregnancy." *Journal of the American Medical Association* 269:1096-2100, April 28, 1993.

16. American College of Physicians, "Guidelines for Counseling Women about Preventive Hormone Therapy." *Annals of Internal Medicine* 117(12):1038-1041, December 15, 1992.

17. Grady, D. et al., "Hormone Therapy To Prevent Disease and Prolong Life in Postmenopausal Women." *Annals of Internal Medicine* 117(12):1016-1037, December 15, 1992.

18. Wolff, M.S. et al., "Blood Levels of Organochlorine Residues and Risk of Breast Cancer." *Journal of the National Cancer Institute* 85(8):648-653, April 21, 1993.

19 Davis, D.L., et al., "Decreasing Cardiovascular Disease and Increasing Cancer Among Whites in the United States From 1973 Through 1987." *Journal of the American Medical Association* 271(6):431-437, February 9, 1994.