

Prostate cancer: 1. The descriptive epidemiology in Canada

Isra G. Levy,* MB, BCh; Neill A. Iscoe,† MD;
Laurence H. Klotz,‡ MD

The case

A 70-year-old woman who experienced a long period of depression after her first husband's death from prostate cancer at the age of 63 has become increasingly anxious about her own health and that of her close family. A few years ago she married a man her own age; he is in good physical condition. Last year the family spent much of the winter in Florida, where the woman noticed several stories in the media suggesting that an epidemic of prostate cancer is occurring in North America and that because early detection can save lives men of retirement age should be checked by their physicians as soon as possible. In addition, 2 close friends were recently diagnosed with prostate cancer. On his latest fishing trip her husband learned from a friend that 1 in 8 men get prostate cancer. He has not seen his family physician for several years, but his wife has booked an appointment for them to discuss their concerns.

Prostate cancer has now surpassed lung cancer as the most frequently diagnosed cancer in Canadian men (except for nonmelanotic skin cancer, which is rarely fatal). Although the number of cases diagnosed annually may have peaked in 1997, it is striking that the estimated incidence for that year exceeded that for breast cancer.¹ Between 1970 and 1990 the incidence of prostate cancer increased steadily by approximately 3% annually. During this period, deaths from the disease also increased, but at a slower rate of about 1% annually.² Prostate cancer is, after lung cancer, the most common cause of cancer-related death in men.

Increasing awareness of these trends on the part of health care professionals and the public has resulted in the recognition of prostate cancer as a significant public health problem. An estimated 48 100 Canadian men were diagnosed with prostate cancer during the 1980s.³ Based on incidence trends that predate the significant use of new diagnostic technologies such as prostate-specific antigen (PSA) testing and transrectal ultrasonography, as many as 35 200 new cases of prostate cancer are expected to be diagnosed in Canada in the year 2016.⁴

The PSA test, which facilitates early detection, has been available in Canada since 1986, although its use did not become widespread until the early 1990s.⁵ Data for that period suggest that the introduction of PSA testing caused, predictably, an initial increase in the observed incidence as the reservoir of existing, undiagnosed cases became apparent.^{1,5}

This 13-part series was made possible in part by an unrestricted educational grant from **ZENECA Pharma**

This 13-part series was made possible in part by an unrestricted educational grant from **Pharmacia & Upjohn Inc.**



Education

Éducation

From *the Department of Epidemiology and Community Medicine, University of Ottawa, and (at the time of writing) the Laboratory Centre for Disease Control, Ottawa, Ont.; †the Toronto–Sunnybrook Regional Cancer Centre, Cancer Care Ontario, and Department of Medicine, Sunnybrook Health Science Centre and University of Toronto, and the Program in Clinical Epidemiology and Health Services Research, Sunnybrook Unit, University of Toronto, Toronto, Ont.; and ‡the Department of Surgery, Division of Urology, Sunnybrook Health Science Centre and University of Toronto, Toronto, Ont.

This article has been peer reviewed.

The members of the Prostate Cancer Alliance of Canada, an umbrella group formed to carry out the recommendations of the 1997 National Prostate Cancer Forum, are pleased to support the intent to inform both health care professionals and lay people about the detection, diagnosis and treatment of prostate cancer through this 13-part series. The list of members of the Alliance appears at the end of this article.

Series editors: Dr. Neill A. Iscoe, Medical Oncologist, Toronto–Sunnybrook Regional Cancer Centre, and Dr. Michael Jewett, Chairman of the Department of Urology, University of Toronto, Toronto, Ont.

CMAJ 1998;159:509-13



In 1997 prostate cancer accounted for an estimated 28% (19 800 cases) of newly diagnosed cancer in men.¹ (The number of cases detected annually may decline somewhat in future, once the pool of prevalent cases detectable by PSA testing is exhausted, but it is not possible to predict the timing, duration or magnitude of such a decline with any certainty.) These 19 800 cases in Canada translate into approximately 1 new case per year in every 750 men and are more than double the 9600 cases that occurred a decade ago, in 1988 (Canadian Cancer Registry; 1988: unpublished data). Also, more than 12% (4100 cases) of cancer-related deaths in men in 1997 are estimated to have been caused by prostate cancer.¹

In view of these data it is likely that most family physicians whose practice population has an age-sex profile similar to that of the general population will encounter at least one patient with a problem related to prostate cancer each year. Despite the relatively good prognosis reflected in annual case fatality rates of approximately 20% (4100 deaths per 19 800 new cases) many such patients will die of the disease. Physicians need to have a clear understanding of the risk of being diagnosed with and dying from prostate cancer and to be able to communicate that risk in a way that is meaningful to patients and their families.

Teaching points

- Prostate cancer is the most commonly diagnosed cancer in Canadian men.
- A man born in 1993 has a 1-in-8 chance of being diagnosed with prostate cancer and a 1-in-26 chance of dying from the disease during his lifetime.
- The risk of developing prostate cancer increases with age.
- With the aging of the population, primary care physicians can expect to be confronted by this disease more frequently.

Trends

A man's risk of being diagnosed with or dying from prostate cancer increases markedly with age. In men under 50 years of age the disease is uncommon and death from it is rare. Between 1980 and the early 1990s the age-specific incidence in Canada increased among all men over the age of 40 (Fig. 1). However, there was no consistent trend in age-specific mortality (Fig. 2). Over the longer period from 1973 to 1993 the incidence rate increased more than 2-fold, from 60.5 to 138.7 per 100 000 men (Fig. 3). Before 1990 the average annual increase was approximately 3%; between 1990 and 1993 it was about 12%. The mortality rate, on the other hand, increased by only about 20% between 1973 and 1989 (from 25.0 to 29.8 per 100 000 men) at an average annual rate of about 1%. It appears to have reached a plateau during the 1990s; after peaking at 31.3 per 100 000 in 1991, it decreased noticeably to 28.2 per 100 000 in 1996.

The 1993 age-specific incidence rates (Fig. 1) are especially relevant if one considers the future impact of this disease. By multiplying the rate for each age group by the number of men in that age group and adding the results, one can derive the total number of cases that will occur in the population as its present age structure is carried into

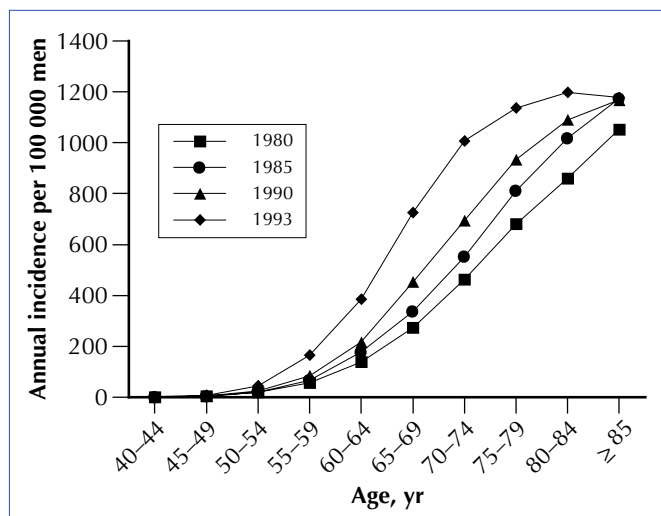


Fig. 1: Age-specific annual incidence rates (per 100 000 men) of prostate cancer in Canada, 1980, 1985, 1990 and 1993.

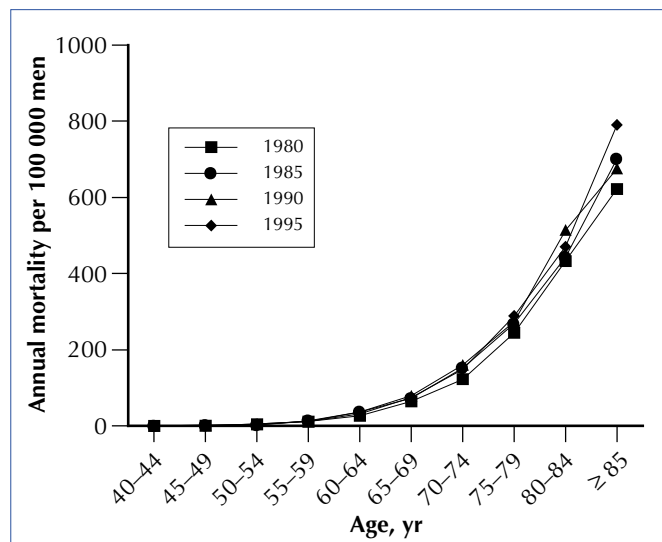


Fig. 2: Age-specific annual mortality rates (per 100 000 men) of prostate cancer in Canada, 1980, 1985, 1990 and 1995.



the future, assuming the ratio remains constant. However, the Canadian population is aging. Fig. 4 shows the age pattern of the male population over 40 years of age in 1996 and the projected pattern⁶ to the year 2016.

The incidence and mortality rates for prostate cancer vary from province to province (Fig. 5), but the variation in observed incidence is much greater than the variation in mortality.

Lifetime and age-specific risks

The current lifetime risk of a Canadian man being diagnosed with prostate cancer is 12.3%, or about 1 in 8, as compared with 1 in 11 in the mid-1980s and close to 1 in 20 in the early 1970s.⁷ The lifetime risk of prostate cancer being listed as the cause of death is 3.8%, or about 1 in 26. These data assume that a cohort of men is observed from birth until death at any age from less than 1 year to more than 90 years.

Estimated risks for men of various ages over their remaining life and for shorter intervals are shown in Table 1. Although a man's *annual* risk of being diagnosed with prostate cancer rises with increasing age, his *lifetime* risk declines the longer he survives. For example, a man of 70 has a lower lifetime risk of prostate cancer than a man of

50 because he has 20 fewer years at risk. Also, shorter-term risks decline among men older than about 75 years because the effect of the increase in annual incidence (Fig. 1) begins to be offset by the increasing probability of dying from another cause.

The extraordinary 1-in-8 lifetime risk of prostate cancer in Canada is consistent with risk profiles seen at the end of the 1980s among men in the United States⁸ and reflects, in part, the recent upsurge in incidence among men of all ages related to the increased use of PSA testing and related diagnostic activity. It has been argued that such estimates exaggerate the true risks, because with the increased sensitivity of diagnostic procedures many of the cases that are detected are microscopic, "clinically insignificant" cancers known to exist in a high proportion of men over the age of 50.⁹

However, this argument does not speak to the emotional, physical and financial impact of the diagnosis and treatment of prostate cancer for individual men, their loved ones and society. For example, in a recent nonrandom survey of Canadian men with prostate cancer, more than a third of the 965 respondents reported side effects of treatment and 25% reported incontinence. Half reported that a problem with sexual function had developed since their diagnosis.¹⁰ Erectile failure occurs in 20% to 90% of patients who have surgery

Teaching points

- Between 1973 and 1993 the incidence of prostate cancer doubled. The increase was greatest after the advent of prostate-specific antigen (PSA) testing.
- Over the same period, the mortality rate increased by 20%.
- The incidence will decline once PSA testing has exhausted the pool of existing undetected cases, but when this will occur or how significant the decrease will be is uncertain.

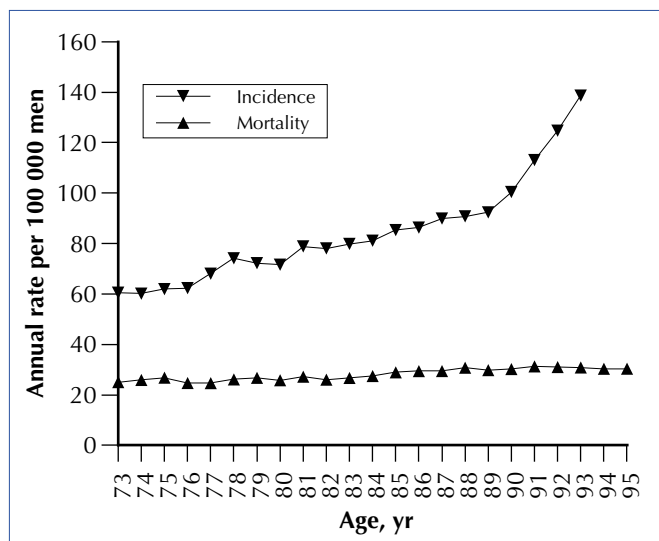


Fig. 3: Age-standardized annual incidence rates of prostate cancer in Canada, 1973–1993, and mortality rates, 1973–1995. Rates are per 100 000 men and are standardized to the 1991 Canadian population.

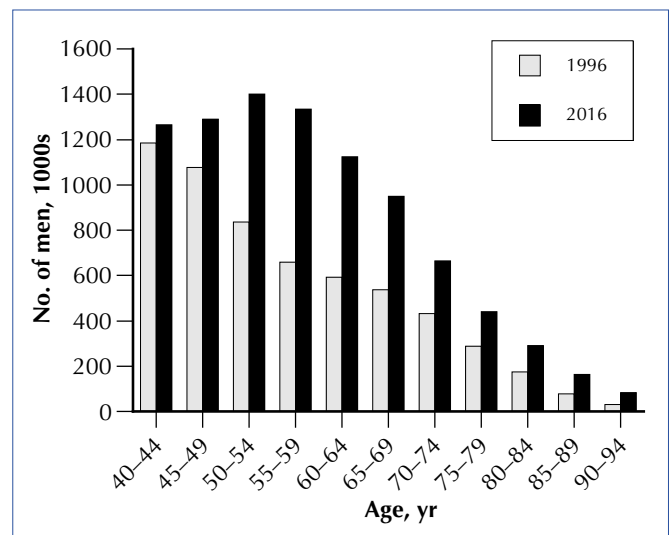


Fig. 4: Age structure of the Canadian male population from 1996 to 2016 (projected).



for prostate cancer and in 20% to 40% who undergo radiotherapy.¹¹

We should also bear in mind that the rise in incidence predates the use of newer diagnostic technologies. As noted earlier, incidence increased by roughly 3% per year in the 2 decades that preceded the adoption of PSA testing in Canada. Although a portion of this increase can be attributed to a trend toward earlier serendipitous detection of the so-called “clinically insignificant” cancers (because of greater use of transurethral prostatectomy for putatively benign hypertrophy),^{1,12} there is still a possibility that a rise in unidentified environmental risk factors has contributed to the increase and will continue to do so. The historical increase in mortality, although relatively small, further suggests that the higher incidence rates cannot be attributed solely to detection of lesions that are clinically insignificant.

Judging from the simple application of age-specific risks to our aging population, it is clear that the burden of prostate cancer will increase dramatically in the coming decades. The aging of the “baby boom” generation alone will have important long-term consequences for health care delivery and research priorities in the context of this disease.⁴ This effect will be independent of, although perhaps compounded by, changes in observed incidence that may result from changes in diagnostic practice.

Predicting annual incidence and mortality is problematic. Even today, there is substantial interjurisdictional variation in incidence in Canada (and in other countries

such as the United States¹³), probably largely as a result of differing diagnostic practices. The future impact on survival of the current use of early detection tools cannot be estimated.¹⁴ Some decrease in observed annual incidence may occur as the pool of prevalent cases being detected by the first “sweep” of PSA testing through the population diminishes. Such a decrease has recently been observed in the United States.¹⁵ It is also possible that the slow increase in mortality that has long been a feature of this disease is finally reversing and that the decrease seen most noticeably in 1996 will be sustained. What *can* be predicted with certainty is that there will be a large increase in

the number of men affected by prostate cancer in the future. This will likely be accompanied by increasing demands on scarce health care and supportive care resources.

The Canadian public has little knowledge of prostate cancer and the controversies that surround it.¹⁶ Increasing awareness of the impact of this disease on individuals and society has led to the founding of the Canadian Prostate Cancer Network, a national network of support groups. In 1997 the Canadian Cancer Society spearheaded the first National Prostate Cancer Forum to raise awareness of the public health burden of the disease and to set an agenda for action in the areas of research, interdisciplinary communication and advocacy.¹⁷

As the prevalence of the disease rises and awareness of its impact increases, primary care physicians will increasingly be faced with questions from patients about their

Teaching points

- A man’s *annual* risk of being diagnosed with prostate cancer increases with age.
- His *lifetime* risk of prostate cancer decreases with age.

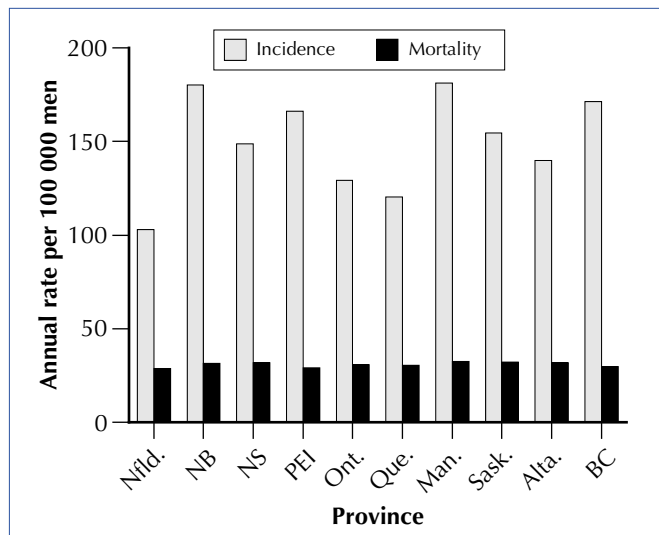


Fig. 5: Annual incidence and mortality rates (per 100 000 men) for prostate cancer in Canada by province.

Table 1: Probability of prostate cancer occurring in men of various ages

Age, yr	Time frame; risk of occurrence, %		
	Within 5 yr	Within 10 yr	Within lifetime
40	0.01	0.04	12.27
45	0.04	0.21	12.26
50	0.20	0.74	12.23
55	0.72	2.13	12.08
60	2.02	4.41	11.57
65	4.04	7.16	10.25
70	6.16	9.45	8.10
75	7.77	10.45	5.45
80	8.18	9.50	2.88
85	6.71	7.73	1.09
90*	5.01	–	0.38

*There are not enough data to calculate the risk of occurrence within 10 years.



risk of prostate cancer. A table of probabilities can be used to assist in such discussions (Table 1). These probabilities are calculated on the assumption that the age-specific incidence and mortality rates for all Canada in a given period will prevail throughout the lifetime of a man anywhere in the country as he ages. Because these rates may not, in fact, remain stable into the future and because they are subject to some geographic variability, patients should be advised that these probabilities are only approximations to guide discussion.

In the case described at the beginning of the article, the family physician can use the table to assure the patient and his wife that his lifetime risk of prostate cancer is not 1 in 8 but, given his age, closer to 1 in 12 (8.1%). This risk, although not insignificant, is also a "long-term" risk. His chance of being diagnosed with prostate cancer in the next 5 years is only about 6%, or 1 in 16.

The table can also be used to show younger men that their risk of prostate cancer in the short term is low. In a group of 1000 men aged 50, only 2 can expect to be diagnosed with prostate cancer in the next 5 years and only 7 will be diagnosed with the disease before they turn 60. However, when those same men reach the age of 75 years, 78 of them can expect to be diagnosed within 5 years and 105 within 10 years. Such considerations may be more relevant and meaningful to individual men of various ages than the 1-in-8 lifetime risk. Family physicians can provide an invaluable service by clarifying for their patients the actual meaning of "all those numbers."

The data should also be of interest to health care planners and policy-makers. The burden of this prostate cancer is high and will rise. Those most at risk are elderly men, who will need appropriate services and treatments.

We thank Howard Morrison of the Cancer Bureau, Laboratory Centre for Disease Control, Health Canada, for helpful comments on the text, and Laurie Gibbons and Chris Waters, also of the Cancer Bureau, for helping to produce analyses and figures. Data were provided by Statistics Canada. The cooperation of Statistics Canada and of the provincial and territorial cancer registries that supply the data to Statistics Canada is gratefully acknowledged.

References

1. National Cancer Institute of Canada. *Canadian cancer statistics, 1997*. Toronto: The Institute; 1997.
2. Levy IG, Gibbons L, Collins JP, Perkins DG, Mao Y. Prostate cancer trends in Canada: Rising incidence or increased detection? *CMAJ* 1992;149:617-24.
3. National Cancer Institute of Canada. *Canadian cancer statistics, 1995*. Toronto: The Institute; 1995.
4. Morrison HI, MacNeill IB, Miller D, Levy I, Xie L, Mao Y. The impending Canadian prostate cancer epidemic. *Can J Public Health* 1995;86:274-8.
5. Levy, IG. Prostate cancer: the epidemiological perspective. *Can J Oncol* 1994;4[Suppl 1]:4-7.
6. *Population projections for Canada, provinces and territories, 1993-2016*. Ottawa: Statistics Canada; 1993.
7. National Cancer Institute of Canada. *Canadian cancer statistics, 1993*. Toronto: The Institute; 1993.
8. Miller BA, Hayes RB, Potosky AL, Brawley O, Kaplan R. Prostate. *SEER Cancer Statistics Review 1973-1990*. Bethesda: National Cancer Institute; 1993.
9. Bowersox, J. Experts debate PSA screening for prostate cancer. *J Natl Cancer Inst* 1992;84:1856-7.
10. Gray RE, Klotz LH, Iscoe NA, Fitch MI, Franssen E, Johnson BJ, et al. Results of a survey of Canadian men with prostate cancer. *Can J Urol* 1997;4:359-65.
11. American Urological Association Guidelines Development Group. *Management of clinically localized prostate cancer*. Baltimore: The Association; 1995.
12. Potosky AL, Kessler L, Gridley G, Brown CC, Horn JW. Rise in prostatic cancer incidence associated with increased use of transurethral resection. *J Natl Cancer Inst* 1990;82:1624-8.
13. Lu-Yao GL, Greenberg ER. Changes in prostate cancer incidence and treatment in USA. *Lancet* 1994;343:251-4.
14. Woolf SH. Screening for prostate cancer with prostate-specific antigen. *N Engl J Med* 1995;333:1401-5.
15. Merrill RM, Potosky AL, Feuer EJ. Changing trends in US prostate cancer incidence rates. *J Natl Cancer Inst* 1996;88:1683-5.
16. Mercer SI, Goel V, Levy IG, Ashbury FD, Iverson DC, Iscoe NA. Prostate cancer screening in the midst of controversy: Canadian men's knowledge, beliefs, utilization and future intentions. *Can J Public Health* 1997;88:327-32.
17. Phillips R, editor. *Call for action on prostate cancer: report and recommendations from the 1997 National Prostate Cancer Forum*. Toronto: National Cancer Institute of Canada; 1997.
18. Zdeb MS. The probability of developing cancer. *Am J Epidemiol* 1977;106:6-16.
19. Seidman H, Silverberg E, Bodden A. Probabilities of eventually developing and of dying of cancer. *CA Cancer J Clin* 1978;28:33-46.

Reprint requests to: Dr. Isra G. Levy, Canadian Medical Association, 1867 Alta Vista Dr., Ottawa ON K1G 3Y6; fax 613 731-1779

The following organizations are members of the Prostate Cancer Alliance of Canada: Canadian Association for Nurses in Oncology, Canadian Association of Radiation Oncologists, Canadian Cancer Society, National, Canadian Prostate Cancer Network, Canadian Prostate Cancer Research Foundation, Canadian Urology Association, Canadian Uro-Oncology Group and National Cancer Institute of Canada

Appendix: Statistical methods

Annual age-specific incidence rates for the period 1973-1993 and mortality rates for 1973-1996 were calculated for prostate cancer (International Classification of Diseases code 185) for all Canada in 5-year age groups. Data were obtained from the Canadian Cancer Registry (formerly the National Cancer Incidence Reporting System) and the Canadian Mortality Database at Statistics Canada. Population data were obtained from Statistics Canada census publications.

Age-standardized incidence and mortality rates were calculated by the direct method for all Canada and for individual provinces using the 1991 Canadian population as the standard. The probabilities of being diagnosed with or determined to have died from prostate cancer were calculated using standard life-table methods.^{18,19} The probabilities are based on a hypothetical cohort of 100 000 Canadian men who are subject, during their lifetimes, to current age-specific incidence and mortality rates (1993) and to all-cause mortality risks (1992-1994).