RESEARCH COMMUNICATION

Cumulative Risk and Trends in Prostate Cancer Incidence in Mumbai, India

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Abstract

Background: Information relating to cancer incidence trends in a community forms the scientific basis for the planning and organization of prevention, diagnosis and treatment of cancer. We here estimated the cumulative risk and trends in incidence of prostate cancer in Mumbai, India, using data collected by the Bombay Population-based Cancer Registry from the year 1986 to 2000.

Methods: During the 15 year period, a total of 2864 prostate cancer cases (4.7% of all male cancers and 2.4% of all cancers) were registered by the Bombay Population-based Cancer Registry. For evaluation of the trend, we applied a linear regression model based on the logarithm of the observed incidence rates. The annual percentage changes were also computed for the evaluation. Cumulative incidence rates percentages were calculated by adding up the age specific incidence rates at single ages and then expressed as a percentage.

Results: Analysis of the trends in age-adjusted incidence rates of prostate cancer during the period 1986 to 2000 showed no statistically significant increase or decrease and the rates proved stable across the various age groups (00-49, 50-69 and 70+) also. The probability estimates indicated that one out of every 59 men will contract a prostate cancer at some time in his whole life and 99% of the chance is after he reaches the age of 50.

Conclusion: The stability in age adjusted-incidence rates indicates that there are no changes in the etiological factors for prostate cancer in Mumbai, India. These findings may be of general interest because changes in diagnostic practices are confounded in the time trends of prostate cancer change in many western countries preventing inferences on the changes in risk.

Key Words: Time trend - incidence - cumulative risk - prostate cancer

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Introduction

Information on cancer incidence trends forms a scientific basis for the planning and organization of prevention, diagnosis and treatment of cancer in a community. A trend, however, always represents a summary curve of changes that are occurred within different groups of people living under different conditions. A record of increase or decrease in incidence, to a large extent, can reflect changes in exposures to carcinogens and improvement in diagnostic ascertainment. Monitoring of trends is important for evaluating changes in population lifestyle, environmental risks and health care effectiveness.

Prostate cancer is primarily a disease of elderly men which has become a major public health burden worldwide. It is now the sixth most common cancer in the world (in terms of number of new cases), and the third in importance in men. The worldwide annual estimate for the number of prostate cancer cases is 543,000 during the year 2000. This represents 9.7% of cancers in men (15.3% in developed countries and 4.3% in developing countries) (Parkin et al., 2001; Stanford et al., 2000). Especially in industrialised world during the last decades of the 20th century it showed rapid increase and it is the most common male cancer in the USA (Ries et al., 2000). In the European Union it is the second most common malignancy in men (Ferlay et al., 1999).

Prostate cancer incidence rates are rapidly increasing worldwide, owing to the population ageing and the introduction of more sensitive diagnostic procedures (Michel

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et al., 1993; Vercelli et al., 2000). There are wide variations in the age-standardized incidence rates of prostate cancer in different parts of the world (Ferlay et al., 2002). In India the age adjusted incident rates of prostate cancer is only one tenth of that seen in the Western World (BCR 2003; Ferlay et al., 2002). Since there are no well planned screening programmes for the diagnosis of prostate cancer in India, we thought, it is worthwhile to study the population-based incidence trend and cumulative risk of prostate cancer in Mumbai, India, where screening for prostate cancer is not customary.

Materials and Methods

The Bombay Population Based Cancer Registry was the first to be established in India, in 1963, as a unit of the Indian Cancer Society at Mumbai with the aim of obtaining reliable morbidity data on cancer, from a precisely defined urban population (Greater Mumbai) (12 million inhabitants). The majority of hospitals in the city are maintained by the Municipal Corporation and the State Government, which are basically responsible for conducting public health and medical services in the city

All malignant tumors including those where the pathologist may have merely suspected a malignant change are registered. Cancer cases where the death certificate is the only source of information, are also included. Patients in whom cancer has been ruled out or has not yet been diagnosed, are omitted from our register.

We utilize the coding system devised by the World Health Organization using code numbers 140-208 as published in the manual of the International Classification of Diseases, Injuries and Causes of Death (WHO 1997). We also utilize the International Classification of Diseases for Oncology (WHO 1976), (ICD-O) simultaneously, for coding the primary site.

It has been shown that the data collected by Bombay Cancer Registry is complete and reliable (Yeole, 2001).

During the 15 year period, 1986 to 2000, a total 2864 prostate cancer cases (4.7% of all male cancers and 2.4% of all cancers) were registered by the Bombay Population-based Cancer Registry.

Population data were estimated from the 1981, 1991 and 2001 census reports (as on 1st March). The estimates for the years 1986 through 2000 (as on 1st July) were obtained by assuming a geometric rate of growth for each age group and sex. Since our definition of a resident differs from the criteria used in the population census, we have corrected our population estimates by eliminating all migrants whose duration of residence in Mumbai was less than one year.

Age adjusted rates were computed using the world population as standard (Plummer, 1997). For evaluation of incidence trends we have used a linear regression analysis based on the logarithm of the observed incidence rates. Logarithmic transformation was preferred specifically because this facilitates the comparison of trends at varying incidence levels, that is where the trends at different ages are examined. A model that fits this data is the logarithm $Y=AB^x$ which represents a linear regression model, where 'Y' is the estimated incidence rate per 100,000 of the population and 'x' is the calendar year minus the initial year (1986) for the current data. 'A' therefore represents the estimated rate of the initial year and (B-1)*100 gives the

Table 1. Number of Incident Cases of Prostate Cancer with Crude (CR) and Age-adjusted (AAR) Rates per 100,000 Population by Broad Age Group with Annual Percentage Changes in CR and AAR, 1986 to 2000

Year	Age group											
	00-49			50-69			70+			Total (All ages)		
	N	CR	AAR	N	CR	AAR	N	CR	AAR	N	CR	AAR
1986	2	0.04	0.01	50	10.7	15.4	56	91.4	90.3	108	2.2	6.1
1987	3	0.07	0.1	75	15.8	21.5	72	115.6	116.6	150	2.9	8.2
1988	5	0.11	0.1	66	13.7	19.9	89	140.6	141.4	160	3.1	8.8
1989	5	0.11	0.1	65	13.3	17.0	71	110.3	111.0	141	2.7	7.3
1990	8	0.17	0.2	80	16.0	21.8	89	136.0	133.8	177	3.3	9.0
1991	6	0.12	0.2	78	15.4	20.5	89	133.8	134.8	173	3.2	8.8
1992	5	0.10	0.1	79	15.3	21.7	104	153.9	155.4	188	3.4	9.8
1993	2	0.04	0.01	77	14.7	21.7	106	154.3	153.6	185	3.3	9.7
1994	4	0.08	0.1	73	13.7	18.0	106	151.8	153.2	183	3.2	9.1
1995	7	0.14	0.2	69	11.7	15.5	110	121.5	119.8	187	3.2	7.4
1996	2	0.04	0.01	103	16.4	20.0	140	134.7	135.0	245	4.1	8.6
1997	7	0.13	0.1	76	11.7	13.9	134	121.5	118.7	218	3.6	7.1
1998	6	0.11	0.1	91	13.5	15.7	141	118.6	117.3	238	3.9	7.3
1999	10	0.19	0.2	105	15.1	17.3	148	116.4	114.0	263	4.2	7.5
2000	5	0.09	0.1	98	13.6	18.9	144	106.6	140.4	248	3.9	8.7
1986-2000	77	0.10	0.11	1185	14.0	18.6	1602	125.4	129.0	2864	3.4	8.2
APC		$+2.92^{ns}$	$+2.60^{ns}$		$+0.08^{ns}$	-1.02^{ns}		$+0.15^{ns}$	-0.74^{ns}		$+3.31^{***}$	-0.12^{ns}

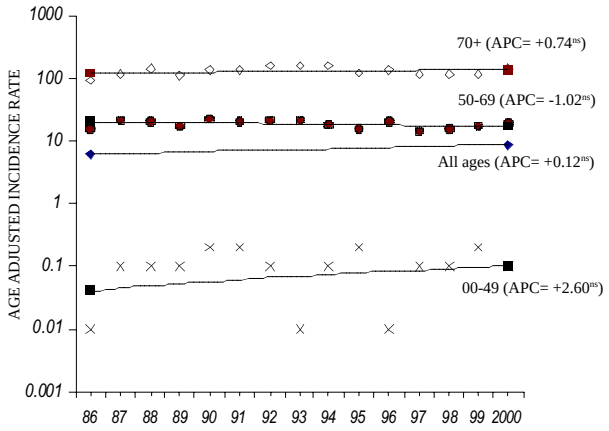
^{ns} -not significant, * significant at the .05 level, ** significant at the0.01 level, *** significant at the0.001 level

average annual percentage change in the incidence rate, during the period.

The cumulative incidence rate is a summary measure of the experience of a population over a longer time span or age-interval. It is obtained by summing up the age-specific incidences for each year in the defined age-interval and then expressed as a percentage. Since age-specific incidence rates are usually computed for five year age intervals, the cumulative incidence rate between birth to 75+ years of age is 5 times the sum of the age specific incidence rates calculated over five year age-groups. The cumulative incidence rate is a directly standardized incidence rate and is a good approximation to the actuarial or cumulative risk. The reason for interest in the cumulative incidence rate is that it has a useful probabilistic interpretation. Another advantage is that as a form of direct age standardization, the arbitrariness in choosing a standard population is removed. The probability of developing a specific cancer, expressed in terms of 'one in every n persons' is computed by reciprocating the estimated cumulative incidence rate expressed as a percentage.

Results

During the 15 year period, 1986–2000, the average crude and age-adjusted incidence rates for prostate cancer were 3.4 and 8.2 respectively per 100,000 population. The crude and age-adjusted rates for different age groups, 00-49, 50-69 and 70+ were 0.10 and 0.11, 14.0 and 18.6, 125.4 and 129.0 respectively per 100,000 populations (Table 1). Analysis of the trend in age-adjusted incidence rates of prostate cancer showed no statistically significant increasing or decreasing trend, even for the various age groups (00-49, 50-69 and 70+) (Table 1 and Fig 1). There was a significant



nsnot significant, *significant at .05 level, **significant at 0.01 level, ***significant at 0.001 level

Figure 1. Trends in Age-adjusted Rates (AAR) of Prostate Cancer Incidence/100,000 for Different Age Groups and at All Ages with Corresponding Annual Percentage Changes, Mumbai, India during 1986 to 2000

increasing trend in the overall crude incidence rate of prostate cancer with an yearly increase of 3.31%, but there were no statistically significant increasing or decreasing trends in the crude incidence rates for the various age groups (00-49, 50-69 and 70+) (Table 1).

The probability estimates indicated that one out of every 59 men will contract a prostate cancer at some time in his whole life, one out of every 79 men will contract a prostate cancer after his 60's, one out of every 235 men will contract a prostate cancer in his 50's or 60's and only one out of 16,660 men will contract this cancer before his 50's (Table 2). From the estimated cumulative incidence rate percentages for prostate cancer in Mumbai, it is evident that 1.73% of the male population in Mumbai will get a prostate cancer at some time in their whole life and 1.28% out of this 1.73%

Table 2. Cumulative Incidence Rate Percent (CIRP) and Life Time Risk Expressed as One in Every 'n' Persons (LTR), at Different Age Groups and for All Ages for Prostate Cancer, 1986 to 2000

Year	Age group							
	00-49		50-69		70+		Total (All ages)	
	CIRP	LTR	CIRP	LTR	CIRP	LTR	CIRP	LTR
1986	0.003	30419	0.37	273	0.90	111	1.27	79
1987	0.005	19994	0.51	197	1.17	86	1.68	60
1988	0.007	11957	0.45	224	1.41	71	1.87	54
1989	0.008	12147	0.39	258	1.11	90	1.51	66
1990	0.010	8269	0.51	198	1.34	75	1.86	54
1991	0.010	9756	0.48	210	1.35	74	1.83	55
1992	0.006	15417	0.52	194	1.55	64	2.08	48
1993	0.003	31466	0.53	190	1.54	65	2.06	48
1994	0.007	15231	0.41	244	1.53	65	1.95	51
1995	0.010	9667	0.38	264	1.20	83	1.59	63
1996	0.003	39198	0.47	212	1.35	74	1.82	55
1997	0.008	12441	0.32	316	1.19	84	1.51	66
1998	0.009	10695	0.36	275	1.17	85	1.55	65
1999	0.013	7455	0.40	251	1.14	88	1.55	65
2000	0.006	15782	0.45	221	1.40	71	1.86	54
1986-2000	0.007	16660	0.44	235	1.28	79	1.73	59

belong to the age of more than 70 years, 0.44% will be in the age range 50-69 years and only 0.007% in the age range of 00-49 years (Table 2).

Discussion

The age-adjusted incidence rates of prostate cancer in Mumbai, India is only 8.1 per 100,000 population and is less than one tenth of the rates seen in the Western World (Ferlay et al., 2002; BCR 2003). Prostate cancer ranked 3rd in age-adjusted incidence rates among all male cancers in Mumbai, India (BCR 2003). The present study showed no increasing or decreasing trend in age-adjusted incidence rates of prostate cancer in Mumbai, during the period 1986 to 2000.

Since the late 1940s, there is a dramatic increase in the identification of prostate cancer cases, notably in the USA and in the Western World, at least in part due to the greater frequency of operations for benign disease of the prostate, with the subsequent incidental finding of asymptomatic prostatic tumors, as well as the escalation in the use of new diagnostic technology including transrectal ultrasound guided needle biopsy, computer tomography, and serum testing for prostate-specific antigen (PSA) (Hankey et al., 1999; Potosky et al., 1995; Jacobsen et al., 1995). However, the steady increase in the mortality rates implies that the escalation in incidence is not solely attributable to incidental discovery and early detection, but to a real change in the risk of developing the disease (Miller et al., 1993).

During the last 20 years, prostate cancer incidence has undergone some of the most dramatic swings observed in cancer statistics. In the USA the incidence of prostate cancer increased by 30% from 80 to 105 per 100,000 men between 1980 and 1988 (Ries et al., 1999). From 1989 to 1992, the incidence of prostate cancer increased, on average, 20% per year, reaching the peak incidence of 179.0 per 100,000 men in whites in 1992 and 250.0 per 100,000 in blacks in 1993 (Hankey et al., 1999). Since 1993, a decreasing incidence trend, at a rate of 10.8% per year, has been observed, and in 1997, the average incidence of prostate cancer in the USA was 149.7 per 100,000 men (Ries et al., 2000; Hankey et al., 1999). Similar trends have been reported in Canada (Mercer et al., 1997), the the UK (Chamberlain et al., 1997), France (Grosclaude et al., 1997), Australia (Threlfall et al., 1998), and the Netherlands (Post et al., 1998), although, in general, they are less marked, or occur later, than in the USA.

Prostate cancer is diagnosed in almost one fifth of U.S. men during their lifetime and the estimated reduction in life expectancy of US men who die of the disease is approximately 9 years (Greenlee et al., 2001). In Mumbai, India, the present study showed that only one out of every 65 men will be diagnosed with a prostate cancer during their lifetime.

A large increase in prostate cancer incidence and mortality trends has been reported in low-risk countries (Hsing et al., 2000) where there is no screening programme for prostate cancer, with rises of 104% in Singapore Chinese, 84% in Miyagi, Japan, 55% in Hong Kong, and 44% in Shanghai, China, between 1975 and 1990. In Mumbai (India) there was only little change in incidence found by an earlier study (Michel et al., 1993). The present investigation thus was in agreement in showing no increase or decrease in the age adjusted incidence rate of prostate cancer during the period 1986 to 2000. It is important to remember that the increasing number of new cases and the increasing trend in the overall crude incidence rates can be explained as due to the increase in the absolute number of elderly men and the marked changes in the age structure in the general population of India.

In a recent study conducted in UK, it has been shown that the change in occurrence of prostate cancer is entirely due to changes in the incidence of localised cases. Incidence of non-localised cases and mortality remained almost constant. The increasing tendency in incidence of localised prostate cancer is likely to be principally due to increased detection, through increased use of prostate-specific antigen (PSA) testing followed by radical resections of the prostate and the aggregate effect of PSA testing and medical treatment of BPH is a stabilisation in the incidence level of localised cases in recent years (Evens et al., 2003). Widespread implementation of prostate cancer screening in western countries has certainly affected several epidemiologic features of the disease including incidence, tumor and patient characteristics, as well as patterns of care and outcomes (Mettlin 2000).

It has been apparent for several years that the age-adjusted incidence rate as well as death rates from clinical prostate cancer vary dramatically from country to country, even if one allows for differences in and availability of screening programs (Waterhouse et al. 1982, Watanabe et al. 1984). The prevalence of histologic prostate cancer is remarkably similar around the world, but the clinical incidence varies widely suggesting that eventhough the initiation rate of prostate cancer is the same but there appear to be differences in the rate of promotion or progression to clinically evident prostate cancer. This interpretation is supported by the increasing risk with migratory changes which suggests that prostate cancer develops as a result of an interplay of genetic and epigenetic events, both of which may be affected by environmental risk factors, perhaps acting as prostate cancer promoters (Yatani et al. 1988, Pienta et al. 1989, Carter et al. 1990). Ultimately, most investigators agree that prostate cancer results from an interplay between genetic factors, endogenous hormones and environmental influences (Ross et al., 1994, Kolonel 1996, Ekman et al. 1999, Pentyala et al. 2000, Bosland 2000).

The stability in the overall age-adjusted incidence rates of prostate cancer in Mumbai, India, indicate that there has been no major alteration in the underlying etiological factors. These findings may be of general interest because changes in diagnostic practices are confounders in time trends of prostate cancer in many Western countries preventing inferences on changes in risk.

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