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# Exploring causes for declining prostate cancer mortality rates in the United States

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**Abstract**

**Objectives:** Prostate cancer mortality rates in the U.S.A. increased in the late 1980s and declined from 1993 until 2003. The purpose of this study is to compare declining prostate cancer mortality rates among states with independent variables that may have an association to explore causes for the decline.

**Methods and materials:** Annual rates of prostate cancer mortality for men over 50 were obtained from the National Vital Statistic System public use data file for states for individual years from 1993 to 2003. The annual rate of prostate cancer mortality decline for each state was calculated by the Joinpoint Regression Program (Statistical Research and Applications Branch of NCI). Annual rates of prostate cancer decline were cross-correlated to state levels of PSA screening, health insurance coverage, obesity, physical inactivity, diabetes, and high cholesterol for males from 45 to 64.

**Results:** Declining prostate cancer mortality rates for white males correlated with high cholesterol levels ($R = -0.42$, $P = 0.002$) and PSA screening levels ($R = -0.28$, $P = 0.05$). Declining prostate cancer mortality rates for black males correlated with health insurance coverage ($R = -0.43$, $P = 0.03$).

**Conclusions:** Declining prostate cancer mortality rates are weakly associated with increased PSA screening for white males but there was no association for black males, possibly because blacks have less access to medical care. The strong inverse correlation between declining prostate cancer mortality rates and levels of white males with high cholesterol levels was unexpected but may be associated with the widespread use of cholesterol reducing medications (statins), which are hypothesized to reduce prostate cancer risk. 

*Keywords:* Ecology; Prostate cancer; Risk factors; United States; Epidemiology

## 1. Introduction

Widespread PSA screening to detect and treat prostate cancer at an early stage began in 1989 in the U.S.A. From 1989 to 1993, there was a sharp increase in prostate cancer mortality rates that was believed to be caused by misattribution bias, i.e., many more men alive with a diagnosis of prostate cancer, and some fixed proportion of these men who die of other causes are misattributed to death from prostate cancer [1].

From 1993 to 2003, mortality rates decreased by about 33% for white males and 29% for black males over 50. There was no change in prostate cancer mortality rates for both white and black males below 50 [2]. Incidence rates followed the same pattern. For males over 50, rates declined by 23% for whites and 30% for blacks. Incidence rates for both white and black males under 50 increased [3]. Both prostate cancer mortality and incidence rates decreased for men over 50 after the introduction of PSA screening for men, which targets men over 50 (see Table 1). These facts suggest that improved prostate cancer detection and treatment may be associated, at least in part, with the decline. One study, which found that part of the decline in prostate cancer mortality resulted from a decrease in late-stage cancers [1], supports this hypothesis.

Some researchers do not believe that PSA screening accounts for the total decline in prostate cancer mortality. A simulation study quantifying the link between population

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Table 1
Age adjusted incidence and mortality rates for males below and above 50 years

| Age | Incidence | | | | Mortality | | | |
|---|---|---|---|---|---|---|---|---|
| | <50 | | >50 | | <50 | | >50 | |
| | White | Black | White | Black | White | Black | White | Black |
| 1993 | 2.5 | 4.0 | 731.8 | 1,230.1 | 0.1 | 0.4 | 131.0 | 295.1 |
| 1994 | 2.4 | 6.6 | 622.4 | 1,107.9 | 0.1 | 0.4 | 128.6 | 288.2 |
| 1995 | 2.6 | 8.6 | 585.1 | 986.8 | 0.1 | 0.4 | 124.2 | 282.0 |
| 1996 | 3.4 | 7.6 | 583.5 | 996.2 | 0.1 | 0.3 | 119.1 | 284.6 |
| 1997 | 3.6 | 10.1 | 600.7 | 981.9 | 0.1 | 0.4 | 113.1 | 267.9 |
| 1998 | 3.7 | 9.2 | 589.6 | 990.0 | 0.1 | 0.3 | 107.9 | 262.5 |
| 1999 | 4.1 | 12.5 | 629.4 | 1,002.3 | 0.1 | 0.4 | 104.3 | 252.9 |
| 2000 | 4.2 | 11.4 | 628.9 | 1,004.3 | 0.1 | 0.4 | 100.0 | 247.6 |
| 2001 | 4.9 | 14.1 | 638.5 | 921.7 | 0.1 | 0.3 | 96.2 | 239.9 |
| 2002 | 4.6 | 13.1 | 623.6 | 980.7 | 0.1 | 0.3 | 93.5 | 227.2 |
| 2003 | 5.1 | 11.4 | 565.6 | 863.9 | 0.1 | 0.3 | 88.3 | 209.2 |

PSA testing and prostate cancer mortality rates found the decline in prostate cancer mortality in the 1990s was unlikely to be solely the result of prostate cancer screening [4]. An ecologic study of PSA screening and prostate cancer mortality in the U.S.A. suggested a weak association between PSA screening and prostate cancer mortality [5].

Also, prostate cancer death rates have declined in countries in which there is no widespread PSA screening [6]. Some studies suggest that advances in treatment may have contributed to the decline in death rates [7,8]. Definitive evidence on the effectiveness of prostate cancer screening on future trends in mortality and survival should come from the results of large-scale screening trials that are still ongoing. In the interim, the objective of this study is to explore the correlation between declining prostate cancer mortality rates and independent variables that may have an association to gain insight into possible causes for the decline. The plan is to compare declining prostate cancer mortality rates with levels of PSA screening, health insurance coverage, obesity, physical inactivity, diabetes, and high cholesterol. A correlation with PSA screening levels or health insurance coverage would suggest that prostate cancer detection and treatment are related to declining prostate cancer rates. An earlier ecologic study [5] explored the relationship between prostate cancer mortality and PSA screening but not the other independent variables examined in this study.

## 2. Materials and methods

### *2.1. Data sources*

Annual prostate cancer death rates for men over 50 from 1979 to 2003 were obtained from the National Vital Statistic System public use data file at the National Center for Health Statistics of the Centers for Disease Control and Prevention [9]. Death rates are calculated by the National Cancer Institute (NCI) using SEER*Stat. Death rates are age-adjusted to the 2000 U.S.A. standard population by 5-year age groups. Population counts for denominators are based on census populations as modified by NCI.

Data on health insurance coverage, obesity, physical inactivity, diabetes, and high cholesterol levels for men, from 45 to 64, were obtained from the Behavioral Risk Factor Surveillance System (BRFSS), an annual cross-sectional, population-based, random telephone survey given by the Centers for Disease Control and Prevention for tracking health care use and risk behaviors at a state level [10]. Data for ages from 45 to 64 were selected since the decline in prostate cancer mortality was not observed in males below 50 (see Table 1). Data for rates of PSA utilization by state among men ages 50 years with no history of prostate cancer were abstracted from published data [11], derived from the 2001 BRFSS. Data for declining prostate cancer mortality rates, PSA screening, health insurance, obesity, physical inactivity, cholesterol, and diabetes percentages for white and black males are provided in Table 2 and Table 3.

### *2.2. Statistical analysis*

The annual rate of prostate cancer decline for each state (and the District of Columbia) from 1993 to 2003 was calculated using the Joinpoint Regression Program. Joinpoint is statistical software for the analysis of trends developed by the Statistical Research and Applications Branch of NCI. The software takes trend data (e.g., cancer rates) and fits the simplest Joinpoint model that the data allow. In some cases, the Joinpoint Program selected a year other than 1993 to obtain the best fit linear model for predicting the rate of decline to 2003. For black males, Joinpoint selected 1997 for Alabama and Connecticut and 1998 for Missouri and Ohio. For white males, Joinpoint selected 1997 for Alabama and 1998 for Illinois and Washington.

Initially, all data were examined for normalcy and to identify outlier values in preparation of calculating correlations between the variables. All variables except declining