The decline in cancer incidence at advanced ages:
Evidence from cancer registry data for the Greater San Francisco Bay Area

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Abstract

Fifty three years ago, Armitage and Doll demonstrated that a multi-stage model of cancer origin (in which cancer cells are the end result of 5 or 6 mutational changes to normal cells) was consistent with their data showing a steep rise in cancer mortality with age. They restricted their analysis to the age groups 25 to 74 because data for older ages was considered unreliable. Since their study, analysis of cancer data has been extended to older ages. In most published reports on cancer, the oldest-old are aggregated together in a single age group: ages 85 and older. The contribution of this study is to analyze cancer incidence data by single year of age, up to age 100, using cancer registry data for the Greater San Francisco Bay Area. A sharp linear decline in overall cancer risk for women and for men is observed from ages 85 to 100. Implications of this decline for human cancer biology are explored.

Contributions of the paper

The main contribution of the paper is to document the decline in cancer incidence at advanced ages. In the United States, the local cancer registry is notified when someone is diagnosed with cancer. Each registry is responsible for collecting cancer diagnosis information including the age of the patient. These case data are combined with Census-based population estimates to derive age-specific rates of cancer incidence and mortality. The published data are usually grouped into 5-year age bins with ages 85+ defined as the open interval. Thus, age patterns of cancer among the oldest-old are generally unknown.

I assembled data from our local cancer registry covering cancer diagnoses reported in a nine county region (the Greater San Francisco Bay Area) for the years 1988 thru 2003. These form the numerator data consisting of counts by age, sex, cancer site (breast, prostate, etc), and year. Denominator information comes from population data from state demographers at the California Department of Finance and from the US Census Bureau population counts by single year of age in 1990 and in 2000. Simple linear interpolation by cohort provides intercensal population estimates. Age-specific cancer incidence rates by sex, year of diagnosis and cancer site are estimated.

Figures 1 and 2 show age-specific cancer incidence for all cancers combined for women and for men for the period 1988-2002. These figures represent our first look at the age

pattern of cancer risk among the oldest-old in the San Francisco Bay Area. Overall cancer incidence appears to peak in the late 80s and declines linearly up to age 100.

The paper assesses several alternative explanations for the observed decline:

- Age misstatement in Census data;
- Under-reporting or under-diagnosis of cancer at older ages (especially among nursing home residents);
- Confounding of age and cohort effects (for example, cohort difference in smoking behavior);
- Genetic heterogeneity in the population so that the very old represent a population group with very low susceptibility to cancer;
- Aging processes which reduce the viability of cancers.

Figure 1. Annual Cancer Incidence Rates among Women, Greater Bay Area, 1998−2002

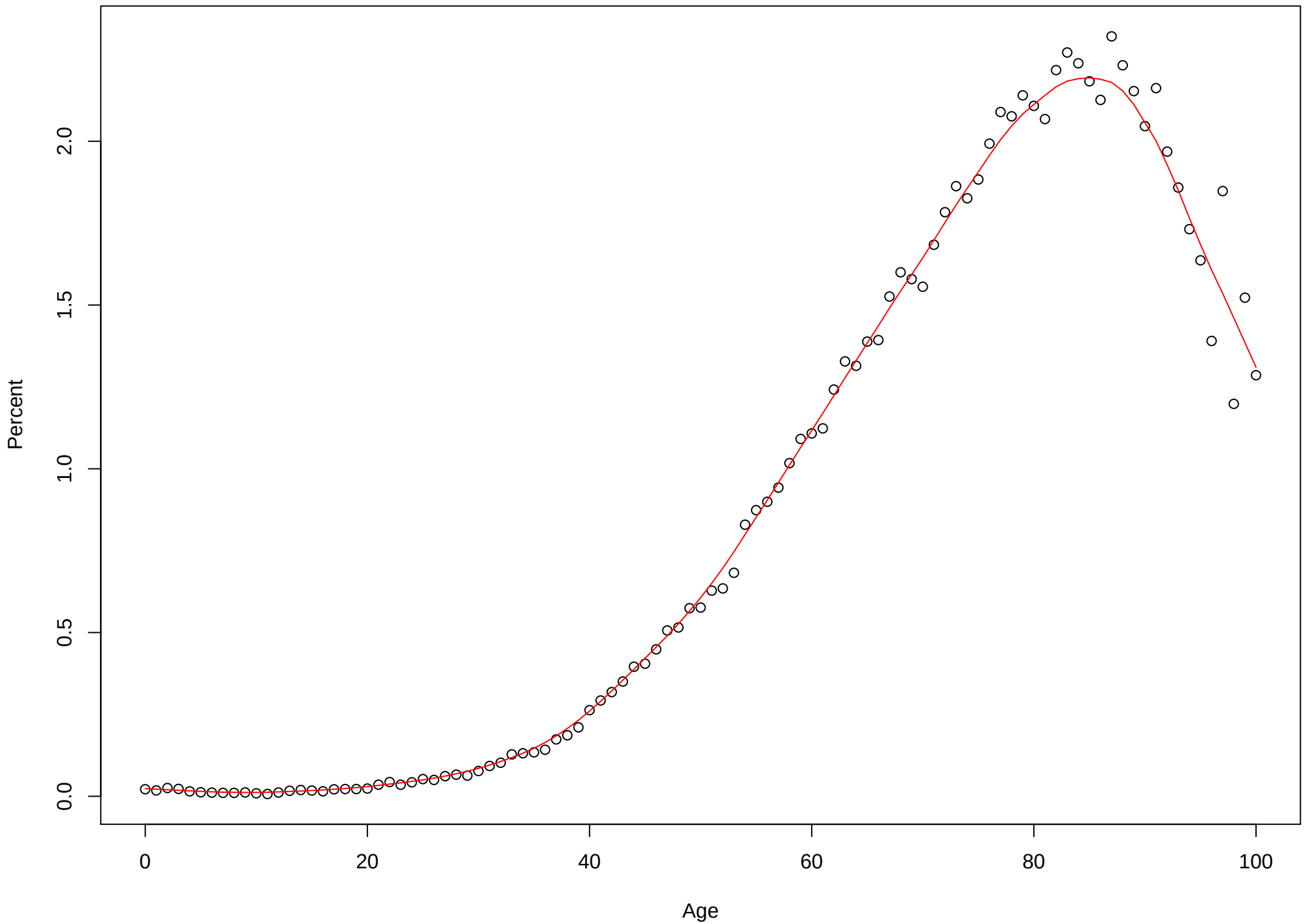

Figure 2. Annual Cancer Incidence Rates among Men, Greater Bay Area, 1998−2002