

# INORGANIC SELENIUM EXPOSURE IN DRINKING WATER AND CANCER INCIDENCE: A NATURAL EXPERIMENT

Marco Vinceti<sup>1,2</sup>, Carlotta Malagoli<sup>1</sup>, Marcella Malavolti<sup>1</sup>, Tommaso Filippini<sup>1</sup>, Silvia Cilloni<sup>1</sup>, Lauren Wise<sup>2</sup>, Massimo Vicentini<sup>3</sup>, Paola Ballotari<sup>3</sup>, Claudio Sacchetti<sup>3</sup>, Paolo Giorgi Rossi<sup>3</sup>

<sup>1</sup>CREAGEN – Environmental, Genetic and Nutritional Epidemiology Research Center, University of Modena and Reggio Emilia, Modena, Italy; <sup>2</sup>Boston University School of Public Health - Department of Epidemiology, Boston (MA); <sup>3</sup>Epidemiology Unit, AUSL of Reggio Emilia, Italy.

## Background and aims

Selenium (Se) is a metalloid of nutritional and toxicological importance in humans. To date, limited epidemiologic evidence exists about the health effects of exposure to this trace element through drinking water. We

investigated the relation between Se levels in tapwater and cancer incidence in the municipality of Reggio Emilia, Italy, where a subset of the population consumed unusually high levels of inorganic selenium.

## Methods

During 1980-1985, 5,182 Italian residents consumed drinking water with Se levels close to the European standard of 10 µg/L in its inorganic hexavalent form (selenate) (Fig. 1-2). Follow-up was conducted during 1986-2013 in Reggio Emilia for the exposed cohort and for a comparison, unexposed cohort (Fig. 3). The unexposed cohort included 110,048 municipal

residents from the remaining part of the municipality, having socio-demographic characteristics comparable with those of the exposed cohort. We used a Poisson regression model to estimate rate ratios (RR) for the association between exposure and cancer incidence from 1986 through 2013, adjusting for age and sex and dividing into 3 subsequent periods.

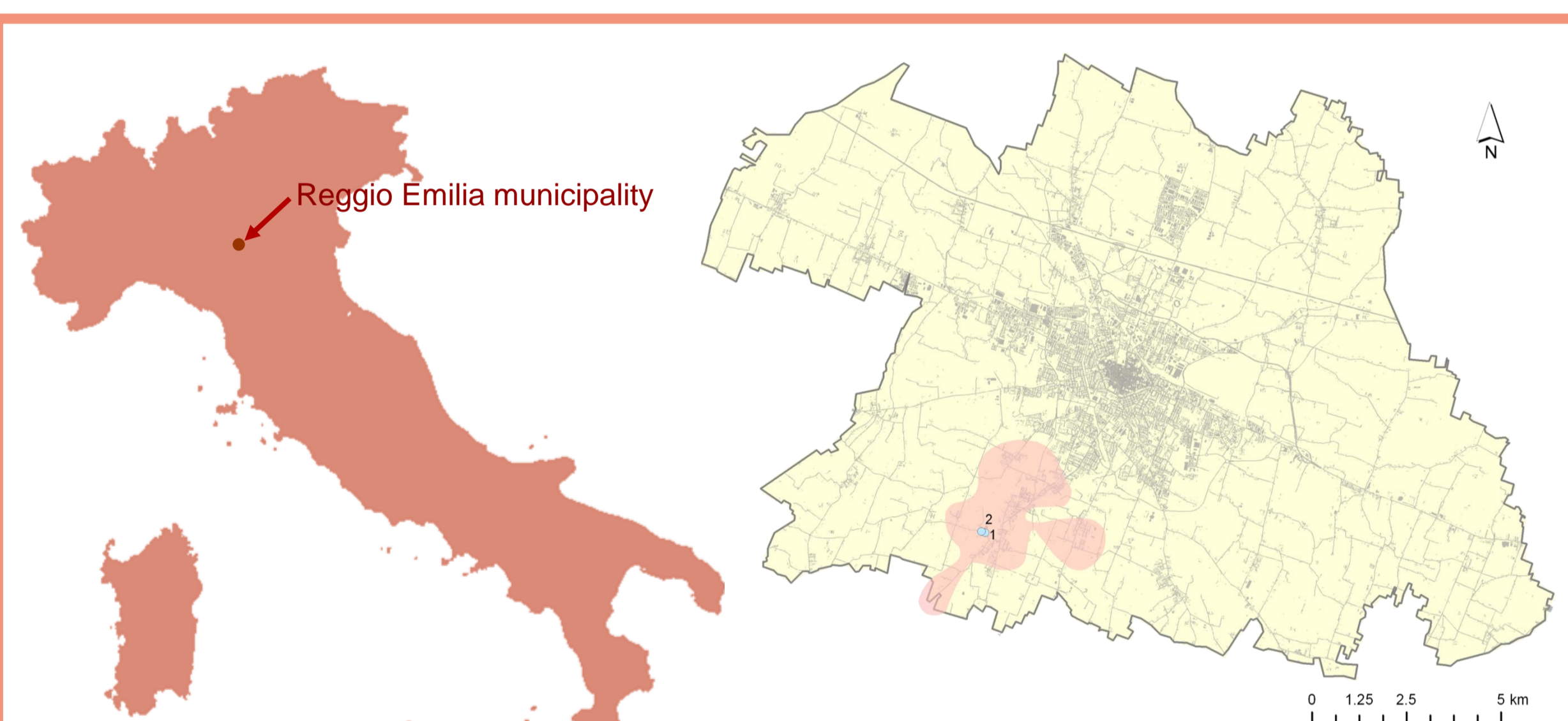


Figure 1. Map of Reggio Emilia, Italy. Shaded area=municipal tapwater with high inorganic Se content (~8 µg/L).

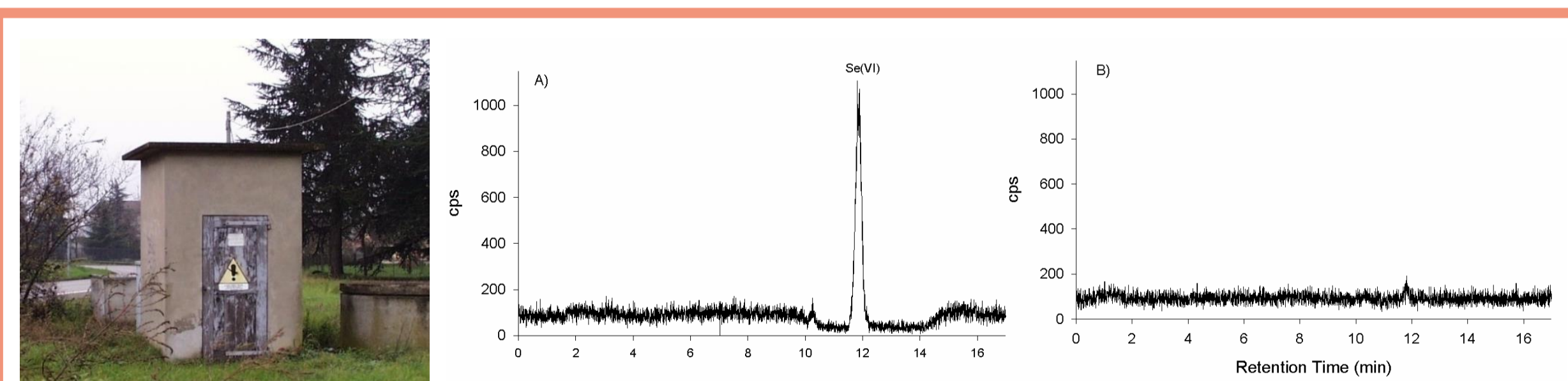


Figure 2. Chromatograms showing the results of Se speciation analysis for water samples distributed in the exposed and unexposed areas in Reggio Emilia municipality.

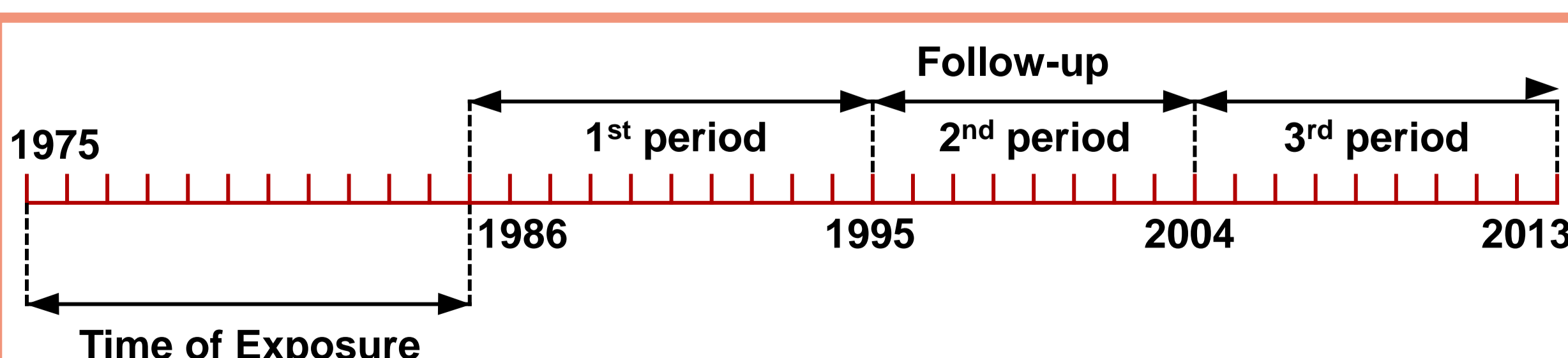


Figure 3. Design of the retrospective cohort study, which involved 5,182 residents of Reggio Emilia exposed to hexavalent inorganic selenium through drinking water.

## Results

We observed little difference in overall cancer incidence comparing exposed with unexposed cohorts. We found higher incidence of neoplasms of buccal cavity and pharynx, Hodgkin's lymphoma, colon-rectum, pancreas, melanoma and non-melanoma-skin cancer in the exposed, with a monotonic trend of decreasing incidence

over time detected for the neoplasms of the buccal cavity and pharynx, pancreas, and for non-melanoma skin cancer. (Fig. 4). Sex-stratified results were similar for Hodgkin's lymphoma and pancreas, with a higher incidence for buccal cavity, colon-rectum, non-melanoma skin cancer in women, and for melanoma in men (Fig. 5).

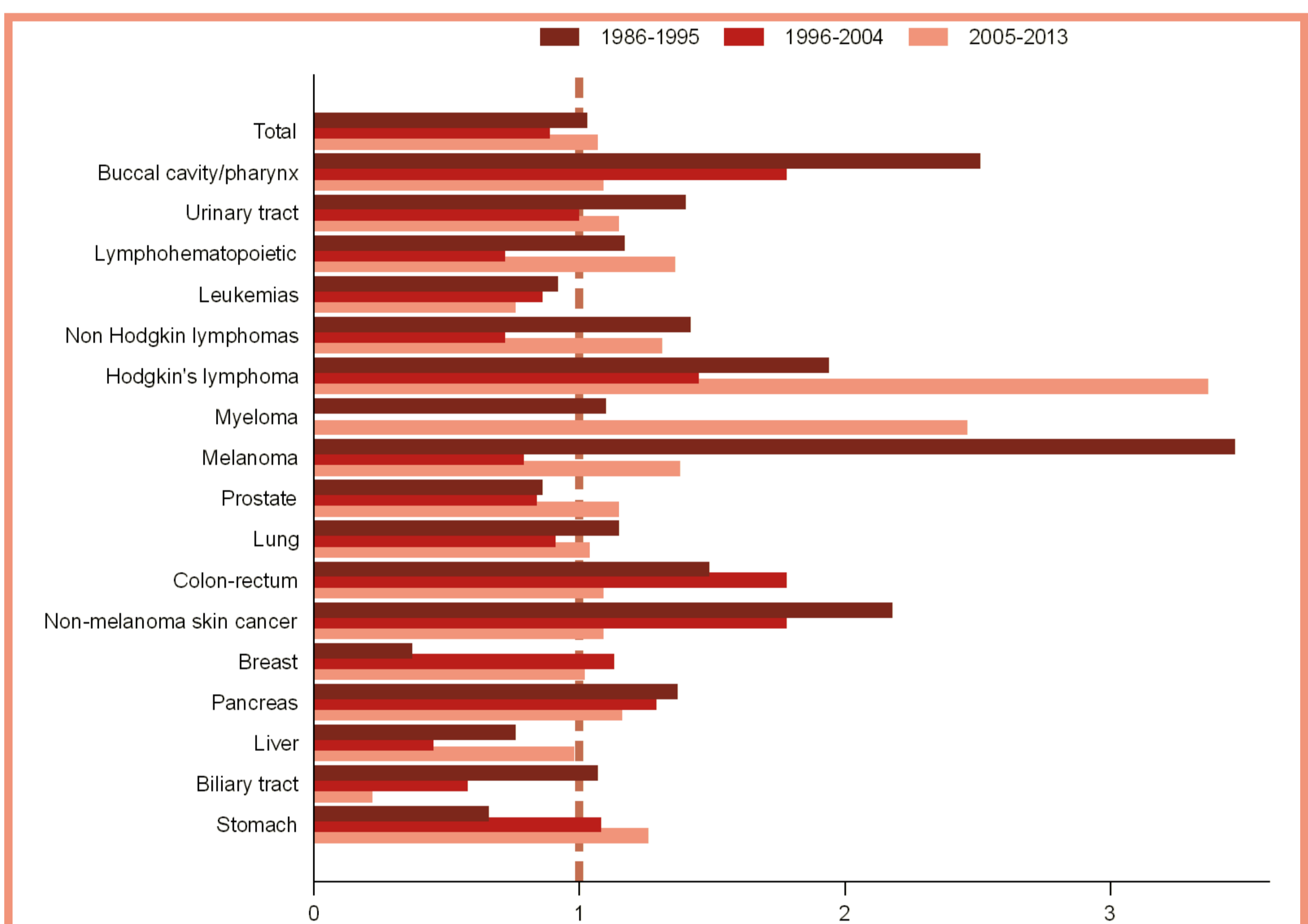


Figure 4. Relative risk of cancer incidence divided in three subsequent periods: 1986-1995, 1996-2004 and 2005-2013.

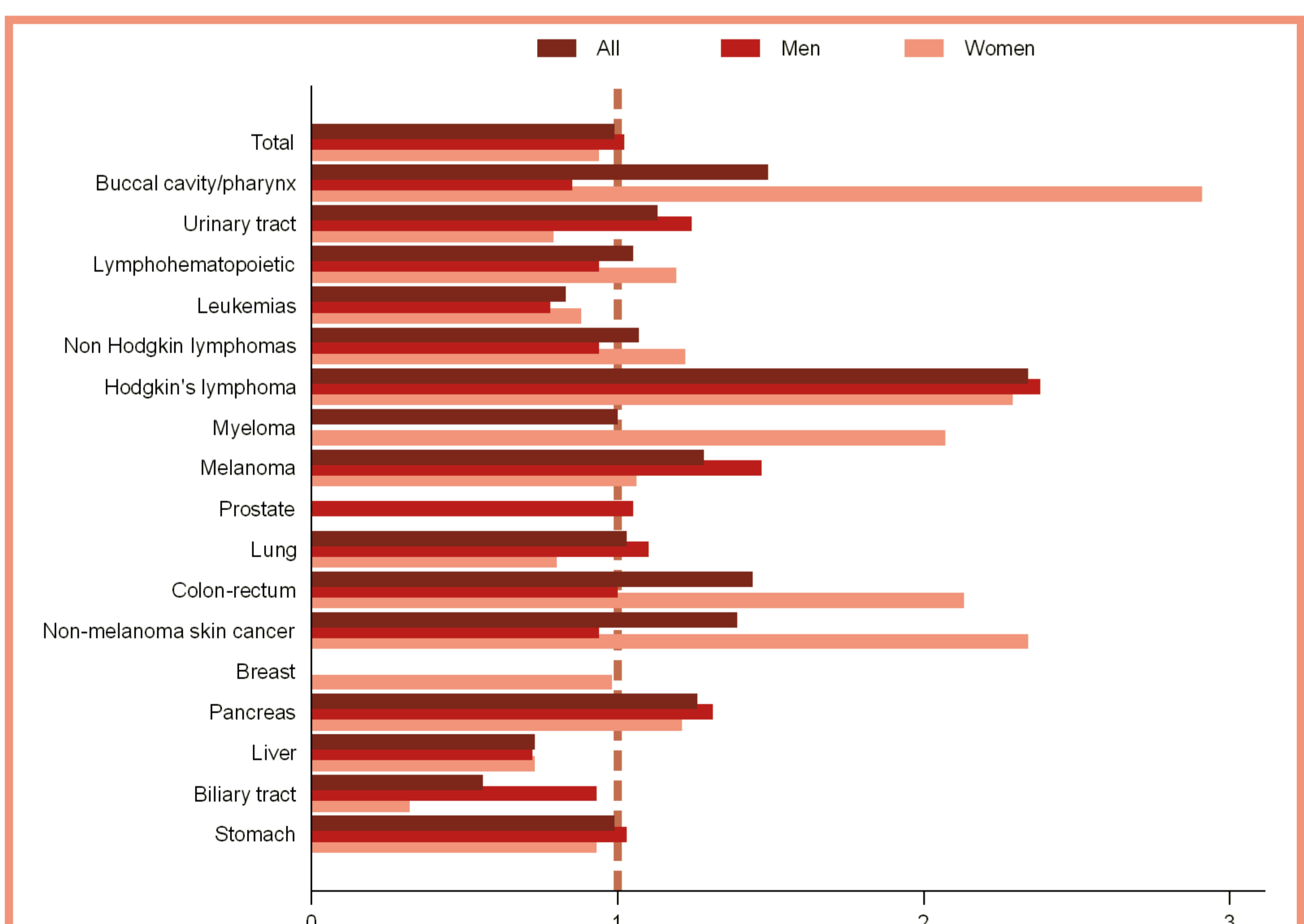


Figure 5. Relative risk of cancer incidence in all subjects and by sex.

## Conclusions

Although there was little inorganic selenium through drinking water, the exposed had a higher incidence of selected site-specific neoplasms.