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# Estimates of prostate cancer burden in Italy

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ABSTRACT

Age-standardized incidence rates of prostate cancer (PC) sharply increased during the period 1990–2005 in Italian areas covered by cancer registries, while corresponding mortality rates remained nearly constant. The latest observations have reported on a reversal of the incidence trend with decreasing values after 2005. We provided incidence, mortality, and prevalence estimates at national and geographical area levels, together with time projections up to the year 2020.

We applied the MIAMOD method, using as input national mortality data for the years 1970–2010 and population-based survival data for the period of diagnosis (1985–2002). We assumed relative survival of prostate cancer remained constant after the year of diagnosis (2005).

The age-standardized incidence rates of PC were estimated to increase during the period 1984–2005, from 31 per 100,000 in 1984 to 93 per 100,000 in 2005. From 2005 onwards, the estimated rates declined to 71 in 2015 and to 62 in 2020. Age-standardized mortality rates slightly increased from 1970 up to about 19 per 100,000 in 1999 and then started to decrease with an estimated reduction of about 2.3% per year. Mortality projections indicated a continuing reduction, with a predicted age-standardized rate of about 12 per 100,000 in 2020. Prevalence was estimated to continuously increase up to a crude prevalence value of 1.2% in the year 2020.

The results indicate that the epidemic peak of PC was reached around the year 2005 followed by declining incidence rates, while a substantial decrease in mortality, starting during the early 2000s, is expected to continue during the 2010s.



## 1. Introduction

Prostate cancer (PC) is the leading cancer in the male European population, with about 420,000 new cases in 2012 [1]. By contrast, PC mortality – with about 101,000 deaths in 2012 – ranks third after those of lung cancer and colorectal cancer [1]. While PC incidence rates increased rapidly during the 1990s, mortality rates changed only modestly, with a tendency to decrease in the late 1990s in most European countries [2]. In Italy, 20% of all cancers occurring in the male population arise in the prostate gland [3]. Data from the pool of Italian population-based cancer registries (CRs), which covered around 30% of the Italian population, showed annual incidence percentage changes of about 4% during the period 2003–2005, and even bigger changes during the periods 1991–1994 (10%) and 1994–2003 (7%). However, these data did not completely describe PC occurrence at a national level; CRs were not active in all Italian regions, and the North was more represented than the South.

Prevalence and incidence estimates and time projections for PC are valuable in health planning. Actually, the vast majority of new diagnoses concern men with organ-confined disease; these men may benefit from radiation or surgery with radical intent. Those with low- and very-low-risk disease may require active surveillance only. On the other hand, treated patients can hardly be considered as cured, since 10 or 15 years after diagnosis they can still have an extra risk of dying with respect to the general population [4]. Thus, all PC patients require a lifelong follow-up with periodical clinical examination, prostate-specific antigen (PSA) testing and, in some cases, imaging examinations for the early detection of progression of clinical and biochemical recurrence.

From the public health point of view, it is reasonable to provide complete incidence data for each region, and for Italy as a whole.

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Estimates of PC incidence, prevalence, and mortality, as well as time projections up to the year 2015, have previously been published [5]. They were based on mortality data available in Italy at regional and national levels and on PC survival estimates up to 2002. Those estimates showed, for the first time, a tendency of PC incidence to stop or to reduce the steep increase observed up to the early 2000s. However, the regional and national estimates were based on official mortality data updated at the latest to the calendar year 2003, a fact that prevented the identification of a possible reversal of incidence trends in the most recent years. In that analysis a preliminary step of mortality projection was then necessary before the application of the usual MIAMOD modeling procedure [6]. In order to overcome this limitation, and to include the latest available data in the analyses, the present study aims to provide more detailed incidence, prevalence, and mortality estimates for PC, also based on updated population and mortality data up to the year 2010.

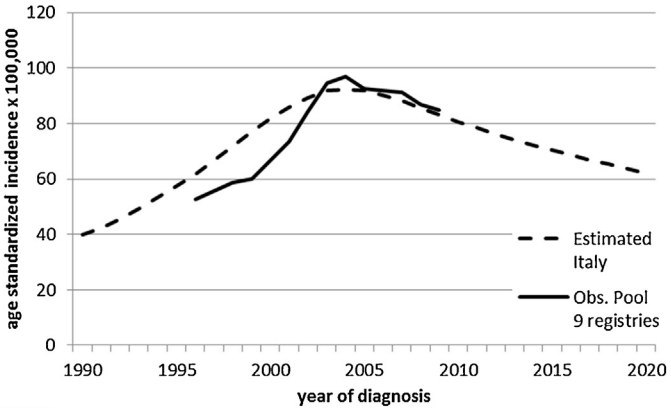


**Fig. 1.** Age-standardized prostate cancer incidence rates estimated in Italy and observed in the pool of nine Italian registries active since 1995.

## 2. Materials and methods

Mortality data for PC, general mortality and population data by age, calendar year, and geographical macro-area (North-West, North-East, Center, and South Islands) for the period 1970–2010 were obtained from the Italian National Institute of Statistics (ISTAT) [7,8]. Cause-specific mortality was missing for the years 2004 and 2005 and was imputed by linear interpolation (by age class) between the previous and the following years. Population data for the years 2009–2010 were estimated on the basis of ISTAT previsions with central scenario. These data were added to the data available from 1970 to 2008.

The MIAMOD method [6,9] was used for the estimation of PC incidence and prevalence. This statistical method is based on a back-calculation approach to estimate incidence and prevalence of chronic irreversible diseases starting from population mortality and patient survival. The method relies on the mathematical relationships between mortality, prevalence, incidence, and survival. The model estimation is based on mortality data from ISTAT for the period 1970–2010, with cause of death coded according to the International Classification of Diseases, 9th revision, (ICD-9) [10]. Relative survival of cancer patients was estimated from observed CR data by means of parametric cure models of the Weibull type at macro-area level.

PC relative survival data for the period of diagnosis 1985–2002 were obtained from the EUROCARE-4 study [11]. Data referred to the populations covered by 21 CRs in Italy jointly covering about 25% of the national population. A linearly increasing trend was fitted up the year of diagnosis 2005, after which, constant relative survival (set at the value of 2005) was assumed.

All estimates were carried out up to age 99 years. Age-adjusted incidence and mortality rates were based on the standard European population. Model-based incidence estimates were checked for consistency with the observational data available from the Italian Association of Cancer Registries (AIRTUM) database and from the published trend of incidence for the pool of AIRTUM CRs [12].

## 3. Results

A synthesis of the checking procedure is shown in Fig. 1, presenting age-standardized PC incidence trends estimated in the whole country, together with the corresponding observed trends from the pool of nine Italian CRs (i.e., Latina, Modena, Naples, Parma, Reggio Emilia, Salerno, Sassari, Umbria, Varese) covering the incidence period 1995–2009. Estimated rates were up to 20% higher than the observed ones during the period 1990–2000, characterized by a very sharp incidence rise. However, they fit well the subsequent flattening and decreasing tail of the incidence trend reported by the CRs.

Figs. 2–6 show, for Italy and for the four geographic macro-areas, time trends of annual age-standardized PC incidence rates (Fig. 2), age-standardized and age-specific PC mortality rates (Figs. 3 and 4), and PC prevalence proportions (Figs. 5 and 6) between 1970 and 2020. In Italy, the age-standardized incidence trend of PC was estimated to increase sharply, in particular during the period 1990–2005, from 40 to 93 per 100,000 men/year (Table 1 and Fig. 1). In 2005 the estimated rates reached a peak and declined to 71 per 100,000 in 2015 and to 62 per 100,000 men/year in 2020 (Table 1 and Fig. 1). The North West regions reached the highest incidence estimates in the years 2003–2004 (age-standardized incidence about 109 per 100,000 men/year), followed by the North East (102), the Center (about 98), and the South Islands with the lowest estimates (72) (Fig. 2). From 2006, the estimated incidence of PC decreased in all the Italian macro-areas, and the drop was particularly steep in the Northern regions. Forecasted age-standardized rates by 2020 were between 58 and 72 per 100,000 men/year in all the macro-areas.

The mortality for PC (Fig. 3) slightly increased from 15 per 100,000 in 1970 to about 19 per 100,000 men/year in 1999 and then started to decrease, down to 15 per 100,000 men/year in 2010, with an annual reduction of about 2.3% with respect to the 1999 level. Model projections have forecast a persisting reduction, with a predicted age-standardized rate of about 12 per 100,000 men/year in 2020. Mortality trends were similar among the various geographical areas, except for the South Islands. Beginning with different death risks in 1970, from 10 in the South-Islands to approximately 20 per 100,000 men/year in the other macro-areas, mortality rates increased up to the mid 1980s. Then, rates started to decrease in the North and Center, but not in the South-Islands, to converge to similar levels in the mid-2000s. After 2000, mortality started to decrease in all macro-areas, with observed rates ranging between 13 and 16 per 100,000 men/year in 2010 and predicted rates of 10 (Northern regions), 12 (Center) and 14 (South) per 100,000 men/year by the year 2020.

Observed mortality rates (Fig. 4) decreased in all the age groups during the period 2000–2010. The annual percentage mortality changes were particularly marked for the age classes under 55 (−3.7%), 55–64 (−4.4%), and 65–74 years (−3.9%), whereas they were lower for age classes 65–74 (−2.3%) and 85+ years (−1.0%). Predicted mortality rates for 2020 were extremely low for ages below 55 years (0.23 per 100,000 men/year), moderate for the central age classes 55–74 years, and very high (423.3) for the oldest ones. Also considering the demographic phenomenon of