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Estimates of cancer burden in Lazio

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ABSTRACT

Aims and background. Since 1983 a population-based cancer registry has been operating in Lazio which provides incidence and survival data and covers the entire Latina province, amounting to 10% of the regional population. The aim of this paper is to provide estimates of the incidence, mortality and prevalence for seven major cancers in the Lazio region for the period 1970-2015.

Methods. The estimates were obtained by applying the MIAMOD method, a statistical back-calculation approach to derive incidence and prevalence figures starting from mortality and relative survival data. Survival was modeled on the basis of published data from the Italian cancer registries.

Results. In 2012 the most frequent cancer sites were breast, colon-rectum and prostate with 5,529, 5,315 and 4,759 new diagnosed cases, respectively. The cancers with increasing incidence trends were breast cancer, lung cancer and skin melanoma in women, and prostate cancer, colorectal cancer and melanoma in men. The incidence rates of uterine cervix and stomach cancer decreased. The male lung cancer rates increased, reaching a peak in the late 1980s, and then decreased. Prevalence increased for all the considered cancers except cervix cancer. In 2012 breast, colorectal and prostate cancer had the highest prevalence, with 68,239, 36,617 and 33,934 prevalent cases, respectively. In the final period of the study the mortality declined for all cancers except female lung cancer. In 2012, the highest mortality rates were estimated for lung cancer in both men and women, with 89 and 40 deaths per 100,000, respectively.

Conclusion. These estimates give a useful description of the present and future cancer patterns in the Lazio region. Incidence, mortality and prevalence projections provide new information for health resource planning. Furthermore, they point to the need to reinforce the organized screening programs, especially for breast and colorectal cancer.

Introduction

Lazio is the third largest Italian region, with a population of about 5.7 million in 2010¹. Lazio is divided into 5 provinces (Viterbo, Rieti, Rome, Latina and Frosinone) and 775 municipalities. The province of Rome is the largest, with more than 4 million inhabitants, while the population of the city of Rome, which is the national and regional capital, reaches 2.7 million.

The regional health system is organized in 13 regional hospitals (i.e. regional hospitals, university hospitals and public or private research institutes); in addition, there are 87 local hospitals (i.e. local health unit hospitals, clinics operating within the national health system, and other hospitals)².

Lazio has an oncological network that provides about 700 hospitalization beds plus 400 day-hospital beds for both oncological and hematological patients. Radiotherapy is provided by 6 hospitals, with 120 plus 50 beds³. There are several referral hospitals in Lazio that serve also many patients from outside the region. In particular there are 23 regional- or national-level hospitals, mainly located in Rome.

Key words: cancer, incidence, prevalence, mortality, Latina cancer registry, estimates, Lazio.

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Cervical and breast cancer screening started in 2001, while colorectal cancer screening was first implemented in 2008. Cervical screening consists of a personal invitation to all women aged 25-64 years for a Pap test every 3 years. Mammographic breast cancer screening is focused on women aged 50-69 years, who are invited every 2 years. Colorectal cancer screening is focused on residents aged between 50 and 70 years, who are invited to undergo a fecal occult blood test every 3 years followed by colonoscopy in positive cases.

In Lazio there is only 1 population-based cancer registry within the Association of Italian Cancer Registries network (AIRTUM). It covers the entire Latina province (550,000 inhabitants), i.e. 10% of the regional population. The Latina cancer registry was founded in the early 1980s and has since collected incidence data from 1983 to 2007, which are regularly published together with survival and mortality statistics. In 2010 a new cancer registry was established for the province of Viterbo (318,000 inhabitants). However, since the Viterbo cancer registry started its activities only in 2011, the first stable data will be available in a few years' time.

Cancer is the second cause of death in the Lazio region, accounting for 34.7% of all deaths among males and 26.2% among females in the years 2006-2009. Lung cancer is the first cause of cancer death among men, followed by colorectal cancer, while breast cancer is the first cause of cancer death in women, followed by lung cancer⁴.

The purpose of this paper is to provide, for the Lazio region, estimates of the principal epidemiological indicators (incidence, prevalence and mortality) up to 2015 for the major cancer sites including lung, breast, prostate, colon-rectum, stomach, cervix uteri and skin melanoma.

Material and methods

Mortality data for all cancers, general mortality and population data by age, calendar year and geographical region for the period 1970-2002 were obtained from the Italian National Institute of Statistics (ISTAT)⁵. Specific mortality data for the years 2003, 2006 and 2007 were used to validate expected mortality projections, as ISTAT had yet to publish data for 2004-2005. Relative survival data for the considered cancers for the period of diagnosis 1985-2002 were obtained from the EURO-CARE-4 study⁶. The data refer to the populations covered by 21 cancer registries in Italy jointly covering about 25% of the national population.

The MIAMOD method⁷⁻⁹ was used to estimate the cancer incidence and prevalence. This statistical method is based on a back-calculation approach to estimate and project the morbidity of chronic irreversible diseases from mortality and patient survival. The method relies on the mathematical relationships between mortality, prevalence, incidence and survival. The model's estimation is based on mortality data from ISTAT for the period 1970-2002, with cause of death coded according to the

ninth revision of the International Classification of Diseases (ICD-9)¹⁰. The relative survival of cancer patients was estimated from observed cancer registry data by means of parametric cure models of the Weibull type at the level of macro area. The geographical area and the age of patients were considered as categorical covariates in the survival model. The way of considering the year of diagnosis (continuous or categorical) and the choice of having a unique term for period and risk or various terms for each macro area depended on the tumors and the sex. The survival estimates for the Central Italian macro area were assigned to Lazio for all cancer sites. The survival time trend after 2002 is assumed to have the same tendency as that estimated over the observation period 1985-2002 for all cancers except prostate cancer, where survival was assumed to be constant from 2005 onwards.

All incidence, mortality and prevalence estimates were carried out for the period 1970-2015 and up to age 99. For cervical cancer, prostate cancer and melanoma, supplementary procedures were applied to account for specific issues related to these sites. For cervical cancer an appropriate methodology^{11,12} was applied to correct the mortality data provided by official statistics, which were flawed by misclassification of cervical cancer as cancer of the uterus not otherwise specified (NOS). This methodology could be applied from 1980 onwards because before that year the ICD-8 classification, which did not distinguish uterus NOS, was adopted in the ISTAT statistics. Corrected mortality data were used as input data for incidence and prevalence estimates by the MIAMOD method. Estimates for this site were carried out up to age 94 years because the distinction of uterus NOS cancer deaths into cervix and corpus uteri cancer deaths in women over 94 years of age is not very reliable. Furthermore, only limited-duration prevalence at 15 years is reported for cervical cancer. Indeed, complete prevalence is highly sensitive to the past trends. For cervical cancer, incidence estimates before 1980 are unreliable due to the subsequent spread of non-organized early diagnosis and to the fact that neither mortality nor cancer registry data exist to support reliable modeling assumptions. Simple backward linear extrapolation of the decreasing trend estimated during the 1980s and 1990s may inflate the past incidence level and consequently (due to the high survival) the estimated prevalence of women with a diagnosis of cervical cancer.

For prostate cancer, because of the rapid changes in the recent time trends, more up-to-date mortality data were used in order to capture recent variations that could not be modeled with data up to 2002. Since mortality data for 2004-2005 were missing, mortality estimates with projections up to 2010 were preliminarily performed by means of the PIAMOD method¹³. The modeled mortality was then used as input for the MIAMOD method.

Projections of the age-specific incidence and mortality rates for melanoma were obtained by linearly projecting the annual percent change of incidence and mortality estimated in the period 2001-2002.

The age-standardized rates were based on the standard European population.

Results

The number of cases and both the crude and age-standardized incidence and mortality rates and prevalence proportions estimated in Lazio for the year 2012 are presented in Tables 1A and 1B for men and women, respectively. In the male population, prostate cancer was the most frequent cancer, with 4,759 estimated new diagnoses. For the other cancers the estimated new cases were substantially lower, ranging between 3,003 for colorectal cancer and 688 for skin melanoma. For women slightly more than 5,500 new cases of breast cancer were estimated to be diagnosed in 2012. For the other cancers, the number of estimated new cases was considerably lower and ranged between 2,312 (colorectal cancer) and 132 (cancer of the uterine cervix).

The highest prevalence was estimated for breast cancer in women and prostate cancer in men. The highest crude mortality rates were for lung cancer, both in men (89 per 100,000) and women (40 per 100,000).

The time trends of age-standardized incidence and mortality rates and crude prevalence over the period 1970-2015 are shown in Figures 1 to 6 for both genders. The results will be described below, grouped by cancer site.

Stomach

The gastric cancer incidence and mortality dramatically and steadily decreased during the whole represented period. In men, the incidence and mortality decreased from 44 and 37, respectively, per 100,000 in 1970 to 18 and 11 per 100,000 in 2015. The trends in women were similar and the rates were always lower in women than men. Conversely, the prevalence is estimated to increase slowly for both genders.

Colon and rectum

For colorectal cancer, the male incidence rates were estimated to increase rapidly until the mid 2000s, then the increase became slightly less marked. The incidence in women showed an increase until the late 1990s and then leveled off. From the mid 2000s there was a moderate decrease in incidence rate. The male incidence was estimated to be almost double the female incidence rate in 2015 (78 per 100,000 *versus* 43 per 100,000). Conversely, the mortality trends presented a marked reduction from the mid 1990s in women and the early 2000s in men. In 2015 the estimated mortality rates were 12 per 100,000 for women and 23 per 100,000 for men. The prevalence was estimated to be rising for both men and women, up to 893 and 713 per 100,000, respectively, in 2015.

Lung

In men the lung cancer incidence rates reached their peak during the late 1980s (with a maximum rate equal

to 97 per 100,000 in 1988) and decreased thereafter. For women they increased from 9 per 100,000 in the 1970s to 33 per 100,000 in 2015. As expected, the mortality trends closely followed the incidence curves. The prevalence was estimated to increase strongly in women and more slowly in men.

Skin melanoma

The melanoma incidence rates were estimated to increase for both genders: from 1.7 and 3.0 per 100,000 in 1970 to 25 and 29 per 100,000 in 2015 for men and women, respectively. In women the incidence was higher than in men for the whole period of study. Conversely, the mortality rates increased slightly between 1970 and the early 1990s and subsequently stabilized. From the early 2000s onwards a slight decrease was estimated for both men and women. The male mortality rates were higher than the female rates; however, they remained low throughout the considered period. In 2015 they were estimated to reach 2.3 and 1.4 per 100,000 for men and women, respectively.

Breast

For breast cancer the age-standardized incidence rates in women were estimated to increase rapidly from 46 per 100,000 in 1970 to about 121 in 2000. Projections based on observations up to 2002 predict a continuing increase albeit of lesser magnitude up to about 145 per 100,000 in 2015. The mortality rates reached a peak (29 per 100,000/year) in the mid 1980s and then showed a steady decline up to a predicted level of 17 per 100,000 in 2015.

Prevalence was estimated to rise steadily in the whole considered period up to nearly 3,000 per 100,000 in 2015.

Cervix uteri

The incidence and mortality rates of cervical cancer clearly declined during the study period. In particular, the incidence dropped from 15 per 100,000/year in the early 1980s to 3 per 100,000 in 2015. The mortality reflected the incidence time trend. Also the 15-year limited-duration prevalence was estimated to decrease for the whole study period.

Prostate

The prostate cancer incidence showed a sigmoidal trend, with a slight increase until the mid 1980s followed by an exponential growth, which tripled the incidence rates in just 20 years leading to an estimated incidence of about 102 per 100,000 in 2004. Projections for the following years seemed to replicate the slight increase pattern of the first trend until reaching 111 per 100,000 in 2015. Mortality for prostate cancer, after an initial increase, remained stable from the mid 1980s up to 2000 and then started to decrease until they stabilized again at around 17 per 100,000 from 2010 onwards. The prevalence was estimated to increase rapidly from the late 1990s.

Discussion

This paper provides an updated description of the burden of the major cancers in the Lazio region, in terms of time trends through 2015 and point estimates in 2012. The agreement between the estimates and the observed data of the Latina cancer registry, available from the AIRTUM database, seems to be reasonably good for almost all cancer types, with the exception of prostate cancer and breast cancer, which both exceeded the expectations. Obviously part of these differences can be explained by the different population characteristics in Latina, especially in comparison with the province and the city of Rome, which is more urbanized and has a slightly older population. It should be underlined that cancer diagnosed in patients without hospitalization, like prostate cancer, may be underreported in the cancer registry especially when not all regional pathology reports are available.

In women, the incidence rates are still rising for breast cancer, lung cancer and skin melanoma. The incidence of cervix and stomach cancer is declining, while for colorectal cancer the time trend remains almost constant. In men, the lung and gastric cancer incidence rates are estimated to be declining while for the other cancers (prostate cancer, colorectal cancer and skin melanoma) an increasing trend is estimated. Prostate cancer has been the first cancer among males since 2000.

One of the major risk factors affecting the observed trend in lung cancer is tobacco smoking. The attributable risk of tobacco is highest for lung cancer and less strong for the other cancers¹⁴. The smoking prevalence in Italy has been decreasing among men since the 1970s. By contrast, the smoking habit is increasing in women and approaches the proportion of male smokers in 1990s¹⁵. According to the data of the Heart Project conducted by the Italian National Institute of Health (ISS), the smoking habits of people aged 35-79 years markedly changed from 1998-2002 to 2008-2009 in the Lazio region: the proportion of male smokers decreased from 35% to 17%, while the proportion of female smokers decreased from 35% to 27%¹⁶. If this is representative of the regional prevalence of smoking, and considering the long latency of lung cancer, these figures indicate that the lung cancer incidence should start decreasing in women by the early 2020s.

Diet and insufficient physical activity are more important risk factors for colorectal, breast and prostate cancer¹⁷. It is reasonable to believe that the modification of the diet, which partially changed from full Mediterranean style toward more Western-type style, had an impact in the rising colorectal cancer incidence. On the other hand, the removal of certain risk factors, such as the consumption of foods preserved in salt and *Helicobacter pylori* infections, contributed to the decrease in stomach cancers.

Screening programs have had a remarkable impact on the incidence and mortality trends of breast and cervical cancer. The projected incidence trend should therefore be considered very carefully, while the mortality of breast cancer shows a more reliable pattern¹⁸. Interpreting trends in prostate cancer is easier since the main factor influencing the magnitude of the increase is clearly linked to the spreading of PSA testing; nevertheless, the preponderance of the PSA factor makes it difficult to evaluate the role of other important factors. The incidence of skin melanoma is increasing¹⁹. Several factors may contribute to this increase, including increased exposure to ultraviolet radiation, increased public awareness of the warning signs of melanoma, and increased screening by clinicians and voluntary associations such as the *Lega italiana per la lotta contro i tumori* (LILT) in the city of Latina.

As expected, the prevalence figures show that female breast cancer (with over 68,000 prevalent cases in 2012), colorectal cancer (36,617) and prostate cancer (33,934) are the main problems for the regional health care system in the near future. In fact, all these cancers (except prostate cancer to some extent) are characterized by a steady increase in incidence and a marked decrease in mortality.

In conclusion, these estimates give a useful description of the present and future cancer patterns in the Lazio region, even in the absence of a regional cancer registry. Incidence, mortality and prevalence projections do not replace cancer registries, which continue to play a key role in surveillance and screening evaluation, but instead provide new tools for health resource planning. From another point of view, these estimates could also serve as a possible source for checking the completeness of cancer registries.

Table 1A – Estimated incidence, mortality and prevalence by cancer site for the year 2012 in Lazio. Number of cases and deaths, crude and European age-standardized (age-std) rates per 100,000 person-years and crude prevalence proportion per 100,000 persons. Age 0-99 years, men

Cancer site	Incidence			Mortality			Prevalence	
	Number of cases	Crude rate	Age-std rate	Number of deaths	Crude rate	Age-std rate	Number of cases	Crude proportion
Prostate	4,759	175.0	109.4	799	29.4	16.7	33,934	1,247.9
Stomach	731	30.1	19.2	467	19.2	11.9	3,734	153.8
Colon-rectum	3,003	123.6	77.2	981	40.4	24.1	19,419	799.4
Lung	2,503	103.0	64.8	2,158	88.8	54.7	5,964	245.4
Melanoma	688	28.3	22.6	79	3.3	2.3	6,309	259.8

Table 1B – Estimated incidence, mortality and prevalence by cancer site for the year 2012 in Lazio. Number of cases and deaths, crude and European age-standardized (age-std) rates per 100,000 person-years and crude prevalence proportion per 100,000 persons. Age 0-99 years, women

Cancer site	Incidence			Mortality			Prevalence	
	Number of cases	Crude rate	Age-std rate	Number of deaths	Crude rate	Age-std rate	Number of cases	Crude proportion
Breast	5,529	210.0	140.7	897	34.1	18.3	68,239	2,592.0
Stomach	564	21.4	10.8	361	13.7	6.5	3,028	115.1
Colon-rectum	2,312	87.8	43.4	778	29.6	13.5	17,198	653.4
Lung	1,436	54.6	30.5	1,065	40.5	21.6	3,675	139.7
Melanoma	865	32.9	26.2	60	2.3	1.4	10,606	403.1
Cervix	132	5.0	3.9	56	2.1	1.4	1,607*	61.2*

*Limited-duration prevalence at 15 years.

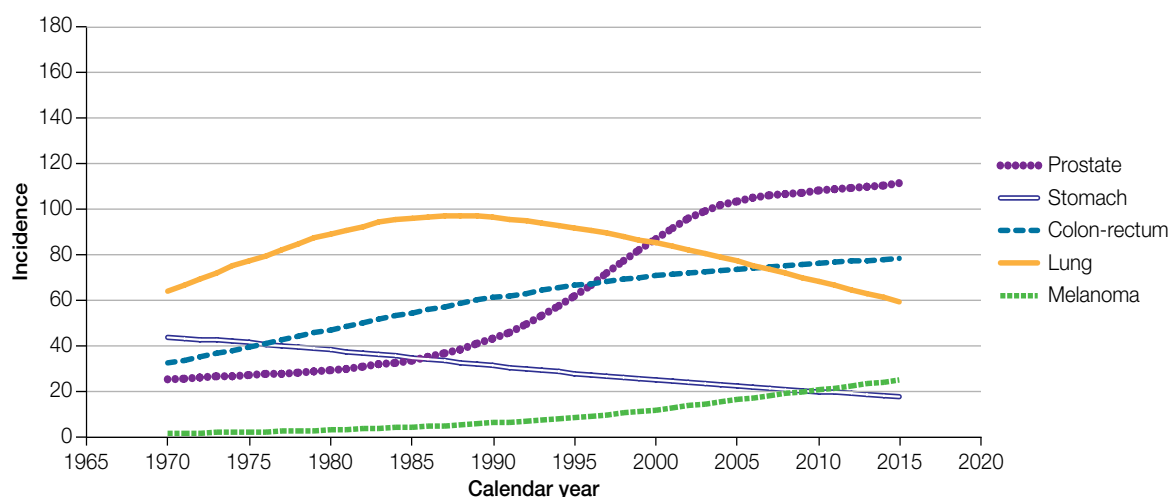


Figure 1 - Incidence estimates by cancer site in Lazio in the period 1970-2015. Age-standardized rates (European population) per 100,000 person-years. Age 0-99 years, men.

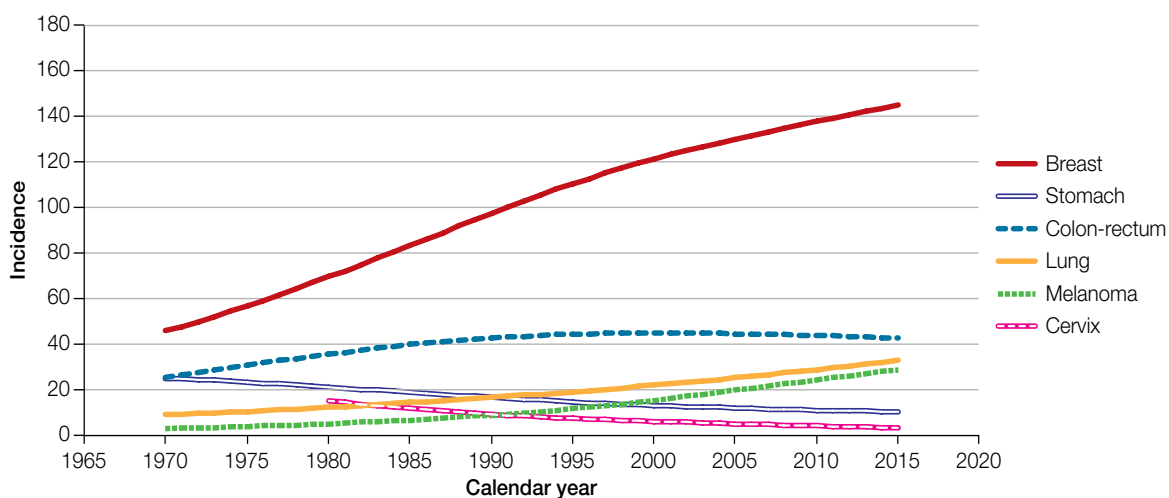


Figure 2 - Incidence estimates by cancer site in Lazio in the period 1970-2015. Age-standardized rates (European population) per 100,000 person-years. Age 0-99 years, women.

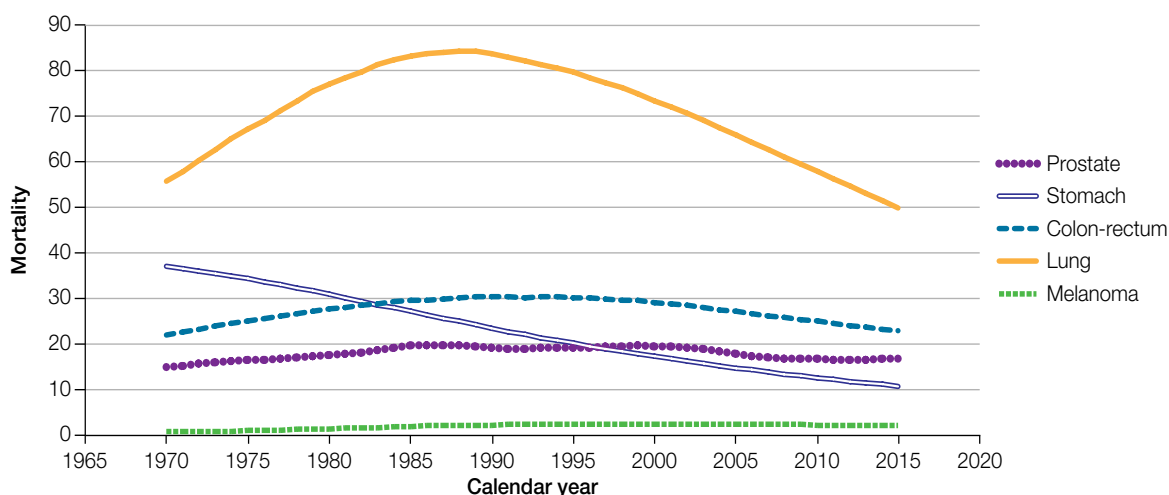


Figure 3 - Mortality estimates by cancer site in Lazio in the period 1970-2015. Age-standardized rates (European population) per 100,000 person-years. Age 0-99 years, men.

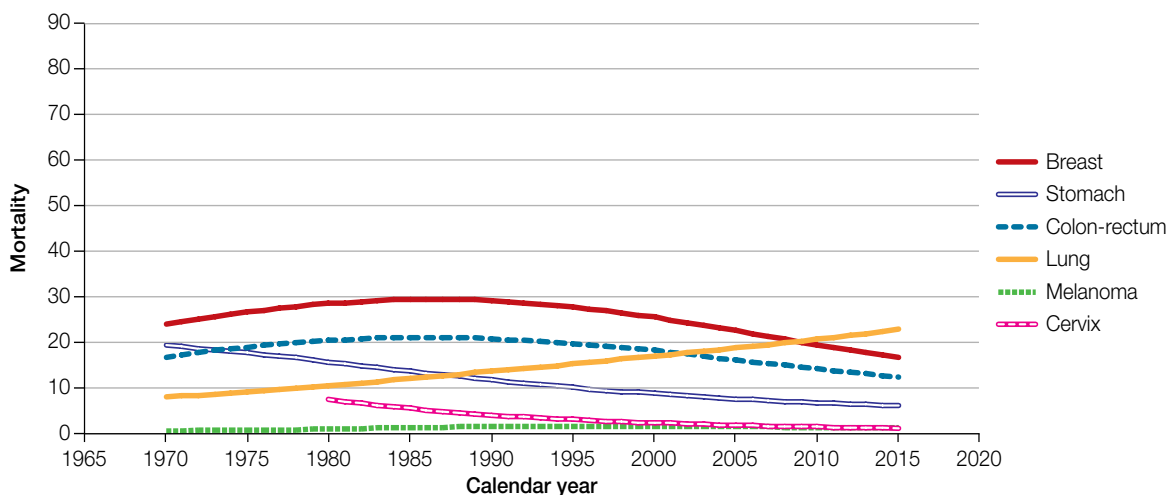


Figure 4 - Mortality estimates by cancer site in Lazio in the period 1970-2015. Age-standardized rates (European population) per 100,000 person-years. Age 0-99 years, women.

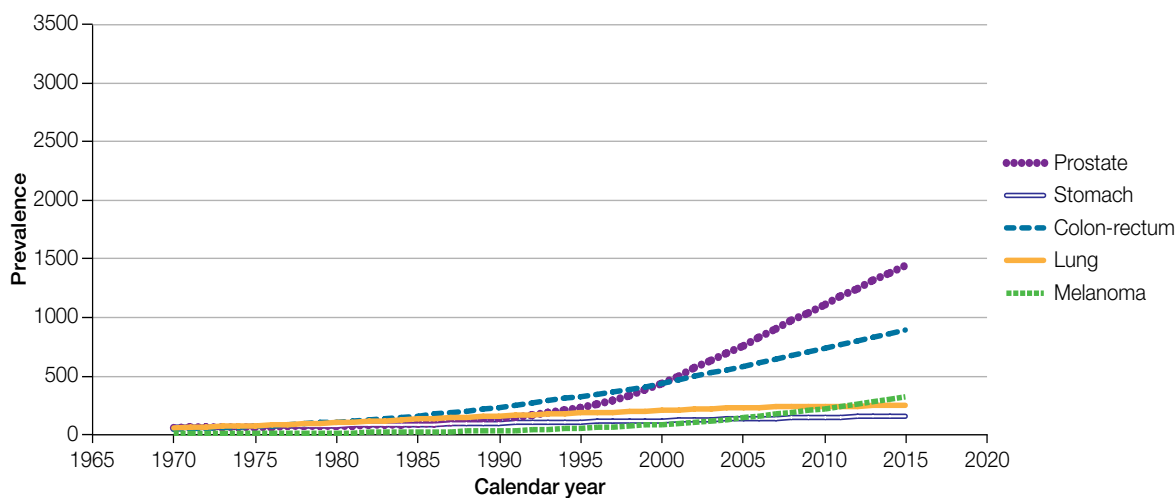


Figure 5 - Prevalence estimates by cancer site in Lazio in the period 1970-2015. Crude proportion per 100,000 persons. Age 0-99 years, men.

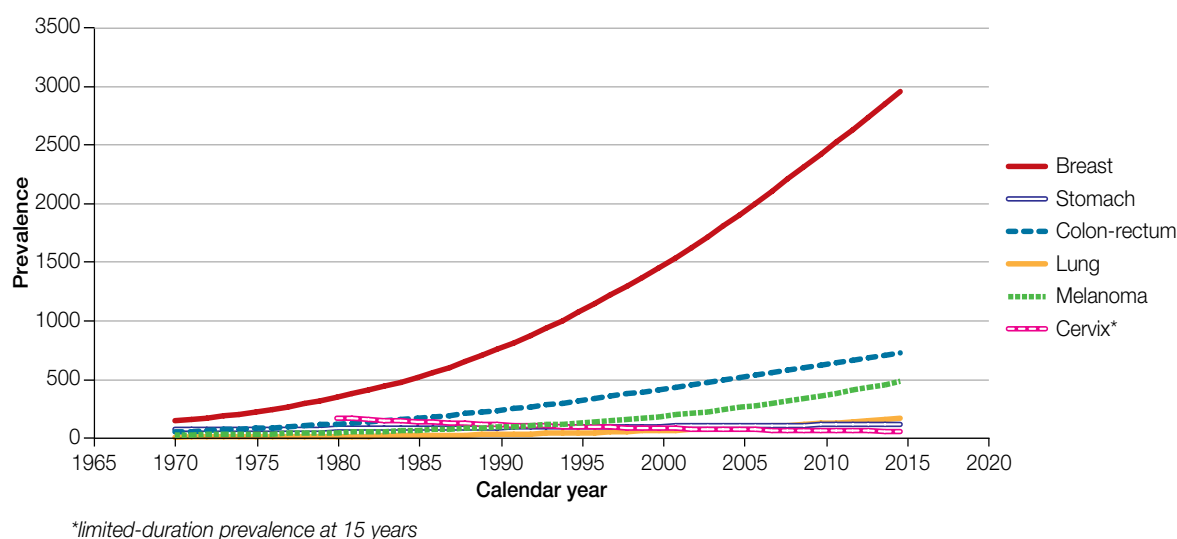


Figure 6 - Prevalence estimates by cancer site in Lazio in the period 1970-2015. Crude proportion per 100,000 persons. Age 0-99 years, women.

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