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Estimates of cancer burden in Campania

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ABSTRACT

Aims and background. In Campania two cancer registries have been operating since 1996, covering part of the province of Naples and the province of Salerno, and amounting to 29% of the regional population. The aim of this paper is to provide estimates of the incidence, mortality and prevalence of seven major cancers for the entire Campania region.

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 cancers were colorectal, breast and lung cancer with 3,969, 3,675 and 3,629 new diagnosed cases, respectively. The cancers with increasing incidence trends were breast cancer, lung cancer and skin melanoma in women, and colorectal cancer and skin melanoma in men. By contrast, the incidence rates of uterine cervix cancer and stomach cancer were decreasing. In men the lung and prostate cancer incidence rates increased, reaching a peak in different periods, and then decreased and stabilized, respectively. Prevalence was increasing for all considered cancers with the exception of cervical cancer. The highest values in 2012 were estimated for breast and colorectal cancer (34,000 and 22,000 prevalent cases, respectively). In the final period under study there was a decline in mortality for all cancers except female lung cancer. The highest crude mortality rates in 2012 were estimated for lung cancer in men and breast cancer in women: 80 and 31 per 100,000, respectively.

Conclusion. This paper provides a description of the burden of the major cancers in Campania until 2015. The estimates highlight the need to reinforce organized screening, especially for breast and colorectal cancer, and to support evidence-based prevention campaigns against female smoking. All these aspects require continuous and updated monitoring of the main epidemiological indicators in the Campania population.

Introduction

Campania is the largest region of southern Italy, with a population of about 5,825,000 in 2010. Like the other southern regions, Campania presents a lower economic level with respect to the national mean. In 2010, the Campania income and consumer levels were both about 30% lower than the corresponding national levels, while the unemployment rate was 15.5% compared with a national rate of 7.8%. The population is the youngest among the Italian regions, with a proportion of 16.1% in the age class 0-14 years, 16.4% in the age class ≥ 65 , and an elderly index of 98.7¹. In the Campania region 2 university hospitals, 8 general hospitals and a comprehensive cancer center (Istituto Nazionale Tumori "Pascale") are active. However, the regional health care system is characterized by a high proportion of smaller scale, and often private, institutions. Half of the 150 health care bodies funded through the

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public health care system are private. This fragmented structure makes it difficult to pursue an optimal management of diagnostic and therapeutic pathways, with the consequent lower performance in terms of outcome in cancer care, and a high rate (10%) of extraregional migration of cancer patients².

Organized breast and cervical screening directed to the whole Campania population has been active since 1998. However, in 2010 the screening programs still covered only half (54.5% and 53.1%, respectively) of the eligible regional population³. Colorectal screening has up to now only partially been implemented in 2 out of 7 local health units of the region. Since 1996, 2 population-based cancer registries have been operating in the region, one covering part of the province of Naples and the other the entire population of the Salerno province. Overall, they cover 29% of the regional population. Both registries provide incidence and survival data.

The data collected by the registries show a slightly increasing incidence trend for all cancers in the Naples area both in men (European population age-standardized rates: from 477 per 100,000 in 1997 to 493 in 2008) and women (from 304 per 100,000 in 1997 to 317 in 2008), which parallels the corresponding trend reported by the pool of Italian registries (from 479 per 100,000 in 1997 to 500 in 2007 in men and from 337 per 100,000 in 1997 to 358 in 2007 in women)⁵. By contrast, the incidence rates for all cancers are stable in the Salerno area at about 380 per 100,000 in men and 260 per 100,000 in women⁵. Recent mortality trends are quite constant in the 2 Campania registries, with the Naples levels being about 20% higher than those in Salerno, while the mortality rates are slightly decreasing in the pool of Italian registries⁵.

The aim of this paper is to describe the time trends of the incidence, mortality and prevalence of the major cancer sites (lung, stomach, colon-rectum, breast, prostate, cervix uteri and skin melanoma) and to estimate these epidemiological indicators up to 2015.

Material and methods

Mortality data for all cancers, general mortality and population data by gender, age, calendar year and geographical region for the period 1970-2002 were obtained from the Italian National Institute of Statistics (ISTAT)⁶, with cause of death coded according to the ninth revision of the International Classification of Diseases (ICD-9)⁷. Specific mortality data for the years 2003, 2006 and 2007 (data for 2004-2005 were not yet published by ISTAT) were coded according to ICD-10 and were only used to validate the expected mortality projections. Relative survival data for the considered cancers for the period of diagnosis 1985-2002 were obtained from the EU-ROCCARE-4 study⁸. The data refer to the populations covered by 21 cancer registries in Italy jointly covering about 25% of the national population.

Table 1 reports the Campania population by province, with the respective coverage by the Naples and Salerno cancer registries, the percentage of people older than 65 years, and the data collection period.

The MIAMOD method⁹⁻¹¹ was used for the estimation of 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 relative survival of cancer patients from observed cancer registry data was modeled by means of parametric cure models of the Weibull type at the level of macro area. The geographical area and the age of the patients were considered as categorical covariates in the survival model. The covariate year of diagnosis was modeled for each site and sex as continuous or categorical, and as unique for all areas or variable by area, according to the pattern of observed survival data.

The survival estimates for the southern macro area were assigned to Campania for all cancer sites with the exception of stomach in males and breast in females, for which region-specific survival was considered because of substantial differences with respect to the overall survival in the southern area. The survival time trend after 2002 was 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 skin melanoma additional procedures were applied to account for specific problems related to these sites. For cancer of the uterine cervix a methodology was applied^{12,13} to derive correct mortality data adjusted for the misclassification with uterus not otherwise specified (NOS) present in the official statistics. This methodology could be applied from 1980 onwards because previously the ICD-8 classification, which did not distinguish uterus NOS, was used in the ISTAT statistics. The 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 old is not very reliable. Furthermore, for cervical cancer only limited-duration prevalence at 15 years is reported. Indeed, complete prevalence is highly sensitive to the past trends. For cervical cancer, incidence estimates before 1980 are scarcely reliable 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 ex-

trapolation 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 which 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 method¹⁴. The modeled mortality was then used as input for the MIAMOD method.

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

The crude and age-standardized rates for all ages were from age-specific rates and population counts. 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 Campania for the year 2012 are presented in Tables 2A and 2B for men and women, respectively.

Among men, the most frequent cancer sites were lung and prostate, with 2,811 and 2,773 diagnosed new cases, respectively, followed by colon-rectum with 2,275 estimated incident cases. Lower numbers of stomach cancer (650) and skin melanoma (512) diagnoses were calculated. In women, breast was the most frequent cancer site with the highest estimated number of new cases (3,675), followed by colon-rectum (1,694) and lung (818), while the estimated figures for stomach cancer, skin melanoma and uterine cervix cancer were considerably lower (419, 209 and 144, respectively). The highest crude mortality rates were estimated for breast cancer in women (30.9 per 100,000) and lung cancer in men (79.6 per 100,000), the lowest for skin melanoma in both sexes and uterine cervix cancer in women. The highest prevalence was estimated for breast cancer in women, prostate cancer in men, and colorectal cancer in both genders. It was estimated that over 34,000 women with a previous diagnosis of breast cancer, nearly 18,000 men with prostate cancer, and nearly 22,000 people with colorectal cancer were living in Campania in 2012.

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

Stomach

For stomach cancer, incidence and mortality were estimated to be steadily decreasing in both sexes, and the figures for men were double those for women. The age-standardized incidence rates decreased from 22 per 100,000 in 1970 to 18 per 100,000 in 2015 in men and from 13 per 100,000 in 1970 to 9 per 100,000 in 2015 in women. The mortality rates strictly reflected the incidence rates, decreasing from 20 to 12 per 100,000 in men and from 11 to 6 per 100,000 in women. Conversely, the prevalence was estimated to increase for both genders: from 20 per 100,000 in 1970 to 55 per 100,000 in 2015 in women and from 20 per 100,000 in 1970 to 93 per 100,000 in 2015 in men.

Colon and rectum

For colorectal cancer the estimated incidence trends differed between men and women. In women, we estimated the incidence rates to increase sharply until 2000, and less markedly, with a tendency to level off at around 35 per 100,000/year, in the following years. Conversely, the male incidence estimates showed a regular increase for the whole study period: from 17 per 100,000 in 1970 to 67 per 100,000 in 2015. After an initial increase until the late 1980s and subsequent stabilization, the mortality rates in females have begun to decrease since 2000: in 2015 the same level of 40 years earlier (12 per 100,000) was estimated. The male mortality trend showed a delay of 10 years with respect to the female trend, increasing until 2000 (from 13 per 100,000 in 1970 to 25 per 100,000), stable in 2000-2010, and decreasing slightly from 2010 onwards (24 per 100,000 in 2015). The male/female ratio increased progressively up to the current level of 1.9. Prevalence was estimated to rise impressively from 1970 to 2015 for both sexes (from 19 to 466 per 100,000 in men and from 24 to 385 per 100,000 in women).

Lung

The incidence and mortality estimates for lung cancer showed different trends in men and women. In men, incidence and mortality showed a steep increase until the early 1990s and a rapid decrease thereafter. Incidence and mortality reached their peak in 1995 (95 per 100,000) and 1994 (83 per 100,000), respectively. The estimated incidence and mortality rates for 2015 are 76 per 100,000 and 60 per 100,000, respectively. Conversely, in women the incidence and mortality rates are estimated to be growing steadily. In 2015, a 3-fold increase in female lung cancer rates is expected with respect to 1970: from 7 to 20 per 100,000 (incidence) and from 6 to 16 per 100,000 (mortality). Prevalence is estimated to rise sharply in men and more slowly in women.

Skin melanoma

The melanoma incidence rates were estimated to increase for both genders but in different ways. During the period 1970-2015, in women a 10-fold increase from 0.6 to 6.2 per 100,000/year was estimated, while in men the incidence rates were estimated to rise much more rapidly, passing from 0.8 to 18 per 100,000/year. The mortality trends were different between men and women. In men a continuing rise, albeit slight, was estimated during the entire study period (from 0.4 per 100,000 in 1970 to 2.3 per 100,000 in 2015), while in women the mortality rates, after an initial increase and subsequent stabilization, were estimated to be decreasing since the late 1990s (down to 0.8 per 100,000 in 2015). Prevalence was practically negligible during the 1970s and 1980s, but was estimated to increase substantially thereafter, for both men and women.

Breast

The incidence rates were estimated to rise with a linear trend for the whole considered period: from 31 per 100,000 in 1970 to 104 per 100,000 in 2015. Mortality was estimated to be rising slightly until the mid 1990s and decreasing thereafter. In 2015 the age-standardized mortality rate is expected to be equal to 22 per 100,000 women/year. Prevalence is expected to grow rapidly in the future (up to 1,315 per 100,000 in 2015).

Cervix uteri

During the study period, the age-standardized incidence and mortality rates declined markedly. The incidence dropped from 14 per 100,000/year in the early 1980s to 3.5 per 100,000 in 2015. Mortality reflected the incidence time trend and decreased from 7.9 to 1.7 per 100,000/year. Also the 15-year limited-duration prevalence was estimated to be decreasing for the whole period 1970-2015.

Prostate

For prostate cancer, the incidence was estimated to increase strongly until 2005 (from 17 per 100,000 men in 1970 to 73) and to stabilize thereafter (around 73 per 100,000 men in 2015). A slight increase in mortality was estimated between 1970 and 2001, from 13 to 19 per 100,000/year, followed by a decrease to 16 per 100,000 in 2015. Prevalence was expected to rise sharply in the forthcoming years (up to 709 per 100,000 in 2015).

Discussion

This paper provides a description of the burden of the major cancers in the Campania region, in terms of trends through 2015 and point estimates in 2012. Incidence rates were estimated to be still rising for breast and lung cancer in women and for colon-rectum cancer

and skin melanoma in men. By contrast, rates have been declining since 1970 for stomach cancer in both sexes and cervical cancer in women. In men the incidence rates for lung and prostate cancer increased, reaching a peak in different periods, and then decreased and stabilized, respectively.

The major risk factor affecting the observed trends is tobacco smoking. Smoking is related to lung cancer, stomach cancer and cervical cancer¹⁵. The smoking prevalence in Italy has been decreasing among men since the 1970s. By contrast, female smoking is on the rise, approaching the proportion of male smokers in 1990s¹.

The estimated regional incidence rates are not necessarily comparable to the corresponding data of the local cancer registries, which represent specific situations: part of the province of Naples and the province of Salerno. However, direct comparison showed good consistency between the regional estimates and the observed data over the time period covered by cancer registration and for the major cancer sites. Such comparison is particularly important for breast and prostate cancers, whose incidence is very strongly affected by the intensity and timing of early diagnostic activities. For breast cancer, a continuously rising trend up to the year 2012 was foreseen in our projections; this is fairly consistent with registry observations up to the year 2007. The projected behavior is based on the assumption that the coverage of breast cancer screening will continue to increase and will gradually include the entire regional eligible population. Consistency between estimated and observed incidence trends was also found for prostate cancer. The model-based estimates show a major rise in prostate cancer incidence in the period 1990-2000, which can be interpreted as due to the spontaneous spread of PSA testing. The data collected by the 2 regional cancer registries present a similar pattern⁵, but with an approximately 8-year delay (from 25.0 in 1997 to 71.5 in 2008 for Naples, and from 35.9 in 1997 to 60.7 in 2004 for Salerno) with respect to the estimates. The observed mortality rates were fairly constant from 1990 onward, with values around 18 per 100,000 for both provinces. These observations suggest that many patients were still diagnosed at a fairly advanced stage until the late 1990s and that the widespread use of PSA testing started several years later in Campania than in most Italian regions. The absence of a significant reduction in mortality during the 2000s suggests a significant proportion of overdiagnosis and perhaps overtreatment among indolent prostate cancer cases detected by PSA testing.

Conclusions

Several factors were reported to act in Campania in terms of modification of cancer risk and of cancer presentation at diagnosis. They are related to population ag-

ing, to activation of population-based organized screening, to advancement of research and application in the field of diagnostics, to changes in lifestyles, and finally to environmental pollution, with particular regard to illegal

toxic waste disposal¹⁶. All these factors have a strong impact on short-term cancer burden trends and warrant continuous and updated monitoring of the main epidemiological indicators in the Campania population.

Table 1 - Campania population, proportion of the elderly population in 2010 and cancer registries with their coverage and beginning of activity

		Population	Population ≥ 65 years of age %	Coverage %	First year of incidence
Region	Campania	5,824,662	16	29	1996
Part of the province	Naples	570,160	12	10	1996
Province	Salerno	1,107,652	18	19	1996

Table 2A - Estimated incidence, mortality and prevalence by cancer site for the year 2012 in Campania. 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	2,773	98.6	72.8	690	24.5	17.1	17,732	630
Stomach	650	22.8	19.0	449	15.8	12.9	2,456	86
Colon-rectum	2,275	79.8	64.2	873	30.7	24.1	11,564	406
Lung	2,811	98.6	81.0	2,271	79.6	64.5	6,083	213
Melanoma	512	18.0	16.3	74	2.6	2.3	4,040	142

Table 2B - Estimated incidence, mortality and prevalence by cancer site for the year 2012 in Campania. 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	3,675	123.1	97.6	921	30.9	22.4	34,128	1,144
Stomach	419	14.0	9.0	305	10.2	6.3	1,564	52
Colon-rectum	1,694	56.8	35.3	668	22.4	13.1	10,389	348
Lung	818	27.4	19.1	660	22.1	14.9	1,996	67
Melanoma	209	7.0	5.9	38	1.3	0.9	2,641	89
Cervix	144	4.8	4.2	74	2.5	1.9	1,533*	51*

*Limited-duration prevalence at 15 years.

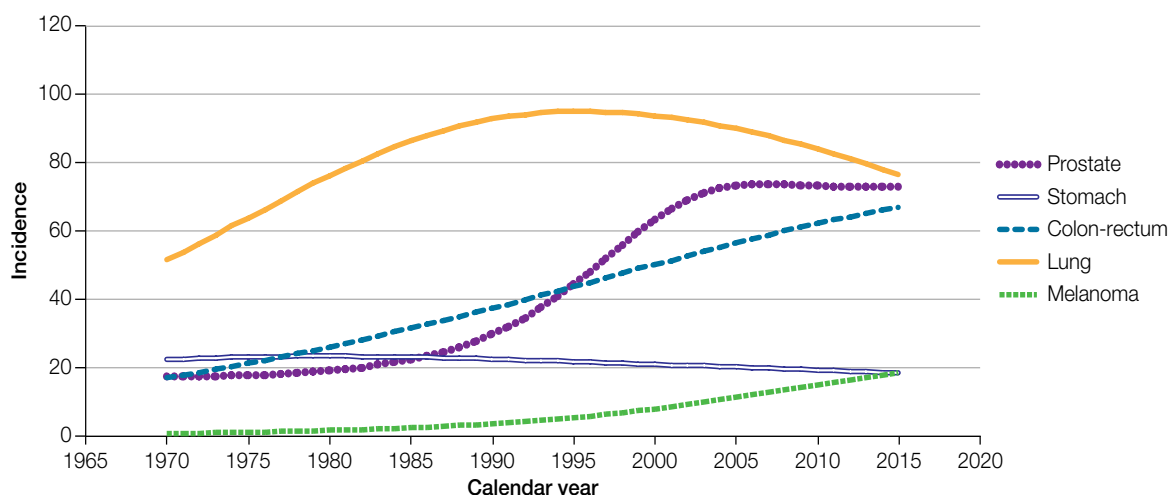


Figure 1 - Incidence estimates by cancer site in Campania in the period 1970-2015. Age-standardized rates (European population) per 100,000 person-years. Age 0-99 years, men.

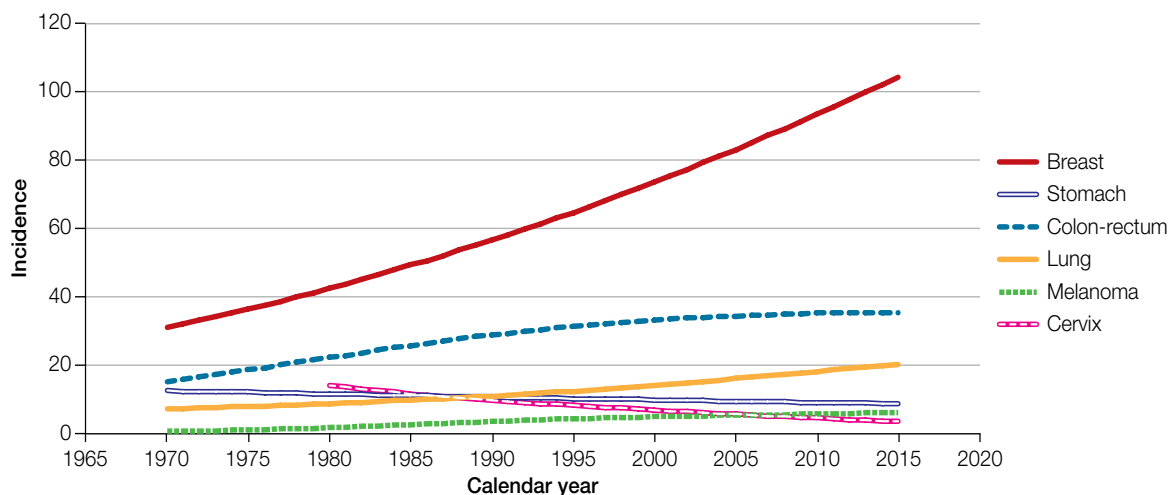


Figure 2 - Incidence estimates by cancer site in Campania in the period 1970-2015. Age-standardized rates (European population) per 100,000 person-years. Age 0-99 years, women.

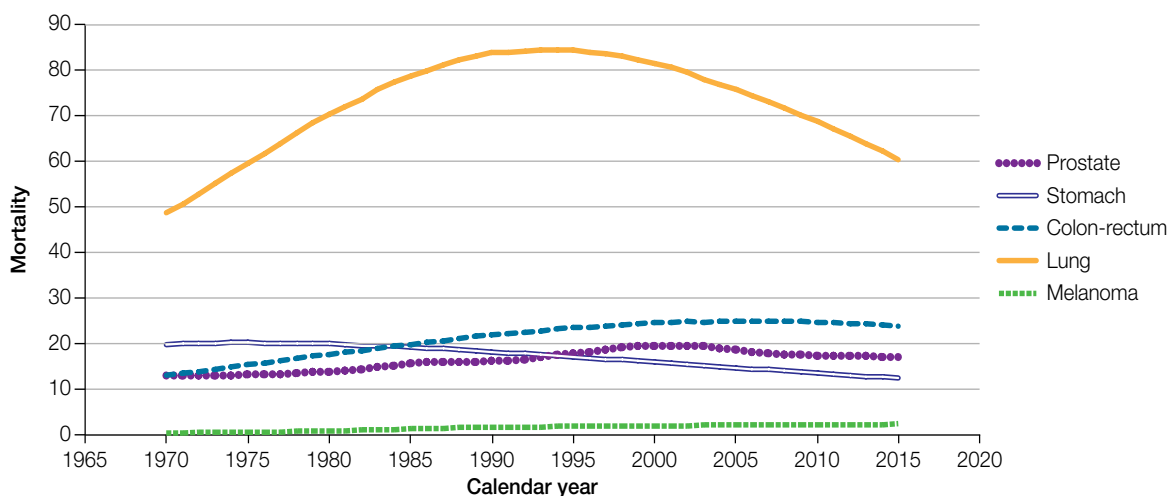


Figure 3 - Mortality estimates by cancer site in Campania in the period 1970-2015. Age-standardized rates (European population) per 100,000 person-years. Age 0-99 years, men.

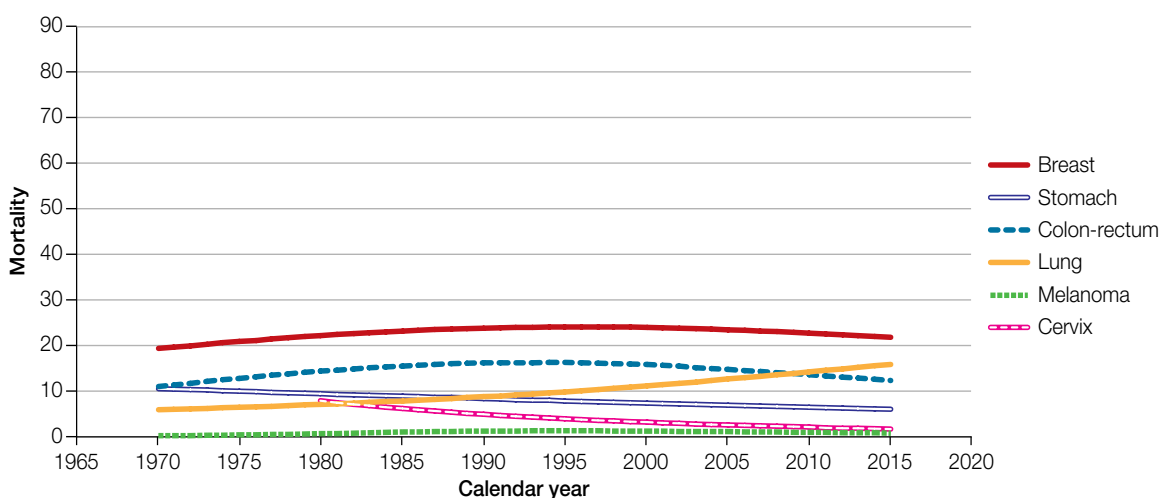


Figure 4 - Mortality estimates by cancer site in Campania in the period 1970-2015. Age-standardized rates (European population) per 100,000 person-years. Age 0-99 years, women.

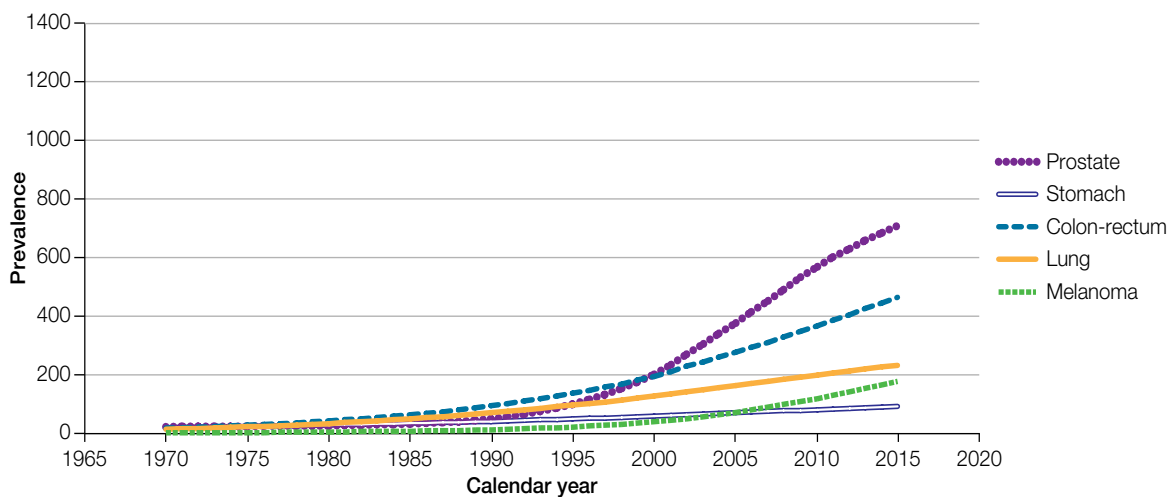
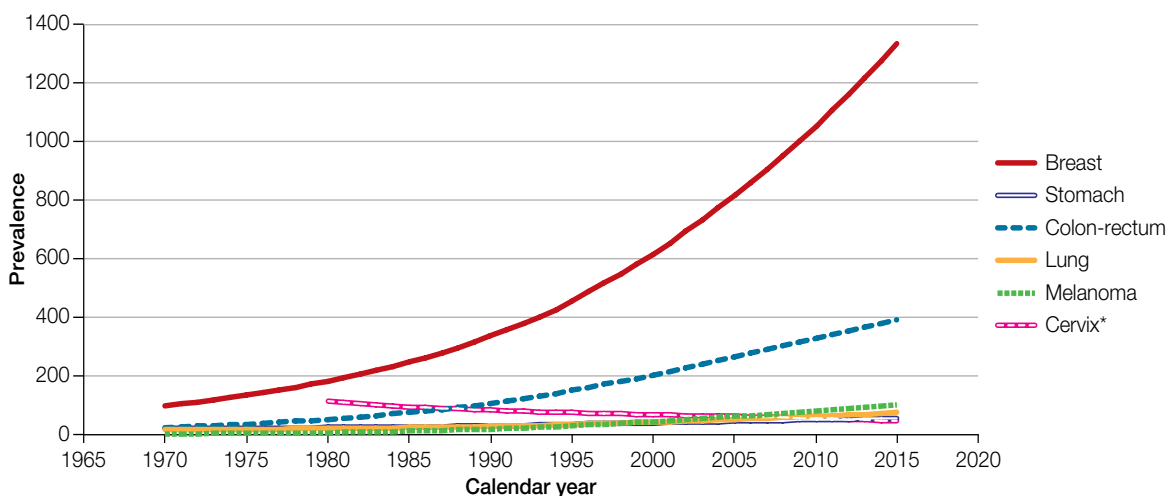


Figure 5 - Prevalence estimates by cancer site in Campania in the period 1970-2015. Crude proportion per 100,000 persons. Age 0-99 years, men.



*limited-duration prevalence at 15 years

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

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