

# Cancer mortality in Rieti province (Latium Region, Italy) for the years 2006-2010: evaluation of temporal and spatial trends and comparison with the other Latium provinces

V. Mattei<sup>1</sup>, F. Santilli<sup>1</sup>, S. Martellucci<sup>1</sup>, J. Di Pasquale<sup>1</sup>, F. Liberati<sup>2</sup>,  
C. Protano<sup>3</sup>, M. Vitali<sup>3</sup>, M. Sorice<sup>4</sup>

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*Parole chiave: Cancro, mortalità, profilo epidemiologico, Rieti*

## Abstract

**Background.** The present research aims to obtain information on cancer deaths in the five Latium provinces in the years 2006-2010 and to highlight similarities and differences between them.

**Methods.** The survey was carried through statistical elaboration of cancer mortality data for the years 2006-2010 obtained from the National Institute of Statistics.

**Results.** The mortality due to oncological diseases in Rieti province showed a decreasing temporal trend for the years investigated. Among all the Latium provinces, Rieti presented the lowest standardized mortality rates. This phenomenon could be related to specific environmental conditions and low levels of air, water and soil pollution affecting the Rieti province.

**Conclusions.** The results of the present study show that the “healthy” environment of Rieti province could be considered as a benchmark for studies in oncological diseases.

## Introduction

Cancer remains one of the major public health problems worldwide. Indeed, World Health Organization (WHO), in 2011, estimated that this disease determined more deaths than all coronary heart diseases or all strokes (1).

Globally, data from GLOBOCAN series of the International Agency for Research on Cancer (IARC) counted for

14.1 million new cases of cancer and 8.2 million deaths in 2012. While the most frequently diagnosed cancers were lung, breast, and colorectal (1.82, 1.67 and 1.36 million cases, respectively), main causes of cancer death were lung, liver and stomach cancers (1,6 million, 745,000 and 723,000 deaths, respectively) (2). Besides, the global socioeconomic and epidemiological transitions is also leading to a “cancer transition”; first of

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1) Laboratory of Experimental Medicine and Environmental Pathology, University Branch of Rieti “Sabina Universitas”, Rieti, Italy

2) UOC Anatomical Pathology, San Camillo De Lellis Hospital, Rieti, Italy

3) Department of Public Health and Infectious Diseases, Sapienza University of Rome, Italy

4) Department of Experimental Medicine, Sapienza University of Rome, Italy

all, changes in fertility and life expectancy result in relevant changes in the global population structure and, thus, in the global burden of cancer at every resource level (low-income, middle-income and high-income countries), with an increase of the number of cases worldwide. Secondly, the “westernization” of lifestyle (tobacco use, diet, sedentariness) is strictly related to the increase of some kind of cancers, such as lung, breast, prostate, and colorectal, especially in low and middle income countries (3). Consequently, the number of cancer cases is expected to increase by about 70% over the next 2 decades (4). According to the global situation, Italian data demonstrate that cancers are the second cause of death (29% of all deaths) overcome only by cardiovascular diseases. Considering only the male population, cancers and cardiovascular diseases are responsible for approximately the same number of deaths. The National Institute of Statistics (ISTAT) counted for 177,351 cancer deaths in 2012 (around 100,000 men and 77,000 women). Besides, the estimated frequency of deaths caused by cancers based on data collected by Cancer Registries are, on average, 3.5 deaths per 1,000 men and 2.5 deaths per 1,000 women each year. Therefore, every day more than 485 people die of cancer in Italy (5). It is important to note that data on cancer deaths derived from Cancer Registries show a decreasing trend of the cancer mortality, for both sexes and for all cancer types, including those at “highest impact”, such as lung cancers. These results can be related to the success of primary and secondary prevention programs, addressed respectively to reduce the exposure to risk factors and to perform earlier diagnosis (5). However, these data are not complete because Cancer Registries are not present all over the Italian territory and, consequently, it is impossible to pursue the recommendation of the WHO regarding the epidemiological profile of

this disease: “in order to combat the global epidemic of cancer and non-communicable diseases (NCDs), it is imperative to create a baseline for monitoring trends and to assess the progress of countries in addressing the epidemic” (6). This problem, however, can be overcome by carrying out *ad hoc* epidemiological studies. In our preliminary report recently published (7), we highlighted that in Region Latium, for example, only two out of five provinces are provided with a Cancer Registry, covering about 15% of the total population. In the same report, we investigated the cancer mortality rates in the province of Rieti (Latium Region) for two years (2008-2009). The aim of the present research was to expand the same study procedure to the period 2006-2010, comparing the previous data with those of the other four Latium provinces (Rome, Viterbo, Frosinone, Latina) in order: 1) to obtain new information on cancer deaths for Rieti province for a longer period of time; 2) to obtain the same kind of information for the other four Latium provinces; 3) to highlight similarities and differences between the five investigated provinces.

## Materials and methods

The present study was performed using data on cancer mortality in the provinces of Frosinone, Latina, Rieti, Rome and Viterbo from 2006 to 2010, as provided by ISTAT. In particular, ISTAT provides annual data for all the five Latium provinces grouped according to sex and age and reported per year and type of cancer. Type of cancer is coded according to the tenth revision of the International Statistical Classification of Diseases, Injuries and Causes of Death (ICD-X) (8). Besides, ISTAT provides annual data on the resident population (intra census population ISTAT data by sex and age classes) of each of the five provinces. Starting from these data we have calculated the arithmetic mean of the

population from January 1<sup>st</sup> to December 31<sup>st</sup> of each investigated year.

Different rates were calculated. Crude mortality rates for cancer diseases were calculated as the ratio of deaths due to cancers and the population of Rieti x 10,000; proportional mortality rates were calculated as the ratio between the number of deaths from cancer and the number of total deaths of Rieti x 100; standardized rates were calculated by the direct method as the ratio between total expected deaths and total reference population x 10,000. The reference populations used for the calculation of the standardized ratios were respectively those reported by Italian 2001 census, European 1976 and 2013 standard populations (9).

The province of Rieti was selected as the reference province of the present study because it is characterized by a large territorial extension (2,749 km<sup>2</sup>) (10), a low population density (11) and an ageing index (number of persons 60 years old or over /100 persons age 15 years old or less) higher than the average Latium population (185.48 vs 141.56) (12). Besides, compared to the other Latium provinces, Rieti territory is characterized by low industrialization and traffic density, reduced waste production and relatively low levels of natural environmental pollutants (Figure 1). In order to verify these differences, average annual levels of some main natural and anthropogenic environmental pollutants, recognized as

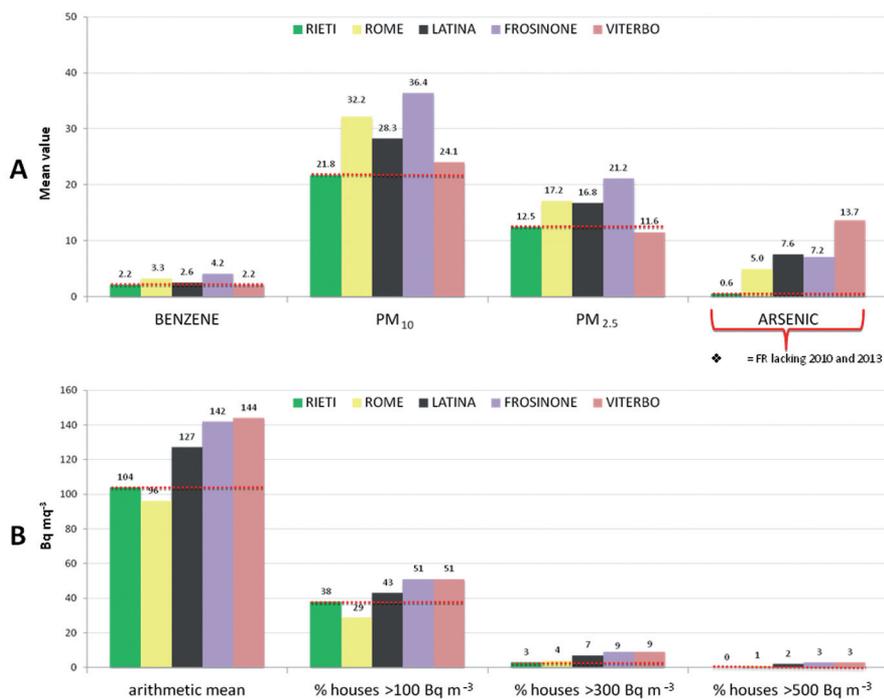


Figure 1 - Representation of the mean values of some pollutants in Latium provinces (ARPA Lazio).  
 A: For each pollutant were considered several years: benzene µg/m<sup>3</sup> (years 2002-2010); PM<sub>10</sub> µg/m<sup>3</sup> (years 2006-2014); PM<sub>2.5</sub> µg/m<sup>3</sup> (years 2011-2014); arsenic (µg/L) value refers to the provincial capitals (Rieti, Rome, Latina, Viterbo and Frosinone) (years 2010-2014)  
 B: Representation of Radon concentration in Latium provinces during 2013 (ARPA Lazio): arithmetic mean Bq m<sup>-3</sup>; percentage of home values greater than 100, 300 and 500 Bq m<sup>-3</sup>

carcinogens, were calculated for each province. Original data were obtained from the routinely environmental monitoring performed by the Regional Agency for Environmental Protection (“ARPA Lazio”). In particular, selected pollutants were arsenic in drinking water (13), radon in domestic indoor air (14) and benzene, PM<sub>10</sub> and PM<sub>2.5</sub> in urban outdoor air (15).

### Results

The mortality due to oncological diseases in the province of Rieti for the years 2006-2010 showed a decreasing temporal trend: the number of deaths diminished from 488 in 2006 to 456 in 2010, with a reduction of 6.6% (Figure 2A). Besides, we observed a decrease in the crude mortality rate from

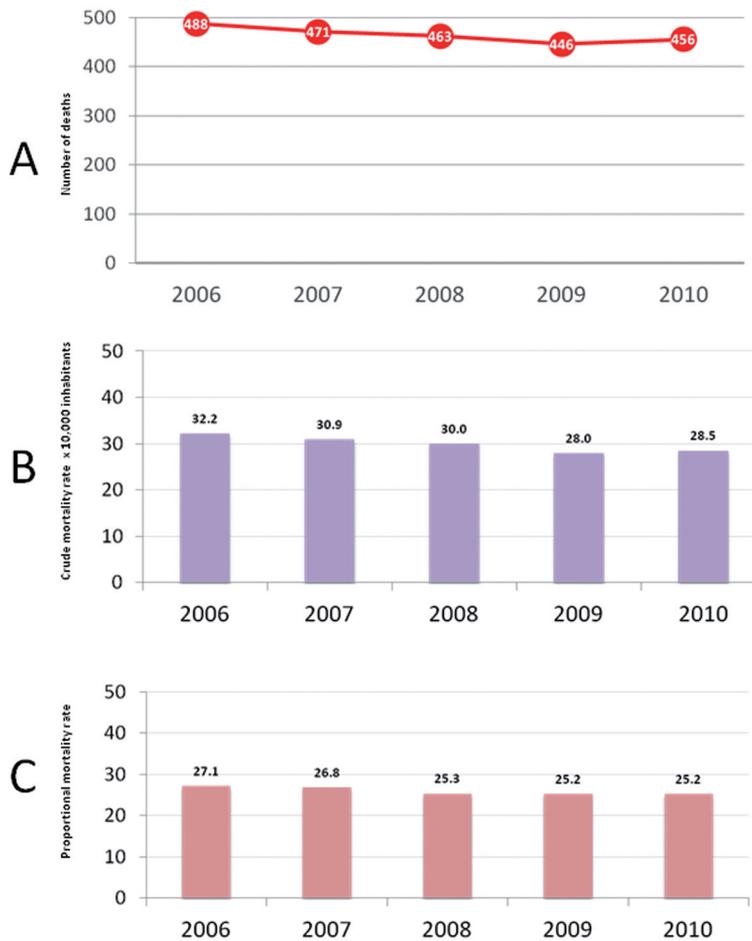


Figure 2 - Trend of Cancer Mortality in Rieti province: years 2006-2010.

A: Number of deaths

B: Total crude mortality rate x 10,000 inhabitants

C: Total proportional mortality rate x 100

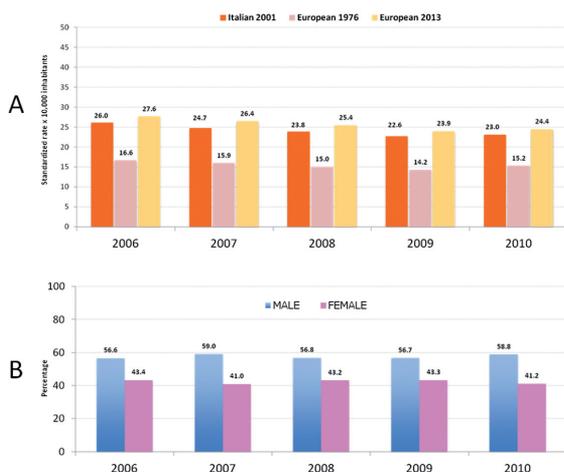


Figure 3 - Trend of standardized rates of cancer mortality in Rieti province: years 2006-2010.  
 A: Standardized rate of cancer mortality in Rieti province with three standard populations: Italian 2001 census, European 1976 and European 2013 standard population  
 B: Percentage of gender mortality

32.2 x 10,000 inhabitants in 2006 to 28.5 in 2010 (Figure 2B) and, simultaneously, a reduction was evident in the proportional mortality rate, that moved from 27.1% in 2006 to 25.2% in 2010 (Figure 2C).

The standardized rate, calculated using the Italian standard population, showed a temporal reduction in the same period: from 26.0 to 23.0 x 10,000 inhabitants (Figure 3A).

Considering the specific mortality rates of Rieti province, gender differences were

observed with a greater number of death in males respect to females. Indeed, male specific rates grew from 56.6% in 2006 to 58.8% in 2010, while female rates decreased from 43.4% in 2006 to 41.2% in 2010 (Figure 3B).

Figure 4 shows the three deadliest cancers according to the anatomic site in Rieti province for the period under consideration: trachea-bronchus-lung, colorectal and stomach cancers. For all these cancers, the temporal trends show a light decrease of

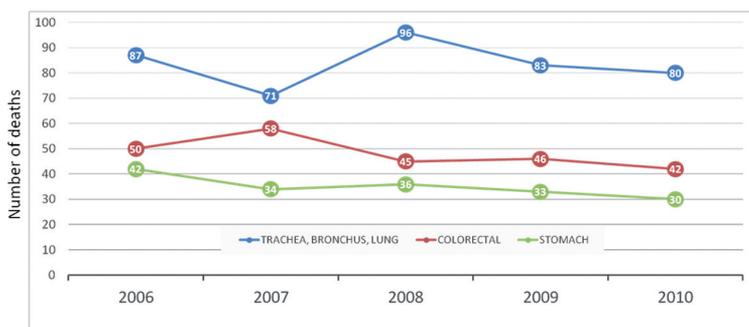


Figure 4 - Trend of cancer mortality in Rieti province: the most deadly types of cancers in 2006-2010.

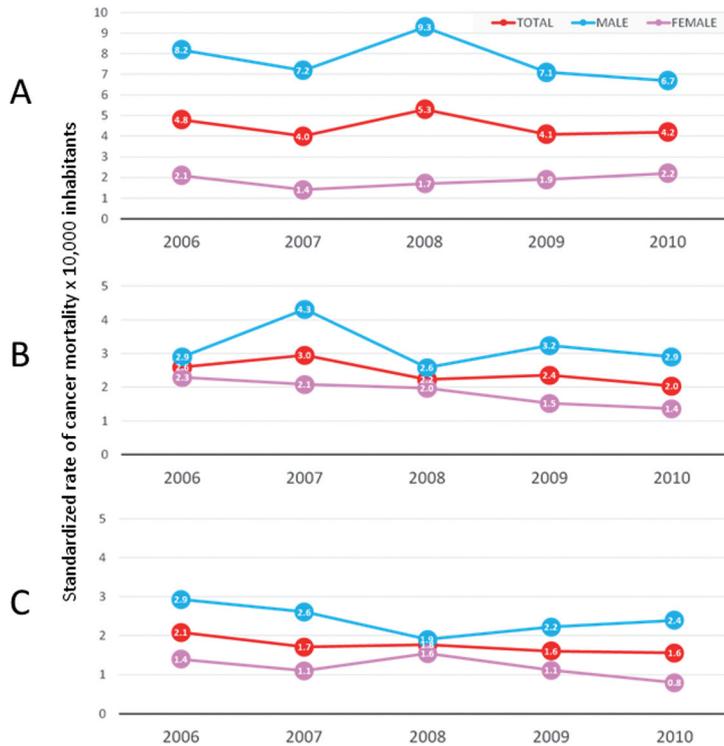


Figure 5 - Trend of standardized rate (italian population 2001 census) for the most deadly types of cancer in Rieti province: years 2006-2010.

A: Total and gender standardized rate of trachea-bronchus-lung cancer x 10,000 inhabitants

B: Total and gender standardized rate of colorectal cancer x 10,000 inhabitants

C: Total and gender standardized rate of stomach cancer x 10,000 inhabitants

the number of deaths, also confirmed by the standardized mortality rates (Figure 5A, B, C). Besides, notice that gender specific standardized mortality rates show the same trend except for trachea-bronchus-lung cancer in the female population.

The comparison between the standardized rates of Rieti and the other Latium provinces in the five years showed that Rieti had the lowest average rate (Figure 6A). Also, we compared specific standardized rates for the deadliest cancers of Rieti province (trachea-bronchus-lung, colorectal and stomach) with other Latium provinces in the five years under test. Rieti had the lowest average rate about trachea-bronchus-lung and colorectal

cancer while, for the stomach cancer, its value is among the lowest (Figure 6B).

### Discussion and Conclusions

The average population of Rieti province grew up by 2.9% during the period 2006-2010, from 151,332 inhabitants in 2006 to 155,654 in 2010 (16). In the same period, this area was characterized by a high ageing index (average 2006-2010 185.5) compared to the whole Latium Region (mean equal to 141.6) (12). Despite the slight increase of resident population and ageing index, this study showed a reduction in the mortality

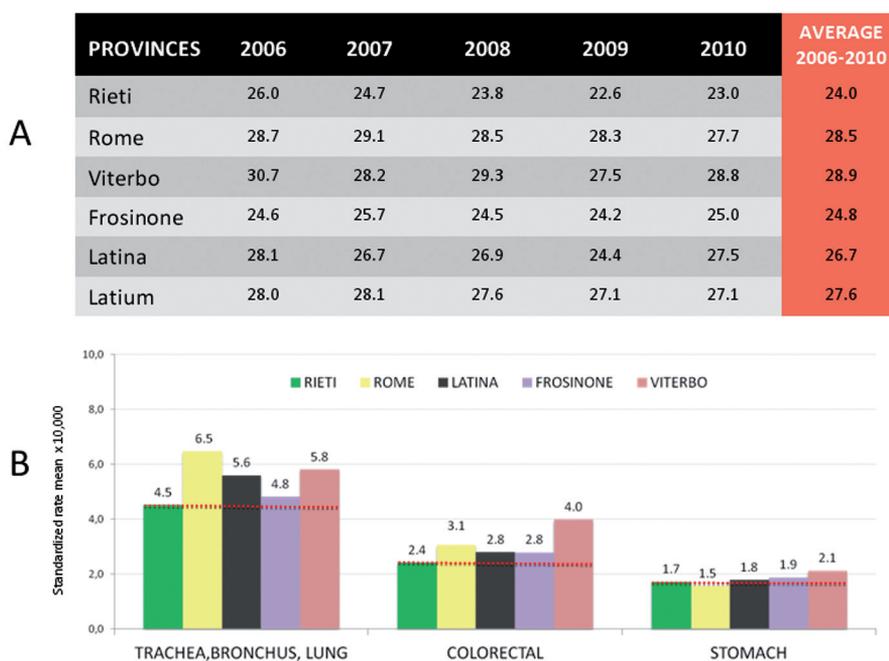


Figure 6 - Trend of cancer mortality in Latium provinces: years 2006-2010 (italian population 2001 census).

A: Comparison of standardized rate between Rieti province and the other Latium provinces

B: Specific standardized rate means of trachea-bronchus-lung, colorectal and stomach cancer

for oncological diseases in the five years: from 488 deaths in 2006 to 456 in 2010. This trend is confirmed by the decrease in crude mortality rate, from 32.2 to 28.5 x 10,000 inhabitants. It is important to note that the comparison of mortality for oncological diseases with other causes of death in Rieti province shows an opposite trend: while cancer deaths decreased, other causes of death slightly increased from 1,313 in 2006 to 1,355 in 2010 (17). These results were confirmed by the proportional mortality rates for cancer, which decrease from 27.1% in 2006 to 25.2% in 2010.

This phenomenon could be related to the improvement of primary prevention in Rieti province (since 2000) and to the implementation of new therapeutic protocols due to the activation – in the Rieti general hospital - of oncological (1997) and radiotherapeutic (2004) Departments, as well

as to the establishment of interdisciplinary teams in oncology care (2007), which allowed an improvement in access to oncology care.

The analysis of the standardized rates shows a decrease in the five years, from 26.0 to 23.0 x 10,000 inhabitants. By comparing the standardized rate of Latium provinces, we noticed a lower mortality value in Rieti province. This phenomenon could be linked to some peculiar features of that province, e.g. low environmental pollution. In fact, several studies show that air (benzene, PM<sub>10</sub> and PM<sub>2.5</sub>) (18, 19), water (arsenic) (20-22) and soil (radon) (23) pollution statistically increase the risk of some kinds of cancer. ARPA Lazio data showed that benzene, PM<sub>10</sub> and arsenic are present in the province of Rieti at lower concentrations than the other provinces of Latium (Figure 1A).

In the five years investigated, the main tumors which influence cancer mortality in Rieti province are those of trachea-bronchus-lung, colorectal and stomach while, in Italy (2007-2010), the oncological diseases that impact most on mortality are respectively lung, colorectal and breast cancers (5). About trachea-bronchus-lung cancer, there was a decrease of the total number of deaths, from 87 in 2006 to 80 in 2010, as confirmed by the specific standardized rate, which moves from 4.8 in 2006 to 4.2 in 2010. Besides, we observed a gender difference: the specific standardized rate decreased in males (from 8.2 in 2006 to 6.7 in 2010), and it slightly increased in females (from 2.1 in 2006 to 2.2 in 2010). Therefore, despite the decrease in the number of total deaths, it should not be neglected that even in the province of Rieti female deaths for this type of cancer are slightly on the rise, following the trend of several countries of northern and eastern Europe (24, 25) and USA (26), where this tumor has become the leading cause of death among women, surpassing the breast cancer.

The comparison among the mean standardized rate of trachea-bronchus-lung in the five provinces of Latium shows that Rieti province has the lowest value (4.5 x 10,000 inhabitants) as compared to the other Latium provinces (Figure 6B). This phenomenon may be affected by low levels of some environmental pollutants that are very active to induce lung cancer and that when present simultaneously act as synergistic factors (benzene, PM<sub>10</sub>, PM<sub>2.5</sub>, radon and arsenic). Indeed, the study "PASSI" for 2009 (27), which aimed to estimate the frequency and the evolution of health risk factors (tobacco use), highlights that not a single Local Health Unit of Latium Region shows statistically significant differences compared to the regional average (30% of smokers).

The results of this study show:

- decreasing temporal trend for cancer mortality in Rieti province, during the period 2006-2010 which may depend on improvement of preventive initiatives and on easier access to oncology care;

- a mortality due to oncological diseases in Rieti province lower than those of the other Latium provinces. This phenomenon may be related to environmental conditions and low levels of air, water and soil pollution.

All these data, in our opinion, indicate that the "healthy" environment of Rieti province could be considered as a benchmark for studies in oncological diseases.

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#### Riassunto

*Mortalità per patologia tumorale nella provincia di Rieti per gli anni 2006-2010: valutazione dei trend temporali e spaziali e loro confronto con le altre provincie del Lazio*

**Obiettivi.** Il presente studio è stato condotto al fine di ottenere informazioni sui decessi per cancro nelle cinque province del Lazio per gli anni 2006-2010 e di evidenziare similitudini e differenze tra le cinque province indagate.

**Metodi.** L'indagine è stata realizzata attraverso l'elaborazione statistica dei dati di mortalità per cancro per gli anni 2006-2010 acquisiti dall'Istituto Nazionale di Statistica.

**Risultati.** La mortalità per patologie oncologiche nella provincia di Rieti ha mostrato un andamento temporale decrescente negli anni esaminati. Tra tutte le province del Lazio, Rieti presenta i tassi di mortalità standardizzati più bassi. Questo fenomeno potrebbe essere correlato con specifiche condizioni ambientali e a bassi livelli di inquinamento dell'aria, dell'acqua e del suolo della provincia di Rieti.

**Conclusioni.** I risultati di questo studio mostrano che l'ambiente "sano" della provincia di Rieti potrebbe essere considerato come punto di riferimento per gli studi sulle malattie oncologiche.

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Corresponding author: Prof. Maurizio Sorice, Department of Experimental Medicine, Sapienza University of Rome, Viale Regina Elena 324, 00161 Rome, Italy  
e-mail: [maurizio.sorice@uniroma1.it](mailto:maurizio.sorice@uniroma1.it)