

# Spatial Analysis and Epidemiology of Lung Cancer in the Northwest of Iran

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## ABSTRACT

**Background:** One of the most important steps in controlling cancer is the identification of places where cancer burden is more than the expected limit.

**Aim:** To investigate the occurrence, distribution, and identification of high-risk lung cancer centers in Ardabil province.

**Methods:** In this study, data from 2011-2016 were collected from the Cancer Registry Center of Ardabil. Periodic prevalence of the total number of cases and the incidence of new cases of the disease per 100,000 people were calculated. The Inverse Distance Weighting (IDW) and *ArcMap GIS10.4.1* software were used to determine the high-risk areas.

**Results:** In a 6-year period (2011-2016), 850 cases of lung cancer were registered in Ardabil Province. The mean(SD) age of the patients was 65.51(13.8) years. The age-standardized rate(ASR) was 70.1 for men and 42.4 for women. The overall prevalence was 96.3 for males and 42.5 for women. The results of IDW analysis show that the residents of Ardabil(capital of the province) with a 21-30% probability, have the highest chance of catching and one of the most dangerous areas in the province.

**Conclusion:** This study provides the most up-to-date information on the epidemiology of lung cancer in northwestern Iran, which can be used for prevention and control interventions. The incidence of lung cancer in men was 2.3 times higher than that of women, and the incidence of this disease in recent years has been increasing. The incidence rate varies in different cities of the province.

**Keywords:** Lung cancer; Spatial analysis; Epidemiology; Ardabil, Iran

## INTRODUCTION

Cancer is one of the most important causes of mortality and disability worldwide<sup>1</sup>. The disease, which is one of the most prevalent and growing diseases, is a large part of the efforts of care systems<sup>2</sup>. Lung cancer is one of the most common types of cancer and the most important cause of cancer death worldwide (Southern Europe, Central and eastern North America, and East Asia), which imposes a major burden of burden<sup>3</sup>. About 17% and 9% of common cancers are in men and women, respectively, and 19% of cancer deaths are related to lung cancer<sup>4</sup>. Lung cancer is the deadliest cancer due to its low chances of survival, despite a recovery in the survival of some types of cancer in recent years, the 5-year survival of lung cancer is relatively low, and is mainly due to the late diagnosis and the advanced stages of the disease<sup>5</sup>. In 2012, around 1.6 million people died of lung cancer (1.1 million deaths for men and 0.5 million deaths for women), mostly in less developed countries<sup>6</sup>. The figure is expected to reach 3 million in 2035 (2.1 million deaths for men and 0.9 million deaths for women)<sup>6</sup>. Although the incidence of lung cancer in women is lower than that of men, it is among the 5 most common cancers (8.5% of all cancers) and the second most common cause of cancer (12.8% of all cancers) among women<sup>7</sup>. According to some reports, the risk of death from lung cancer increases with age. The mortality

rate for lung cancer in the age group under age 45 is between 1% and 8%, and in the age group above 65%, it is 30%<sup>8,9</sup>. There is ample evidence that cigarette smoking is one of the most important causes of lung cancer<sup>5,10,11</sup>. But 25% of deaths from lung cancer occur among non-smokers<sup>10</sup>. Air pollution, a history of pulmonary diseases such as tuberculosis and pneumonia, high doses of radon, and exposure to industrial and chemical carcinogens such as asbestos, silica, and arsenic are other risk factors for lung cancer<sup>12</sup>. Due to the difference in the location-based environment, the incidence of cancer varies from place to place<sup>13,14</sup>. The emergence of Geographic Information System (GIS) and the production of high-resolution digital maps of the Earth's climatic and ecological conditions allow us to better identify the relationship between the geographical dispersion of a disease and its relation to climate and environmental variables, and help us to do a right planning for controlling and preventing it<sup>15,16</sup>.

Therefore, one of the most important cancer control measures is to identify places where the cancer burden is greater than the expected limit. The aim of this study was to determine the incidence, distribution, and dispersion of lung cancer in Ardabil province and to determine the high-risk areas of the disease that can be useful for policy-making and planning in order to control the burden of lung cancer.

## MATERIALS AND METHODS

In this study, data on lung cancer from 2011 to 2016 were obtained from the Cancer Registry Center of Ardabil University of Medical Sciences. Age as a continuous variable was shown by mean and standard deviation (SD) and gender variable as numbers and percentages. The t-

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test was used to compare the mean age in men and women. The periodic outbreak of total cases during the 2011-2016 was calculated for 100,000 people. The incidence rate was also obtained from new cases of the disease per 100,000 people. Data were analyzed using SPSS version 20; IBM Corp., Armonk NY, USA).

**The study area:** Ardabil Province is located in the northwest of Iran, bordering the Republic of Azerbaijan on the north. And 37.45 to 39.42 N. latitude and 47.30 to 48.55 E. longitude and a height of 4811-15 meters above sea level. The population of this province in 2016 was about 1270000 according to the statistics of the Ardabil Province's the Management and Planning Organization.

**Spatial analysis and IDW:** In order to determine the spatial dispersion and spatial analysis of lung cancer, all cases of disease occurred during the years of study in Ardabil Province and pathology confirmed by lung cancer were included in the study, which comprised 84 points and after extracting geographical coordinates, entered the *ArcMap 10.4.1* environment, and its dispersion map was prepared. In addition, IDW analysis was used to determine the risk areas. In this model, distance as the known variable weight is reversely used to predict unmeasured (unknown) points, meaning that as much as we get away from a disease point, the probability of developing the disease will be less.

## RESULTS

During a 6-year period (2011-2016), 850 cases of lung cancer were recorded in Ardabil Province, 597 males

(70.2%) and 253 females (29.8%). The mean (SD) age of the patients was 65.51 (13.8) and the median age was 67 years. The mean (SD) age for men was 65.81 (13.31) and for women, it was 65 (14.51), which was not statistically significant (T-test;  $P > 0.05$ ). the majority of pts with lung cancer (95%) were aged between 40-90 years (Fig. 1).

The overall incidence of lung cancer in this study is 65.7 per 100,000, which is 2.3 times higher in males than in females (96.3 in men and 42.5 in women). During these years, there is an increasing trend in the incidence of lung cancer in the province, and the incidence is different for men and women during these years (chi-square test;  $P < 0.001$ ) (Table 1).

Spatial dispersion of the disease in the province indicates that the disease has occurred over the past six years in 84 areas, including 13 urban areas and 71 rural areas. More than 48% of cases have occurred in the county of Ardabil. Survey on the prevalence of the disease indicates that warmth with an average prevalence of 98 per 100,000 is the most prevalent disease, and *Namin* with 33 per 100,000 has the least number of cases (Fig. 2).

The results of the IDW analysis show that residents of the Ardabil urban district, which is the capital of the province, with a probability of 31 to 20 percent, have the highest incidence of lung cancer and is considered as a high-risk region so that its extension is extending to the south of the province. In addition, the north side of the city of *Parsabad*, *Germiand Meshginshahr*, with a probability of 4-10%, are among the areas at risk in the province with regard to lung cancer (Fig. 3).

Fig. 1. Age distribution of the study population

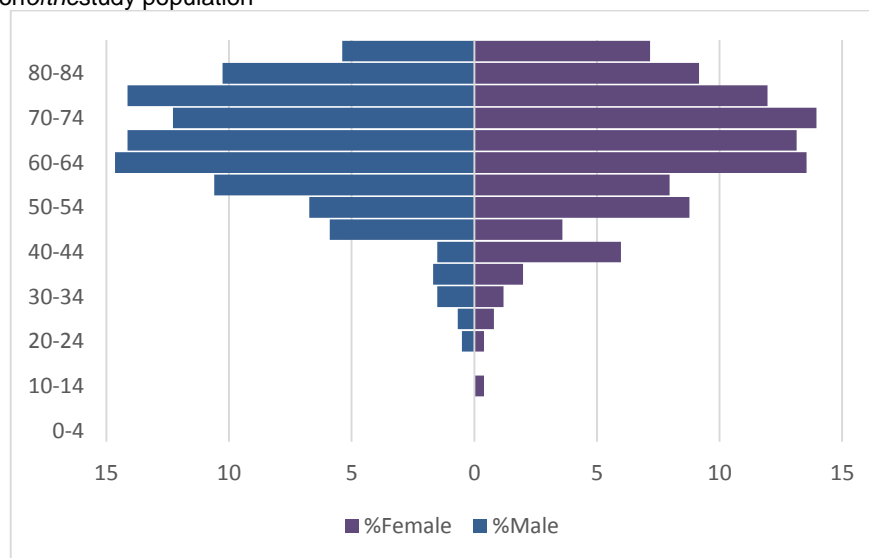


Table 1. Demographic and epidemiological characteristics in patients with lung cancer Spatial

Population studied	N	Age(SD) (Min-Max)	pp	lr 2010-11	lr 2011-12	lr 2012-13	lr 2013-14	lr 2014-15	lr 2015-16
Male	597	65.81(13.31) (21-95)	96.3	12.6	13.7	15.2	16.9	17.7	20.2
Female	253	65.02(14.51) (13-92)	42.5	10	5.3	5.5	6.1	7.4	8.2
Total	850	65.57(13.68) (13-95)	65.7	10.9	8.7	10.4	9.7	12.2	13.9

Fig. 2. The outbreak of lung cancer in Ardabil Province

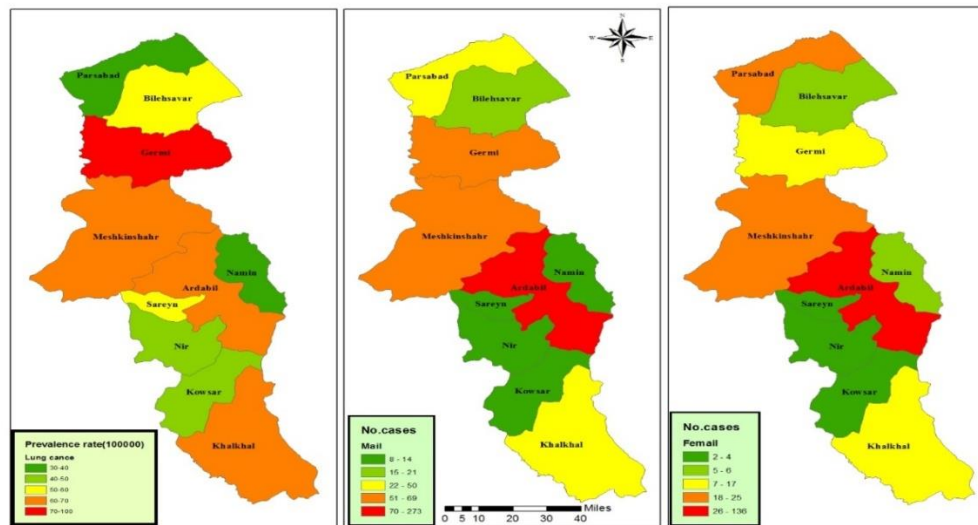
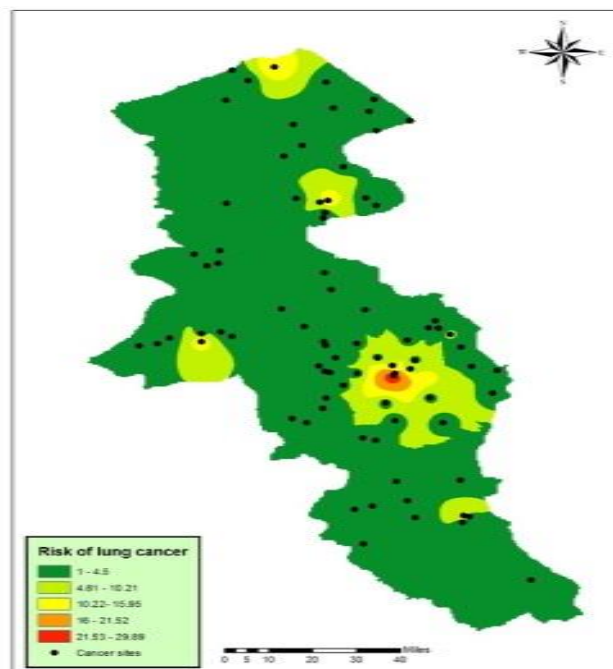


Fig 3. IDW analysis of high-risk areas for lung cancer in Ardabil Province



## DISCUSSION

Regional information on cancer patterns is an essential basis for identifying prevention and control priorities for cancer. This study was conducted to obtain regional and geographical information on lung cancer in Ardabil Province. The median age of patients with lung cancer in this study was 67 years (with a mean of 65.5%), indicating the pattern of the disease in Ardabil Province appears in middle age. More than 95% of patients were between the ages of 40-90. In the study conducted by Ghamari et al., the average age was 65.7%, and also, about 94% were in the age range of 40-90 years, which is consistent with the results of this study<sup>17</sup>. Also, in the study conducted by

Ridge et al., the median age of patients with lung cancer was 67 years and about 90% are in the age range of 35-90 years<sup>18</sup>. In the study conducted by Ghamari et al., 20 patients under 20 years of age were diagnosed<sup>17</sup>. In this study, there was only one patient under the age of 20 years, which this result was consistent with Ridge et al.'s study<sup>18</sup>. As a result, the incidence of the disease among people under 20 years in Ardabil Province is much lower than in other regions. The data showed that as age increases, the incidence of lung cancer increases, as well, but it decreases after age 80. Other studies have also shown that the incidence of cancers in adults is less than 75 years of age<sup>13,17</sup>. This can be due to a reduction in the

proportion of the population in this age group or due to illness and morbidity, which reduces the diagnosis of cancer in this age. According to the Table 1, there has been an increasing trend in lung cancer in the province from 2011 to 2016, so that it increased from 10.9 per 100,000 to 13.9 per 100,000 people. Perhaps this increase in the incidence of illness is due to improved diagnostic methods in recent years or increased air pollution, environmental changes, and other causes. Other studies have also shown an increasing trend in the incidence of cancer in recent years (13, 19, 20). Studies that have focused on lung cancer, have also confirmed the increasing incidence of lung cancer in recent years, especially in developed countries (21-24). The trend for an increased incidence of lung cancer was higher in men than in women, and for 5 years, it increased from 12.6 to 20.2 per 100,000 people. In the study conducted by Ghamari et al., the increased incidence of lung cancer was higher in men than in women (17). In this study, men were more likely than women to have lung cancer, so that the periodic outbreak in men was 2.5 times more than in women (96.3 for men and 42.5 for women). Because in terms of occupational and exposure to environmental risk factors, men are more likely to be at risk than women. Also, high levels of smoking in men are a possible contributing factor. In a study of lung cancer patients, Naghan PA et al. found that 74% of patients with lung cancer were men, and men were 2.8 times more likely than women for catching the disease (21). Furthermore, in a study of the incidence of lung cancer, Vardanjani et al. showed that the incidence of lung cancer in men was 2 times higher than in women (67% of the patients were male) (22). In the study of lung cancer, Ghamari et al. concluded that lung cancer in men is 2.5 times more than in women (17). A comparison between the results of all these studies with the results of the present study shows that in all regions of the world, the incidence of lung cancer in males is higher than in women. The spatial analysis of data in the region showed a different distribution pattern of lung cancer in Ardabil province. The highest incidence of lung cancer (42% of cases) in both genders occurred in Ardabil city. The results of the IDW analysis also show that Ardabil has the highest risk of lung cancer, and residents of this region have a high chance of getting the disease, which this could be because the county of Ardabil is the capital of the province as well as to be industrialized, which increased the risk of cancer. In another study in Fars Province (another province of Iran), spatial analysis of cancer data obtained the highest ASR for the provincial capital (25). Another study conducted to investigate the distribution of cancer cases in Isfahan province (another province in Iran), shows that the highest incidence of cancer is in the capital of the province<sup>13</sup>

## CONCLUSION

This study provides the latest information on the epidemiology of lung cancer in northwestern Iran, which can be used for prevention and control interventions. The incidence of lung cancer in men was 2.3 times higher than in women, and the incidence of this disease has increased in recent years. The incidence rate is different in different cities of the province, and the risk in the provincial capital is

greater, and Ardabil is one of the high-risk areas of lung cancer in the province, which should be considered in the large-scale planning of disease control and prevention.

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**Conflict of Interests :** The Authors declare that they have no conflict of interests.

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